RECONFIGURATION OF ANDEAN FIELDS:

CULTURE, CLIMATE AND AGROBIODIVERSITY

by

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(Under the Direction of Virginia D. Nazarea)

ABSTRACT

This dissertation examines sociocultural and biophysical reconfigurations in an Andean agricultural landscape. Decline in the diversity of crops grown by the world's farmers has long been a scientific concern. Recently, climate change has been recognized as a new threat to agricultural sustainability, further heightening the need for diverse crops adapted to a broad range of environmental conditions. Still, there is inadequate scientific insight into the present extent of agrobiodiversity in farmers' fields and the dynamics affecting its loss and persistence.

The present research examines these issues through an in-depth and longitudinal case study in Cotacachi, located in the Northern Ecuadorian highlands. It sets out to document the area's crop and varietal diversity, and spatial and temporal change in the composition of crops in farmers' fields. In particular, it examines whether and how these field reconfigurations relate to shifts in cultural and climatic patterns. The study builds on 16 months of fieldwork between 2003 and 2010, employing participatory observation, interviews, surveys, focus group discussions, workshops and mapping.

The results show that Cotacachi's fields are populated with rich agrobiodiversity, encompassing 103 crop species and a total of 367 varieties within 20 of these. This richness, however, is not evenly distributed – most crops and varieties are present in low frequencies while a few are widespread. The low frequencies partly result from a reduction in the extent of many crops and varieties during the past century, yet this trend has been partly reversed in the course of the last decade. This decline and expansion of diversity bear close linkages to sociocultural trends affecting the value and priority attributed local food and agriculture. Recent climate change challenges farming in multiple ways, generally resulting in lower harvests. On one hand, this process hampers seed saving, but on the other, farmers draw on the local agrobiodiversity as they reconfigure the crop composition of their fields in response to warmer temperatures and changing precipitation regimes. The findings point to the potential of cultural revitalization to spark agricultural diversification, and highlight the importance of supporting the maintenance of locally rooted crop diversity to enhance farmers' resilience to climate change.

INDEX WORDS: Agricultural Anthropology, Agrobiodiversity, Andes, Climate change, Crop diversity, Cultural identity, Ecuador, Ethnoecology, Farmer decision making, Food, Genetic erosion, *In situ* conservation, Kichwa.

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DEDICATION

To the world's farmers

for their tireless efforts

to care for the growth

of plants and animals,

giving sustenance

to us all.

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This dissertation is the fruit of an academic journey that began as I set out one summer from the Norwegian fjords and hopped on a cargo ship to cross the Atlantic. Looking back on the years that since have passed, I am filled with gratitude to the numerous people who have guided and accompanied me along the way.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

This study examines recent reconfigurations in an Andean agricultural landscape. In particular, it investigates patterns and processes of change in the composition of crops in farmers' fields, and how these processes are linked to pattern shifts in the realms of culture and climate. The global human population surpassed 7 billion in 2011 and is projected to reach 9 billion by 2050 (UN 2011). Such an unprecedented mass of people will depend on sustenance from a productive agriculture; without a well-functioning food system future generations cannot survive. A fundamental, although often overlooked factor in agricultural production is agrobiodiversity. It is widely held that the agricultural biodiversity extant on the world's farms was reduced through the past century, a process which is known as *genetic erosion* (FAO 1996; FAO 2010). This development has long concerned scientists, since it undermines the sustainability and adaptability of agricultural systems (Fowler and Mooney 1990; Frankel 1970; Harlan and Martini 1936; Harlan 1975; Nazarea 1998; Rhoades 1991). The promotion of a sustainable food future requires more knowledge on the conservation status of agrobiodiversity and the factors currently driving change in its extent. This research addresses these issues through a case study in the Ecuadorian highlands – part of the Andean center of crop origin. In particular I examine how two yet underexplored but potentially powerful factors influence farmers' management of crop diversity: cultural identity and climate change.

While the relationship between cultural identity and agrobiodiversity remains largely unexplored in the literature, it is well established that there is a close link between identity and food choice (Appadurai 1988; Brown and Mussell 1984; Fischler 1985; Gabaccia 1998; Ohnuki-Tierney 1993; Weismantel 1988). Since subsistence-oriented farmers eat most of what they grow, I here hypothesize that cultural identity also is important for farmers' planting decisions.

Climate change constitutes a potential new threat to agricultural sustainability and the persistence of agrobiodiversity, yet little research has investigated how it affects farmers' management of plant genetic resources (Parry, et al. 2004; Jarvis, A., et al. 2008). Here I examine the impacts of recent climatic change on local agriculture, and in particular whether it has led farmers to alter the crop composition of their fields.

1.2 Historical and Theoretical Framework

1.2.1 The Development of Agrobiodiversity

Agrobiodiversity can be defined as "the genetic variation existing among the species, breeds, cultivars and individuals of animal, plant, and microbial species that have been domesticated, often including their immediate wild relatives" (Heywood and Watson 1995: 6). In this work, I will focus on the part of agrobiodiversity constituted by the variation between and within cultivated plant species, also frequently called crop diversity (Brush 2004) or plant genetic resources (FAO 2010)[1]. Agricultural biodiversity is the product of natural and artificial selection taking place over some 10,000 years of farming. Since people began moving from collection to cultivation as a main subsistence strategy in the Neolithic, the collective work of

[1] I will use these terms – agrobiodiversity, agricultural biodiversity, crop diversity and plant genetic resources – interchangably in this dissertation.

farmers has resulted in the domestication of about 500 crops and the development of great genetic diversity within each of these (Harlan 1992).

During the 20th century, the world's agricultural fields went through unprecedented processes of standardization and simplification. In the year 1900, Mendel's laws of inheritance were rediscovered (Bowler 1989), and in the decades that followed, plant breeding became a science (Schlegel 2007). With new efficacy, breeders were able to cross farmers' landraces as well as wild crop relatives and develop new varieties with specific sets of characteristics. In parallel with this advance, agricultural mechanization progressed, the most significant of which was arguably the entry of the tractor and the exit of draught animals, allowing larger areas to be worked in a shorter amount of time. Simultaneously, a suite of new agrochemicals was composed and commercialized: mineral fertilizers, pesticides, fungicides and herbicides. The promotion of this new package of input factors led to the restructuring of fields, first in the global North, then in the global South (Fowler and Mooney 1990). Numerous small fields planted in polycultures of diverse seeds were turned into fewer but larger fields grown in monocultures of much more uniform planting material. In the South, the project was launched with great fanfare in the 1960s and 70s, and the ensuing transformation of rural landscapes was baptized the Green Revolution (Evenson and Gollin 2003).

This grand shift boosted the production of selected staples (Evenson and Gollin 2003), changed agriculture's main energy source from human and animal power to petroleum, created a stream of rural-urban migration (Cleaver 1972), and helped steer diets away from seasonal variation toward increased reliance on a low number of staple grains (Popkin and Gordon-Larsen 2004).

While many have heralded these pattern shifts, and a Nobel Peace Price was awarded to Norman Borlaug for the work (Nobel Foundation nd), problems have also been identified. One main concern has been that the process undermines its own future; plant breeders depend upon the access to a wide diversity of landraces in order to continue releasing new varieties as former ones succumb to the evolution of pests (Frankel 1970; Harlan 1975; Ochoa 1975). If all farmers let go of the diverse landraces and adopt only modern varieties, breeders will one day find themselves without new raw material.

1.2.2 The Conservation of Agrobiodiversity

At the height of the Green Revolution, the replacement of traditional varieties, *landraces*, with modern ones was seen as an inevitable outcome of modernization (Harlan 1975; Hawkes 1983). The initial reaction to the observation of *genetic erosion* – the disappearance of diversity from farmers' fields – was the large scale collection and storage of seed and other plant propagating material *ex situ*, in gene banks (Hawkes, et al. 2000). By 1996, more than 6 million accessions were held by a global network of gene banks (FAO 1996), and by 2010 this figure had risen to 7.4 million (FAO 2010). However, by the end of the 1980s, research showed that agrobiodiversity was more resilient than first believed. Even in centers of crop diversity where modern varieties had been adopted, *some* landrace diversity still persisted (Brush, et al. 1988; Vaughan and Chang 1992).

These observations led to new developments both in terms of conservation and research agendas. On the applied side, they provided prospects for complementing the *ex situ* approach with *in situ* conservation – the continued cultivation of diverse crop varieties "in the surroundings where they have developed their distinctive properties" (Convention on Biological

Diversity, Article 2; UNEP 1993). This approach would ensure the continued presence of diversity in the hands of farmers and Southern nations (Altieri, et al. 1987), and further, if kept diverse, the world's farms have much larger capacity to maintain genetic resources than do gene banks (Brown 1999). The approach is also more dynamic than its *ex situ* counterpart in that it captures continued evolution of genetic combinations as well as sociocultural systems of knowledge and practices associated with the plants (Nazarea 1998). During the past couple of decades, then, *in situ* conservation has emerged as a new paradigm in agrobiodiversity conservation (Brush 2000; Maxted, et al. 1997).

1.2.3 Recent Research on in situ *Conservation of Agrobiodiversity*

The possibility and imperative of *in situ* conservation requires research on the actual extent of crop diversity, on longitudinal change in diversity levels and on farmers' decision making regarding what to plant. Insight into these patterns and processes is crucial for the effective planning and execution of conservation initiatives (Brush 2004, FAO 2010). Surveys have shown that despite the trend of genetic erosion, extensive diversity continues to populate farms and home gardens in some parts of the world (Zimmerer 1996; Nazarea 1998; Brush 2004; Galluzzi, et al. 2010; Jarvis, D.,et al. 2008). Still, research on the present extent of crop diversity has progressed slower than expected, and is largely lacking for most countries (FAO 2010).

Accurate assessment of longitudinal change in agrobiodiversity is difficult due to the paucity of baseline data and hence, such research is scarce (Brush 1999; Guarino 1999). However, there are a few recent studies. One way researchers are approaching the problem of quantifying change over time in farmer managed crop diversity is to resurvey areas that have previously been surveyed in connection with collection expeditions. Several of these case studies show a decrease in landrace diversity during the course of the 20th century (Hammer, et al. 1996; Shewayrga, et al. 2008; Teklu and Hammer 2006; Tsegaye and Berg 2007), although some have found stability in terms of the number of varieties (Barry, et al. 2007; Bezançon, et al. 2008) or crop species (Nabhan 2007) present in an area.

1.2.4 Agrobiodiversity and Economic and Agronomic Factors

Research on farmers' decision making in relation to crop diversity indicates that the maintenance of crop diversity can to some extent be explained by landraces' adaptation to particular agroecological conditions (Perales et al. 2003), risk management (di Falco and Perrings 2003) and weak market penetration (van Dusen and Taylor 2005), and cross-sectional studies have attributed variation in levels of diversity between farms to variation in argoecological, economic and market-related factors (Benin, et al. 2004; Brush, et al. 1992; Brush and Meng 1998; Rana, et al. 2007; van Dusen and Taylor 2005). This body of research highlights that maintaining landrace diversity is a rational strategy for many of the small-scale farmers the research is focused on; in some areas landraces perform better than modern varieties, and even in areas where modern varieties yield well, landraces may still provide overall more stable yields, reducing risk. A wider crop and varietal diversity further improves pest management, and constitutes a varied base for subsistence farmers' diets (Bellon 1996; Brush 2004; Rhoades and Nazarea 1998).

1.2.5 Agrobiodiversity and Cultural Identity

In addition to agronomic and economic considerations, research rooted in ethnoecology has shown that cultural values play a role in farmers' maintenance of diversity (Nazarea 1998, 2005; Veteto 2010). Nazarea (1998) shed light on the importance of cultural memory for biodiversity conservation; farmers carry intimate knowledge about the properties contained in seed – their agronomic and culinary performance and requirements. This cultural memory is a combination of empirical experience, sensory embodiment and social learning. In a sense, it is the apex of millennia of experimentation in fields and hearths, and its maintenance and transmission is central to the maintenance of agrobiodiversity.

Given the importance of cultural memory for agrobiodiversity maintenance, one might expect that cultural identity would play a role in shaping patterns of agrobiodiversity across farms. However, few studies have to date investigated the relationship between cultural identity and diversity. Brush explains how this lack of inquiry is linked to the dominant methodologies to investigate farmers crop diversity decisions: “Cultural identity almost certainly plays a role, although this factor is often submerged by a research methodology designed to study individual selection and make cross-sectional comparisons of variety choice. In these analyses of rational choice, culture becomes a residual factor used to explain the diversity that has not been explicated by individual decision making.” (Brush 2004: 258). Recently, however, a few studies have compared diversity levels between people of different ethnicity living in similar environments, and indeed found variation between ethnic groups (Brush and Perales 2007; Perreault-Archambault and Coomes 2008; Stromberg, et al. 2010).

If cultural identity plays a role in diversity decisions, then one might further expect changes in this realm to effect changes in agrobiodiversity. This process has so far not been a topic of scientific inquiry, although researchers have expressed concern that cultural change will erode fields’ diversity. For example, Birol et al. (2006) find that high levels of diversity in Hungarian home gardens have survived shifting political regimes and agricultural arrangements, but warn that incipient sociocultural changes stemming from outmigration and reduced dependency on home gardens for food may cause reductions in biodiversity during the coming years. In Mexico, Perales et al. (2003) similarly note cultural change as a potential future cause of diminishing maize diversity.

1.2.6 Food and Agrobiodiversity

Although a number of papers acknowledge the importance of end-use qualities for seed selection, this factor is – as in the case of cultural identity – often regarded as residual, referred to when other measured variables cannot account for variation in diversity (e.g., Perales et al. 2003). This trend is starting to change, however, and analyses that consider consumption and end-use factors are increasing in number. Brush (2004) and Zimmerer (1996) show that consumption criteria are important for potato landrace maintenance in Peru and Nazarea (1998) displays how variation in consumption purposes and preferences sustains sweet potato diversity in the Philippines. Tsegaye and Berg's (2007) study of durum wheat in Ethiopia and Rana et al.'s (2007) paper on rice in Nepal also address the role of food as an incentive for maintaining diversity.

1.2.7 Food and Cultural Identity

In contrast to the scarce literature on agrobiodiversity and cultural identity, food's role as a marker of sociocultural difference and group identity is a returning topic; its life giving character lending it power to forge bonds between family members (Moisio, et al. 2004), classes (Goody 1982; Roseberry 1996), nation states (Appadurai 1988; Belasco and Scranton 2002) and carriers of the same ethnicity (Brown and Mussell 1984; Gabaccia 1998); to include and exclude in patterns of culture. Holzman (2006) asserts that food's sensory dimensions of taste and smell makes it an excellent memory medium, as reflected in studies of food showing how food plays a part in nostalgia, invented traditions, and imagination (Seremetakis 1994; Sutton 2001).

Studies have further shown that the symbolic meanings and practical role of different kinds of foods may change over time. Appadurai (1988) and Wilk (1999; 2006) trace the recent rise of national and regional cuisines in India and Belize, and thus show how global movements give rise to new categories at local levels. Mintz in Britain, as well as Ohnuki-Tierney in Japan show how through history new imports are adapted and adopted as core markers of local identities (Ohnuki-Tierney 1993; Ohnuki-Tierney 1999) 1997. Mankekar (2002), Ray (2004), Choo (2004) and Duruz (2005) explore "eating at the borders" (Duruz: 51); negotiations, fusions and transformations in the foodways of both newcomers and natives as people moving between regions bring with them culinary traditions and give rise to new markets for food.

1.2.8 Food and Identity in the Andes

In rural areas of the Andes, food has traditionally been cooked from a diverse array of products including native roots, tubers, legumes, fruits, grains and pseudo-grains (National Research Council 1989) and Old World grains, legumes, fruits, vegetables and livestock products integrated in post-Columbian times (Crosby 1972). However, during the past decades, introduced foods such as sugar, noodles, rice, cooking oil and MSG flavoring have gained terrain (Orlove 1987; Weismantel 1989). Studies have found strong and layered symbolic meanings attached to these different kinds of foods. Graham (2003) explains how in her field site in Peru, locally grown foods are referred to as *yana mikhuy* (black foods), whereas those brought in and bought in stores are called yuraq or *misti mikhuy* (white or mestizo foods). This kind of categorization is widespread in the Andes (Weismantel 1988), and extends to the current study's field site Cotacachi (Camacho 2006; Skarbø 2005). The former category has typically been associated with indigeneity, rural backwardness, soil and dirt, in contrast to the latter foodstuffs' symbolic link to urban sophistication (Orlove 1998; Weismantel 1988). Thus, in addition to factors such as the spread of the market economy expanding the availability of new foods, and changes in people's daily schedules toward more time spent away from home for education and off-farm work, again reducing time available for growing and preparing food as well as increasing purchasing power, the spread of diets high in non-local "mestizo foods" in rural areas might also be linked to the high prestige with which they have been associated (Orlove 1987). Since most landraces are cultivated for home consumption purposes (Rhoades 1984; Skarbø 2006), a reduction in reliance on one's own production in favor of purchased foods is likely to reduce each households demand for diverse traditional crops. One might therefore expect that the incorporation of non-local foods in people's diets in the Andes has had negative consequences for crop diversity.

1.2.9 Reindigenization in the Andes

After centuries of discrimination and exclusion from dominant political arenas, the situation for indigenous people across Latin America has drastically changed during the past couple of decades. In an environment of democratization and state endorsement of multiculturalism, indigenous groups have consolidated grassroots social movements, and their leaders have entered government bodies on all levels (Laurie et al 2005; Selverston-Scher 2001). This complex process can both be tied to international currents such as human rights, conservation and aid movements, trade and intergovernmental cooperation, and unique local histories (Jackson and Warren 2005; Van Cott 2008). Through the process, the meanings of indigeneity are transformed. Although racial discrimination still is far from extinguished, identification with indigeneity has become highly valuable currency to garner political and financial support and to sell goods (Greene 2004; Korovkin 1998). Politicians, indigenous leaders, traveling merchants and tourist agencies alike turn to symbols of past civilizations, re-baptize themselves with indigenous names, and swap sweatshirts for ponchos and body paint. While some analysts have highlighted the instrumental value of these moves, others argue that this reindigenization is more profound than put-on surface displays to attract outsiders. For instance, Meisch (2002) shows how a recent musical renaissance in the Otavalo region has revived the role of music in indigenous social events, in addition to generating income both from tourists in the area and foreign street performances. Thus, the return to things associated with indigeneity forms part of strategies to engage with modernity, while simultaneously encompassing a deepened "heartfelt" pride and appreciation of traditions and heritage. Other studies have shown how such reindigenization has played out in a variety of social arenas, provoking a creative revival of the indigenous in rituals and celebrations (Wibbelsman 2005), dance performances (Mendoza 1998), beauty pageants (Rogers 1998), clothing (Van Vleet 2005) and language (Viatori 2007).

Little research has so far explored the recent reindigenization's implications for food and agriculture. In the realm of food, Paulson's (2003; 2006) recent work from Bolivia presents an important exception. She describes how food serves as a medium for a new level of public recognition and celebration of indigenous roots, in the forms of intensified indigenous ritual meals during local town fiestas and national politicians' public identification with and embracement of indigenous foods. Paulson's research thus indicates a departure from the above described deep-held associations of indigenous food with dirt and backwardness (Orlove 1998), toward new and more positive symbolic values, in line with studies from other cultural domains reviewed in the previous paragraph.

This Andean setting provides an excellent arena to investigate the role of cultural identity in agrobiodiversity maintenance. From the above literature review it is hypothesized that if cultural identity indeed shapes farmers' diversity decisions, then on farm diversity should vary between farmers that are deeply rooted in a certain culture and those who do not maintain cultural traditions to a large degree. Further, one might expect the recent reindigenization process, in which indigenous identity have risen in esteem, to have stimulated a re-appreciation of indigenous food traditions and the crops that form their base.

1.2.10 Climate Change and Agriculture

Global climate change is predicted to severely alter the environmental conditions for agriculture through the current century, and simulations indicate that expected changes in precipitation, temperature and CO^2-concentrations will amount in yield reductions in many parts of the world (Burke, et al. 2009; Jones and Thornton 2003; Lobell, et al. 2008; Parry, et al. 2004; Schenkler and Lobell 2010). A study of effects on agricultural impacts across the African continent suggests that temperature increases will be particularly influential in altering the crop's growing conditions (Lobell et al. 2008). More frequent incidence of extreme weather, climate induced changes in pest and disease occurrences, and increased strain on water resources are likely to pose additional challenges to the world's farmers (Thornton, et al. 2010). It is clear that adaptation measures must be implemented in order to maintain viable production systems (Adger, et al. 2007; Rosenzweig and Tubiello 2007). Insight from the emerging literature on agriculture and climate change building on computer modeling and simulations of future scenarios is crucial in order to plan adaptation initiatives and prepare for what is to come. Yet ultimately, the world's capacity to adjust agricultural production to the altered conditions depends on the observations and actions of farmers. Thus, policy planning should additionally be informed by research on how farmers so far perceive, experience and adapt to climate variability and change (Finan and Nelson 2001; Howard 2009).

1.2.11 Climate Change and Agrobiodiversity

Climate change brings new attention to agrobiodiversity in at least two perspectives. On the one hand, climate change might potentially intensify pressures of genetic erosion. For instance, Morin and colleagues (2002) showed that traditional rice diversity in an area of the Philippines declined abruptly following several subsequent years of extreme weather associated with strong El Niño/La Niña events in 1996-1998. Given that such extreme events are predicted to become more frequent in the future, one might expect the risk of losing diversity to rise. According to Andy Jarvis and co-workers "climate change is likely to be an additional threat to agricultural biodiversity, increasing genetic erosion" (2008: 12), but they also point out that there is little research and knowledge about this potential process: "It is however poorly understood how the increase of climate risk, and change in the climate baseline might impact the current diversity in landraces found *in situ*." (2008: 13).

On the other hand, crop diversity has been presented as a central part of the solution to climate change adaptation. Fowler notes that "[c]onserving crop diversity is the prerequisite for the future evolution and success of agriculture. (…) If we do, we may well be able to adapt successfully, and in time, to future climate change" (2008: 501). The threat of climate change has heightened the need of seeds that are able to thrive in altered environmental conditions, placing a new imperative on the conservation and maintenance of diversity. It has lead to a renewed emphasis on collection efforts, both of landrace diversity and wild crop relatives, and their conservation (FAO 2010, Fowler 2008). Further, it has led to new agendas for crop breeding, where traits such as drought and salinization tolerance are given priority (CGIAR 2009, Ortiz 2011). Crop and landrace diversity has also been highlighted as a source for resilience in itself; in contrast to uniform, formally bred modern varieties, landraces typically contain greater genetic diversity, and might therefore directly provide a source of adaptation for farmers (Jarvis, A. et al. 2008, Ortiz 2011). After all, this diversity has provided resilience to climatic variabiliy throughout agriculture's past, and, as pointed out by Fowler (2008), crop landraces have gone through plenty of evolutionary processes adapting to new climates as people have brought them into new environments, especially during the last half millennium after the Colombian exchange. Still, our understanding of landraces' evolutionary potential to adapt to rapidly changing climatic conditions is limited (Jarvis, A., et al. 2008).

Another way through which farmers may adapt is by adding alternative crops and varieties to their fields, wholly or partially replacing ones that no longer thrive (Easterling et al. 2007). In an analysis of future climate scenarios for the African continent, Burke and colleagues (2009) find that by 2050 climates will change so much that an intensified movement of planting material between nation states will be necessary. Computer modelling predicts that crop climates will change substantially in future years, suggesting the need of an intensified movement of planting material between nation states (Burke et al. 2009). Recent range shifts in wild species in response to global warming, specifically toward higher latitudes and altitudes, have been extensively documented during recent years (Parmesan and Yohe 2003, Parmesan 2006), but little research has examined corresponding range shifts in cultivated species. An exception is constituted by Odgaard et al.'s study, which shows that in conjunction with rising temperatures during the first decade of the 21st century, the cultivation of maize has become more prevalent further north in Denmark (Odgaard et al., 2011).

1.2.12 Climate Change in the Andes

Global trends of climate change during the past decades are well reflected in the Andes. Pooled data from across the region shows an average increase in 0.1°C/decade over the past 70 years, intensifying to 0.32-0.34°C/decade during the last quarter of the 20th century (Vuille and Bradley 2000, Vuille, et al. 2008). Data from the Ecuadorian highlands yield an average increase of 0.9°C between 1960 and 2006, although at some stations, the rise amounts to 2.4°C (Ontaneda 2007). Analyses of precipitation records show more varied results, but there are clear trends of decreasing cloud cover and increased incidence of extreme weather events, in particular during the last three decades (Haylock, et al. 2006; Magrin, et al. 2007; Ruiz, et al. 2008). These changes are linked to an accelerating meltdown of the region's tropical glaciers, a process again expected to affect hydrological patterns in highlands as well as surrounding lowlands, threatening the water supplies of rural and urban populations (Bradley, et al. 2006). Trends of warmer, more irregular and more extreme weather are predicted to continue into the future (Magrin, et al. 2007; Urrutia and Vuille 2009; Jarvis, et al. 2011).

The observations of already occurring as well as expected climatic changes indicate that the Andes is a pertinent region to study the impact of climate change. Model simulations predict that Ecuador is one of the countries that will suffer most in terms of declines in agricultural production; depending on the climate scenario, yields are expected to drop by an average 18.1-30.9% by 2080 (Cline 2007).

1.3 Research Problems

The above literature review shows that despite of the central role of agrobiodiversity in sustaining humanity's future food supply, scientific insight into the present conservation status of crop and intracrop diversity is deficient for many areas. It is clear that much genetic diversity has been lost from the world's fields, but the severity of this loss is not well understood (Brush 2004; FAO 2010). Further, the dynamics affecting loss and persistence of diversity on farms are in need of further investigation. In this regard, agronomic and economic factors have received comparatively much research attention, but the above review indicates that cultural identity may also play a profound but little explored role. Finally, the literature reviewed above suggests that climate change invariably will influence farmers' fields and the crop diversity they contain, yet the ways in which this will and already might be playing out is in need of investigation.

This research addresses these issues through a case study in Cotacachi, located in the Northern Ecuadorian Andes (Figure 1.1). First, it sets out to address the lack of scientific insight into diversity's conservation status by a detailed documentation of the area's crop and intracrop diversity. Second, it aims at expanding understanding of dynamics in the maintenance of agrobiodiversity by investigating spatial and temporal change in diversity levels and their drivers, with a particular emphasis on the potentially significant, but poorly understood, roles of cultural identity and climate change.

Cotacachi is deemed an appropriate site for this research for several reasons. The Ecuadorian highlands form part of the Andean center of crop diversity (Harlan 1995; Vavilov and Dorofeev 1992), and therefore hold particular importance for *in situ* conservation. So far, however, scant research on agrobiodiversity conservation has been carried out in Ecuador in comparison with other parts of the Andes (Brush 2004; Brush, et al. 1995; Quiros, et al. 1990;

Zimmerer 1996; Zimmerer 2003). The current project aims to contribute to change this situation. Previous studies from Cotacachi indicate that a number of crops are grown by Cotacachi's farmers (Ramirez and Williams 2004; Skarbø 2005, 2006) and the present research aims at documenting this diversity in greater detail.

Cotacachi is also a particularly appropriate site to investigate the role of cultural identity in agrobiodiversity maintenance. Cotacachi's rural areas are mainly inhabited by people identifying as indigenous Kichwa (UNORCAC 2007; INEC 2011), and Cotacachi *cantón*[2] was the first county in Ecuador to elect an indigenous mayor, in 1996. People from the area have played key roles in the buildup of local as well as national indigenous and peasant movements (Ortiz Crespo 2004).

In Cotacachi, climate change is starkly manifested in the recent loss of its volcano's glacier, affecting local hydrological patterns (Rhoades 2007; Rhoades, et al. 2006). Already at the turn of the millennium farmers noted increased climatic irregularity as a factor presenting new challenges to agricultural production, resulting in higher harvest loss (Rhoades et al. 2006). Further, farmers in a community located in the highest part of the agricultural zone, right below the *páramo*, Ugshapungo, noted that they recently had been able to grow maize – a crop that formerly had been restricted to the warmer, lower parts of Cotacachi (Skarbø 2005). These former observations indicate that the area is one in which climate change is already affecting local fields and farmers' decisions, warranting further investigation into these processes.

[2] A *cantón* is an Ecuadorian geographical-administrative unit, roughly corresponding to the size of a United States county. The country is divided into 24 *provincias*, which altogether encompass 224 *cantones*. Each *cantón* is further subdivided into various *parroquias*.

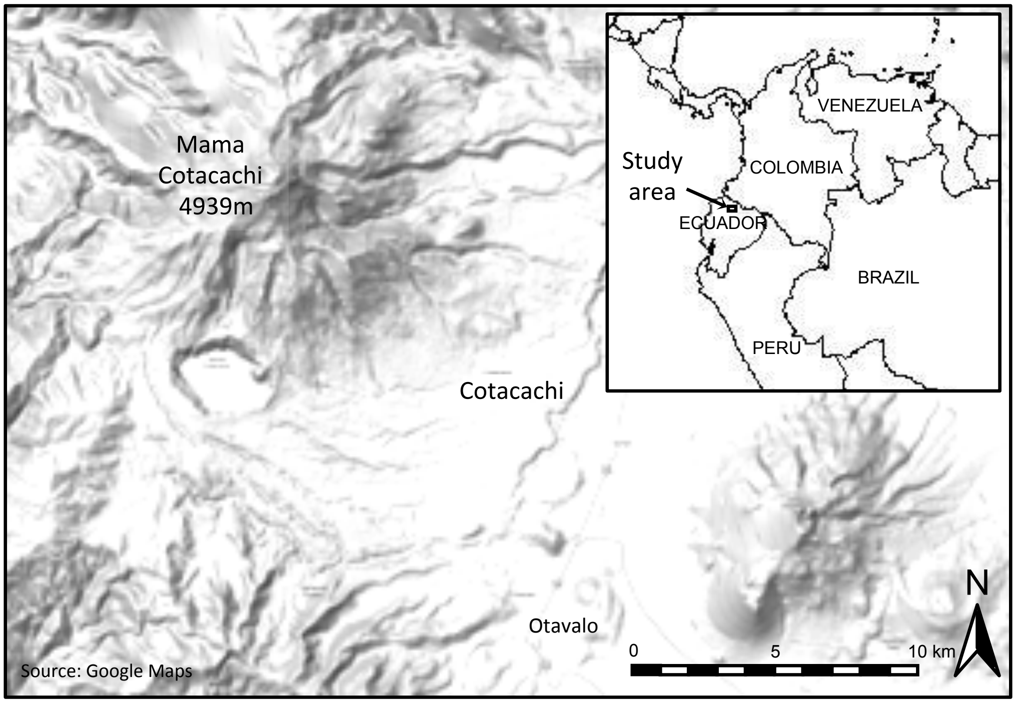

Figure 1.1: Location of the study area Cotacachi in Northern Ecuador.

Figure 1.2: Fields of Cotacachi.

1.4 Cotacachi: Folks and Fields on a Mountain's Slopes

Cotacachi *cantón* is located about 80 km north of Ecuador's capital Quito, in the country's northern highlands (Figure 1.1). It is the home to a total of 40,036 inhabitants (INEC 2011), and covers an area of 1848.5 km^2, encompassing a vast array of habitats and ecosystems (Peñafiel Cevallos 2003). From the Inter-Andean valley bottom in the east it stretches up to the peak of Mama Cotacachi, at 4939m, and down through the cloud forest and out west into Ecuador's coastal tropical lowlands. This study however, is focused on the *cantón*'s Andean part, including the *parroquias*[2] Quiroga, San Francisco, El Sagrario and Imantag, and covering an area of 219 km^2 (Zapata Ríos, et al. 2006). Data from a survey carried out in 2005 showed that 15,884 people lived in one of 43 Andean rural communities (UNORCAC 2007). The remaining population is mainly urban and divided between the three small towns of Santa Ana de Cotacachi (normally referred to as Cotacachi), Quiroga and Imantag. While a majority of urban inhabitants identify as mestizo, most rural residents consider themselves indigenous (INEC 2011). The urban population is mainly engaged in service, trade and tourism sectors, and the town of Cotacachi is also known for its leather industry. Agriculture remains an important rural activity, and over four fifths of community households own and cultivate their own land (UNORCAC 2007). At the same time, many engage in wage work, within sectors such as construction, industry, larger-scale agriculture (haciendas [estates], flower greenhouses), handicraft production and tourism. Women also take posts as domestic workers or perform laundry service. Many men migrate weekly to Quito or further destinations (Flora 2006), while women to a larger degree stay on farm or work in nearby towns.

Agriculture is carried out from the valley bottom at approximately 2300m and up toward an altitude of about 3200-3300m (Figure 1.2). Agricultural production is roughly divided into two systems: that practiced by large haciendas, and that by smallholders belonging to one of the rural communities spread on the slopes of Mama Cotacachi. While haciendas typically produce on a large scale and market oriented, smallholders' production is more for subsistence use – although some also grow for the market. During colonial and post-colonial times, well into the 20th century, most land in Cotacachi and the surrounding regions was owned by mestizo-white hacendados and the Catholic Church, and worked by indigenous peasants (Meisch 2002, Moates and Campbell 2006), like in most of the Ecuadorian highlands (Becker 2008, Lyons 2006). Members of the latter group were only remunerated by usufruct rights to land for their own subsistence production, as well as water and wood collection. Land reforms in 1964 and 1973 partly dismantled this exploitative system, and communitarians gained land rights and independence (Becker 2008, Meisch 2002, Moates and Campbell 2006). However, the process was largely uneven; the amount of land allotted varied extensively, and much land remained under hacienda control. Some were only given rights to the small parcels their families had cultivated for subsistence purposes prior to the reforms, while others actually were able to access parts of former hacienda fields (Lema 1995, Skarbø 2005). By the year 2000, an estimated 40% of the hacienda fields of 1963 had been converted to smaller, redistributed parcels of less than 5 hectares (Zapata Ríos, et al. 2006). As a result, smaller fields then constituted a total of 6334 ha (Table 1.1). According to a survey conducted in 2005 (UNORCAC 2007), there are 3224 households in Cotacachi's 43 communities, and, assuming all parcels less than 5 ha belongs to them, each household on average cultivates about 1.96 ha. However, in reality, also within and between communities, land sizes vary. In the present study's survey of 89 farms across five communities, average reported farm size was 1.05 ha (standard deviation 1.72 ha), with a range of 0.035-10.0 ha. According to local inheritance patterns, each child is given a section of the parents' land at generational shifts, implying a constant decrease in the size of households' holdings.

Table 1.1: Size of cropland in Cotacachi, 1963 and 2000. Data source: Zapata Ríos et al. 2006.

Size of cropland	1963 (ha)	2000 (ha)	Change (ha)
<5 ha	4107	6334	2227
>5 ha	5523	3048	-2475
Total	*9630*	*9382*	*-248*

The struggle for land is ongoing in Cotacachi. In the 1990s, the community of Tunibamba won a long court fight for land rights to the hacienda surrounding the community settlement (Moates and Campbell 2006). In the community of El Batan, villagers joined together to take up a bank loan and purchase a tract of another adjacent hacienda in 2005 (Francisco Guitarra, pers. comm.). Some of the younger households in this community close to urban Cotacachi had next to no land before the purchase, and the 0.125 ha achieved per participating family now give them the opportunity to substantially increase food self-sufficiency.

On the one hand, this process is facilitated by decreasing land productivity and interest in agriculture among some hacendado families, but on the other, it is discouraged by rising land values, due to recent urbanization projects – not least catering to a new immigrant wave from North America. Thus, another part of the hacienda that El Batan's communitarians were able to partly buy was purchased by a land developer and turned into a gated community for foreign immigrants. The frictions set in motion by this quite recent of globalization's unpredictable turns are indeed worthy a deep inquiry, but here I shall let it rest. Likewise, examining haciendas and their histories and current states would surely yield interesting insights, but since a dissertation can only encompass so much, neither did I include them in my research. This study focuses on agriculture as practiced by Cotacachi's communitarians.

1.5 Methodology

Dissertation research was conducted through 12 months of fieldwork in Cotacachi during 2009-2010. I employed a multi-method approach, principally consisting of participatory observation, interviews, farm household surveys, workshops and mapping. Throughout the year I lived and took part in a multitude of everyday and festive activities in the compound of a three-generation family in the community of Turuco, located in the study area's lower zone, approximately 1.5 km from the town Cotacachi. I also spent time and participated in a suite of agricultural, food-related and communal activities in several other communities. I further attended events and activities arranged by the local municipality and non-governmental organizations. In particular, I collaborated with and participated in many of activities arranged by the *Unión de Organizaciones Campesinas e Indígenas de Cotacachi* (UNORCAC) – an important local non-governmental organization working to achieve *development with identity* (*desarollo con identidad*) (Rhoades 2006) and *good living* (*alli kawsay/buen vivir*) in the 43 Andean communities of Cotacachi's Andean zone (UNORCAC 2008). These experiences gave ample opportunity to observantly participate in patterns and motions of culture, climate and agriculture.

I conducted various types of interviews, including life history interviews (Counihan 2004; Nazarea 1998) and open-ended and semi-structured interviews with farmers and representatives for various governmental and non-governmental organizations. In collaboration with UNORCAC and colleagues at the University of Georgia I arranged a series of workshops focused on agrobiodiversity, food and climate change, with a combined participation exceeding 200 people. Another major activity consisted of a farm survey in five communities, encompassing 89 households. During the survey, I collected detailed information regarding among other topics agrobiodiversity, food consumption and farm characteristics. Because of the extensive nature of the interview schedule as well as collection of food consumption data at several points in time, each household was visited at least twice during the course of the fieldwork. In the analysis of survey data, I additionally draw on data collected from a subset of the surveyed farms during my research in the area in 2003-2004.

Together with Kristin VanderMolen I examined and mapped shifts in the patterns of maize cultivation through farmer-guided transect walks along the upper edge of Cotacachi's agricultural zone. During much but not all of the work, I was aided by research assistant Rosa Ramos, who is an experienced farmer with great knowledge of the area's agrobiodiversity. Most Kichwa in Cotacachi are bilingual and also speak Spanish, but some, and especially elderly women, prefer Kichwa for a free-flowing conversation. Although I gained a certain level of Kichwa skills during the course of the time in Cotacachi, I far from master it fully, and it was invaluable to be able to conduct interviews and facilitate focus group discussions also in Kichwa with her help. For data management and analyses I used Microsoft Excel and STATA IC 11.2 for Mac.

1.6 Structure of the Dissertation

The collection of articles springing out from this inquiry is organized as follows. Chapter 2 documents the portfolio of crops and varieties cultivated in Cotacachi in 2009, and analyzes the relative importance of planting material of different origin as well as the distribution of different kinds of diversity in the area. It presents evidence of a rich but unevenly distributed diversity. The next chapters examine changes over time in fields' crop composition as well as people's perceptions and preferences of local and non-local foods. Chapter 3 presents some basic spatial and temporal patterns ordering agriculture in Cotacachi's communities and shows how these were reconfigured toward the end of the past century, leading to simplified fields. Chapter 4 centers on currents and countercurrents in Cotacachi's foodscape during the past four decades. It shows that the process of reindigenization, in concert with other trends, has reshaped the values placed on different types of food during recent years. Chapter 5 draws on comparative data from my previous work in the area and presents a longitudinal analysis of changes in crop diversity between 2003 and 2009. Chapter 6 recounts the successful emergence of a new farmers' market in Cotacachi, demonstrating an increased interest on part of the urban population in accessing products grown by indigenous farmers in the countryside surrounding their towns. Chapter 7 focuses on the rather formidable recent transformations of the crop diversity of one single crop, quinoa, induced by a rising international demand and the programs of governmental and non-governmental organizations. Chapter 8 examines patterns behind the currently observed uneven distribution of diversity, by analyzing which farm and household factors are associated with higher and lower levels of agrobiodiversity. In a novel fashion it incorporates cultural variables in an econometric analysis framework, and demonstrates that these indeed matter in shaping household's diversity decisions.

The following two chapters examine the impacts of climate change on Cotacachi's agriculture. Chapter 9 examines the diverse ways in which these pattern shifts affects agricultural production and how farmers deal with new challenges. Chapter 10 centers on one particular adaptation measure: the expansion of maize cultivation to higher elevations. Finally, Chapter 12 provides a synthesis of the insights gained from the research, and discusses implications and future research directions.

1.7 A Note on Language

As noted above, Cotacachi is a highly bilingual area, and most rural residents speak both Kichwa and Spanish. In this text, words in both languages appear in *italics,* as do Latin scientific species names. In Chapter 2, Kichwa and Spanish words are distinguished between by placing Kichwa terms in ***bold italics***. Kichwa is only recently being established as a standardized, written language in Ecuador, and there are many different ways of writing each word. This work follows the conventions of the recent dictionary published by the Ministry of Education (Ministerio de Educación 2009). The English names of Andean crops indicated here are those used in National Research Council (1989). For a full overview of crop plant names and their translations in Kichwa, Spanish, English as well as botanical species names, please refer back to Tables 2.1a-e in Chapter 2.

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CHAPTER 2

THE AGROBIODIVERSITY OF COTACACHI: DOCUMENTATION OF CONTENT AND EXTENT[3]

[3] Skarbø, K. To be submitted to *Economic Botany*.

Abstract

This study documents the content and extent of the agrobiodiversity cultivated by Kichwa farmers in Cotacachi, Ecuador. This area forms part of the Andean highlands, a center of origin and diversity of a number of crops. The maintenance of agrobiodiversity on farms in the world's centers of crop diversity is important for agriculture's capacity to adapt to changing environments. So far, research on the conservation of Andean agrobiodiversity has mainly been focused on the Central Andes and on the potato. The present study expands former insights by an investigation from the Northern Andes encompassing the diversity of a broad portfolio of crops.

Data were collected through participant observation, interviews, focus group discussions, workshops and a farm survey. The results show that Cotacachi's farmers collectively cultivate a rich but unevenly distributed crop and intracrop diversity. A total of 103 crop species are grown for food and forage, and about half of these are of New World origin. Within 20 of the most important field crops, 367 varieties are documented, 90% of which are landraces. The most diverse crops are common beans (*Phaseolus vulgaris*) and maize (*Zea mays*). There is great unevenness among crops as well as varieties in terms of their extent among the area's farms. Likewise, farms vary widely in terms of the number of crops and varieties grown. The low frequencies of certain crops and varieties may be an indication of a reduction of their extent during the past decades.

2.1 Introduction

2.1.1 Introduction

This study sets out to document the agrobiodiversity[4] grown in the Kichwa communities of Cotacachi in the Ecuadorian Andes. Literature on Ecuadorian agrobiodiversity is scarce, despite its location in the Andean center of crop domestication and diversity (Harlan 1995; Vavilov and Dorofeev 1992), and it is high time for researchers to begin to comprehend the nature and extent of the crop and intracrop diversity present on the country's current farms. The maintenance of agrobiodiversity in this region is important both in local and global perspectives; plant genetic resources from the world's centers of crop diversity will play a central role for agricultural adaptation to changing future environments (FAO 2010). Knowledge about the current status of on-farm agrobiodiversity is needed in order to effectively plan conservation initiatives. The present study adds to insights from other parts of the Andes (Brush 2004; Brush, et al. 1995; Quiros, et al. 1990; Zimmerer 1996) by investigating the content of the locally present crop diversity, its local classification, the relative importance of Old World vs. New World crops as well as modern varieties vs. landraces, and the distribution of this diversity among the area's farms.

2.1.2 The Andean Cradle of Agriculture

Andean agriculture has deep roots. Abundant variation in environmental conditions along altitudinal, climatic and soil gradients in this tropical setting has given rise to the evolution of rich wild biodiversity (Young, et al. 2002). Archaeological research shows that early foragers subsisted on a diverse plant portfolio, including grains, seeds, nuts, fruits, greens, bulbs, roots

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[4] The study focuses on the part of agrobiodiversity constituted by cultivated plants, and thus excludes the diversity of animals, invertebrates and microorganisms found in agricultural systems. The term agrobiodiversity is used interchangably with the term crop diversity in this paper.

and tubers (Dillehay and Rossen 2002). As foragers moved toward agriculture through subsequent millennia, a range of plants was also brought into the *domus*. The archaeological record of agriculture goes back to around 8000 BC; squash phytoliths on the Ecuadorian coast and arrowroot and tree crop remains in the Colombian sierra have been dated to this period (Pearsall 2008). Other early domesticates include gourds, other roots and tubers, cotton, peanut, jack bean (*Canavalia plagiosperma*), lupines (*Lupinus mutabilis*), quinoa (*Chenopodium quinoa*), amaranth (*Amaranthus caudatus*) and cañahua (*C. pallidicaule*), and before 2500 BC common beans (*Phaseolus vulgaris*), lima beans (*P. lunatus*), potato (*Solanum* spp.), sweet potato (*Ipomoea batatas*) and *Capsicum* peppers were also grown (Pearsall 2008). Over time, all these crops were dispersed within the region, and landraces adapted to different environments developed. Along the way, crops from other areas were introduced. Maize (*Zea mays*) is a particularly significant and early import; from its domestication in Mexico it wound its way southward, and already by about 6000 BC, people had introduced it to what is now Colombia (Pearsall 2008). The earliest maize records on the Ecuadorian coast date as far back as to 5000 BC (Zarrillo, et al. 2008). Large-scale landscape modifications, including terracing, irrigation networks, and raised fields, allowed for intensified agricultural production, and are associated with the rise of grand civilizations including the Tiwanaku and the Inca empire (Chepstow-Lusty, et al. 2009; Morris 1999).

After the Spanish conquest around 1500 AD, new crops were added Andean fields (Crosby 1972; Hernández Bermejo and León 1994). On the coast, sugarcane and bananas were to become important plantation crops, grown in monoculture and over vast areas. Other introduced crops that were to thrive in the lowlands are rice and various fruits, notably citrus. In the highlands, wheat, barley, rye, faba beans, peas and lentils as well as new fruits and vegetables were integrated with the formerly grown crops. The adoption of this new host of crops must have reduced the space allocated to native crops; however, it also significantly expanded the crop diversity available to farmers. It is difficult to assess the impacts of the "Columbian exchange" on native crop diversity, as inventories are lacking (Hernández Bermejo and León 1994). It may well be that species and varieties once exploited fell out of use, but, general surveys have shown that a significant portion also persisted and developed – despite disdain and stigma as "poor people's food", and perhaps much because of the crops' high adaptation to local environments and deep inscription in culture (National Research Council 1989). Even if it has been observed that species from both the New and Old Worlds are grown in the Andes today, there has been little investigation of the relative importance of each group.

A second major influence on the world's and the Andes' agrobiodiversity ensued as crop breeding advanced as a science through the 20th century. Development of formally bred modern varieties (MVs) for developing country agriculture began in the 1940s, and in the 1960s and 70s, a wave of high yielding MVs of major staple crops spread across the Global South, especially in Latin America and Asia (Fowler and Mooney 1990). Together with chemical fertilizers to raise yields, agrochemicals to fight pest and disease and the promotion of mechanized monoculture production, this process is known as the *Green Revolution* (Evenson and Gollin 2003). It has been credited for increasing the volumes of marketed food supplies, but at the same time blamed for a host of new problems including chemical pollution, unemployment (Cleaver 1972; Shiva 1991) and, loss of local crop diversity (Fowler and Mooney 1990; Frankel 1970; Rhoades 1991). Alarms about erosion of Andean potato diversity date back to the 1970s – when concerned scientists saw that their improved varieties wiped away from farmers' fields the very diversity from which they were bred, and from which supposedly the future's new varieties would also be created (Ochoa 1975).

In the 1980s and 1990s, however, it became clear that extinction was not complete; in sites in Southern Peru even market-oriented farmers at least maintained some native landraces for home consumption (Brush, et al. 1992). Zimmerer (1996) found that in the same region, native diversity of potatoes, melloco (*Ullucus tuberosus*), maize and quinoa survived in certain pockets of the agricultural landscape. Few studies have investigated the fate of crop diversity in the Ecuadorian Andes.

2.1.3 The Present Study

This paper adds to the literature on agrobiodiversity conservation through a case study in Cotacachi, an area in the Ecuador's northern highlands. It takes a comprehensive approach, encompassing documentation of diversity at both crop and intracrop levels. It seeks to identify the impact of the two major incursions of agrobiodiversity identified to have taken place during the past five centuries, by analyzing the relative importance of Old World versus New World species and modern varieties versus landraces. Finally, in order to better understand the conservation status of the overall present crop diversity, it also includes an analysis of crops' and varieties' distribution among the area's farms.

This approach will broaden former insights in two ways. Research documenting the extent of Andean agrobiodiversity has primarily been focused on the Central Andes, and much attention has been given the potato. By its focus on Ecuador and the complete crop portfolio, the current study provides fresh and comparative material.

The paper is structured as follows. First, I review previous research and approaches to classify and assess cultivated biodiversity. Next, the study area and methods are reviewed. In the ensuing sections I present results and discuss them along the way. I first present an overview of the crops present in Cotacachi, followed by an analysis of the relative importance of species with Old World versus New World origin. Next, the intracrop diversity is reported, including a discussion of how farmers classify the within-crop diversity they manage and an examination of the extent of modern varieties versus landraces. After this, I present an analysis of diversity's distribution among the area's farms. Two dimensions of this distribution is examined: the commonness of each crop and variety, and the numbers of crops and varieties on each farm. At then end of the paper, the results are discussed in relation to previous research.

2.1.4 Classification and Assessment of Cultivated Biodiversity

2.1.4.1 Classification of Biodiversity

Folk classification of biodiversity has been a recurring topic in ethnoecological research since the 1950s, when Conklin (1954) documented an extensive system of plant classification among the Hanunóo in the Philippines, with over 1800 named plant categories. Since then, it has been shown that elaborate folk taxonomies ordering the realm of living beings into related categories exist in many different cultures (Anderson and Medina Tzuc 2005; Atran 1985; Berlin 1992; Berlin, et al. 1966; Berlin, et al. 1974; Boster 1985; Ellen 1993; Hunn 1982; Nazarea 1998). It has further been demonstrated that these categories or taxa are ordered in relation to each other in ranked systems, and that on one level ("generic taxa"), they correspond rather closely with genus or species scientific taxa (Berlin 1992). In the case of domesticated species, generic folk taxa are in many cases subdivided into specific and varietal taxa (Berlin 1992).

2.1.4.2 Classification and Assessment of Intracrop Diversity

Analyses have shown that on an individual/household level, there is good correspondence between farmer-identified varieties and biological units arrived at through agromorphological, biochemical or DNA analyses. For instance, Quiros et al. (1990) showed high consistency between farmer named potato varieties and phenotypes identified by analysis of biochemical markers (isozymes). The Peruvian farmers participating in the research tended to slightly underestimate the number of potato varieties in relation to those found in the laboratory analysis. Research from Morocco on faba beans likewise showed agreement between farmer identified varieties and phenotypes arrived at through hierarchical cluster and multivariate discriminant analysis of agromorphological traits, and a further analysis of molecular markers confirmed that within-variety genetic variation was lower than that between varieties (Sadiki, et al. 2007).

This correspondence has a logical cultural-biological explanation; farmers create varieties by selecting for plants with certain traits that appear in the field, and when these traits have a genetic base, they (and any other traits to which they are genetically related) are reinforced through time. As any plant may be favored for a number of different traits, suiting multiple uses, needs and likes, different varieties develop during the course of generations. It was of course Darwin who first pointed this process out, and to convince the reader he used the example of strawberry varieties' rapid development during the 19th century:

> As soon, however, as gardeners picked out individual plants with slightly larger, earlier, or better fruit, and raised seedlings from them, and again picked out the best seedlings and bred from them, then, there appeared (aided by some crossing with distinct species) those many admirable varieties of the strawberry which have been raised during the last thirty or forty years.
>
> (Darwin 1964 [1859]: 42-43)

Ethnoecological research has shown that farmers often use morphological criteria to distinguish between varieties (Boster 1985; Nazarea 1998). Indeed, Boster (1985) has argued that a distinct morphology is key for newly appearing variants to survive and become varieties; it is only if a plant type can be perceptually distinguished from others that farmers may appreciate it as different, and if it in addition exhibits some other favorable trait, the chances increase it will be propagated. Color has been identified as a particularly important trait for distinguishing varieties (Berlin 1992). Morphologically distinct varieties are further characterized and evaluated by a set of different criteria. For instance, sweet potatoes in the Philippines are evaluated according to criteria linked to gastronomy, life habit, familiarity, agronomy and function (Nazarea 1998).

While the correspondence between farmer-named varieties and biologically distinct units is proven to be good, the consistency between farmers in how they name varieties is not always complete: sometimes the existence of synonyms (different names applied the same variety) and homonyms (the same name applied to distinct varieties) complicates this relation (Camacho Villa, et al. 2006). Examinations of rice diversity in Nepal (Bajracharya, et al. 2006) showed that such patterns may vary by site. Cluster analysis of agromorphological traits revealed that seed lots bearing the same name sampled from different farms carried similar traits within two sites. In a third site, however, the overall morphological variation was much lower, and a similarly clear pattern could not be distinguished. Sadiki et al. (2007) showed that for faba beans in Morocco, the consistency in variety naming decreased with geographical distance; while farmers in the same village largely named varieties with the same agromorphological traits by the same name, the use of alternative names became more prevalent in villages of increasing distance. In sum, the extent to which farmers name populations with a similar genetic makeup by the same name seems to vary by site and be higher for farmers living in close proximity than those further away.

Scientists working with agrobiodiversity have as yet failed to agree on how to define the units of intracrop diversity that farmers manage (Camacho Villa, et al. 2006; Zeven 1998). Here I employ the term *seed lot* defined as "the set of seed of a particular type, selected and sown by a specific farmer during a season" (Louette 1999: 112). Louette (1999) further defines a *variety* as "the set of farmers' seed lots that bear the same name and are considered to form a homogenous set" (p. 112). I employ this definition with weight on the second part, taking into account that sometimes synonyms and homonyms confuse the link between a name and a variety. Varieties can be divided into two main types: *landraces* and *modern varieties* (MVs)[5]. A much-cited definition for a *landrace* is that of Harlan (1975)[6], while a more recent and concise proposal defines it as "a dynamic population(s) of a cultivated plant that has a historical origin, distinct identity and lacks formal crop improvement, as well as often being genetically diverse, locally adapted and associated with traditional farming systems" (Camacho Villa, et al. 2006: 381). Landraces are often contrasted with modern (scientific) varieties (MVs) that have been bred and released from plant breeders, synonymous with high yielding varieties, improved varieties and formal varieties. In this paper, I use the terms "landrace" and modern variety (MV) as referred to above, as well as the term "variety" as encompassing any or both.

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[5] Sometimes further categories are used, such as farmer varieties (FV), which may also encompass modern varieties that have been cultivated and managed by farmers over an extended period of time, resulting in modifications of the varieties' characteristics (Almekinders and Louwars 1999, Zimmerer 2003).

[6] "Land races have a certain genetic integrity. They are recognizable morphologically; farmers have names for them and different land races are understood to differ in adaptation to soil type, time of seeding, date of maturity, height, nutritive value, use, and other properties. Most important, they are genetically diverse. Such balanced populations-variable, in equilibrium with both environment and pathogens, and genetically dynamic-are our heritage from past generations of cultivators. They are the result of millennia of natural and artificial selections and are the basic resources upon which future plant breeding must depend." (Harlan 1975: 618)

There are several ways to measure agrobiodiversity (Brush 2004; Smale 2006). Here I mainly employ *count*, which is a *richness* measure, defined as the "number of farmer-managed units of diversity" (Smale 2006: 9) on the crop and intracrop levels.

2.1.5 Study Area and Methods

This research was carried out over a 12-month period in 2009-2010 in the Andean zone of Cotacachi Cantón in the Northern Ecuadorian Andes. The area covers 219 km^2 and an altitudinal span of 2080-4939m, and harbors high levels of wild and cultivated biodiversity (Rhoades 2006). Agriculture is carried out from the plain fields of the Inter-Andean valley bottom at 2300m and up the slopes of the dormant volcano Cotacachi to an altitude of about 3300m. Before land reforms in the 1960s and 1970s, most agricultural land belonged to haciendas, owned by mestizo-whites and labored by indigenous Kichwas (Moates and Campbell 2006). Although sizeable tracts of hacienda land remains today, 67.5% of cropland is constituted by fields less than 5 hectares, most of which are owned and farmed by Kichwa households settled in one of the 43 communities in the area's rural zone (UNORCAC 2007; Zapata Ríos, et al. 2006).

Data for the current paper were collected during participant observation, interviews, focus group discussions, workshops and a survey of 89 farm households. An initial overview of local crop diversity and its classification was gained through previous work (Skarbø 2005; Skarbø 2006), interviews and focus group discussions. On this basis, a list of crops grown for food[7] or forage was compiled[8], and a subset constituting the most important field crops suitable

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[7] Food is here broadly understood as everything that is ingested, including herbs used as condiments and teas.

for further examination of intracrop diversity was identified. These two lists were used to prepare an interview schedule for the subsequent farm survey. For the survey, households were sampled across five communities representing differences in geographical and altitudinal distribution in the area, as well as variations in average farm size and ratio of subsistence vs. commercial production. In these relatively small communities (mean=57 households, standard deviation=26), purposive quota sampling taking into account age of household heads was used to ensure representative inclusion across age groups (Teddlie and Yu 2007). The survey included 20 households in each community except for one, where no more than a total of nine households were living at the time of the study, and the sample only reached this number. All interviews were conducted by the author, in the majority of cases accompanied by a Kichwa-Spanish bilingual research assistant. Interviews were carried out in Spanish, Kichwa, or a combination of the two languages, according to the preference of the interviewee. Household heads were asked to list all crops cultivated during the previous 1-year period. After an initial free listing of crops, each of the crops included in the prepared list were prompted for[9]. For 18 field crops (20 species), diversity was also assessed at the intracrop level. Within each of these crops, farmers were asked to identify and describe each variety they had planted during the previous year. Most interviews were conducted on the farms, and whenever possible, the elicitation was accompanied by field and garden visits as well as demonstrations and photography of stored seed.

During the research it was recognized that varieties were not consistently named by the same name by all farmers. Several steps were taken to sort out the issue of naming, in order to

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[8] The survey thus excluded certain species commonly grown for fiber (***chawar mishki***/*penco blanco* [*Furcraea cabuya*]), fencing (*lechero* [*Euphorbia laurifolia*], ***kabuya***/*penco verde* [*Agave americana*]) and ornamental (flowers) purposes.

[9] In the case of herbs, this prompting list was not exhaustive, and only contained 10 species. This may have slightly influenced the data, causing some herbs to be missed from the survey because farmers did not remember them, resulting in a slight underestimation of household herb diversity.

arrive at an overview of the total intracrop diversity. First, photographs allowed visual comparison of varieties from different farms. Second, three workshops were arranged where farmers brought in seed samples and discussed crop classifications and variety characteristics and names. Third, my field assistant Rosa Ramos, who is a highly experienced local farmer and researcher, accompanied me on a majority of the survey interviews as well as during workshops, and collaborated closely in systematizing the data. These efforts have likely lead to a close approximation of characterizing the actual intracrop diversity perceived and managed by Cotacachi's farmers. Still, and especially within the extremely diverse common beans (*Phaseolus vulgaris*/***purutu***/*fréjol*/*poroto*)[10] there might remain a limited number of superfluous synonyms or homonyms in the data presented here.

Five types of crops are distinguished between in the research: field crops, vegetables, fruits, herbs and forage crops. Field crops encompass crops that are usually grown in larger extents in fields, whereas the other groups are typically grown in home gardens. In practice, the categories are somewhat diffuse; some crops that here are categorized as field crops may be included in home gardens (such as yacon, arracacha, sweet potato, runner bean), and sometimes vegetables are included in fields (e.g. some cabbage plants may be planted in a maize/bean intercrop). However, for purposes of this analysis, these categories provide a useful approximate frame. Data analysis was performed using STATA IC 11.2 for Mac and Microsoft Excel.

[10] In the text, scientific (Latin) plant names and Spanish terms are given in *italics*, while Kichwa terms are given in ***bold italics***. For many Andean crops there is no standardized English name; here they are written according to conventions in NRC (1989).

2.2 The Richness, Classification and Origin of Crop and Intracrop Diversity in Cotacachi

2.2.2 Crop Diversity in Cotacachi

2.2.2.1 Overall Crop Diversity

A total of 103 cultivated[11] food and forage species were documented in the research. In accordance with patterns found in previous research (Berlin 1992), local crop classification in Cotacachi mostly corresponds to scientific species divisions. The 103 species correspond to 107 locally recognized crops. The three different potato species[12] present in the system are distinguished between on a subcrop ("specific" in Berlin's [1992] terms) level, but considered types of the same crop (***papa***/*papa*). In contrast to potatoes, the different varietals of *Allium cepa* (onions) and *Brassica oleracea* (cabbage, cauliflower etc.) are considered different crops, as is common in other folk taxonomies. Tables 2.1a-e provide an overview of crop names, origins and popularity on Cotacachi's farms. Considering the number of species present in the system, fruits (32) and herbs (30) are most numerous, followed by field crops (25) and vegetables (15). Only one forage species is documented.

2.2.2.2 The Relative Importance of Crops with Old World and New World Origins

Roughly half (49) of the species are of New World origin, and the other half (54) are introductions from the Old World – most of which are domesticates from the Mediterranean and Near East regions (Tables 2.1a-e and 2.2a). However, patterns of origin vary among kinds of

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[11] I have here counted the weedy ***ara papa*** (*Solanum* sect. *Petota*) as a cultivated species, although it is considered half-wild by local farmers as well as scientists (Spooner and Hetterscheid 2006). According to farmers in Cotacachi it does require some management in order to thrive, such as toleration, throwing seed (tubers) back into fields, and keeping pigs out of fields.

[12] The distinction into three different species applied here is based on the widely accepted classification presented by Hawkes (1990). However, scientists continue to discuss potato species classification, and Spooner and colleagues have proposed to lump all cultivated potatoes into one species, divided into different Groups (Huamán and Spooner 2002, Spooner and Hatterscheid 2006).

crops (Table 2.2a). As much as 18 (72%) of the 25 field crop species are of American origin. When it comes to vegetables the picture is reversed; only 4 of the 15 species are New World domesticates, while 11 (73%) are Old World introductions. Native and introduced fruit species are equally represented in terms of number, as 16 New World and 16 originally Old World fruits are grown. Introduced Old World species dominate among cultivated herbs (19 or 63% of 30 species). The single registered forage species is alfalfa (*Medicago sativa*), with origin from the Old World.

As measured by the number of farms where they are grown, the relative distribution of crops of Old and New World origin is slightly different from the relation between total species number of the two origins. Table 2.2b shows the sum of the number of times a species was registered during the farm survey (N=89), broken down by crop group (i.e. the sum of the number of farms where each species of each crop group is grown). In total, species with New World origin were registered 801 times, while Old World species registrations totaled 794, resonating with the near-half distribution between the New vs. Old World species numbers noted above. The relation between crop species of the two origins is also maintained in the case of field crops; 476 (74%) of the 644 field crop registrations concern New World crops. Yet for the vegetable and herb crop groups, the dominance of Old World crops is increased when considering proportion of registrations – they make up as much as 91% and 80%, respectively. Conversely, New World fruit species are registered more frequently (249 or 62%) than Old World ones (150 or 38%).

In sum, Old World introductions have come to play important roles in Cotacachi's farming system. Both in terms of number of species in the area as well as presence on surveyed farms, they equal New World native crops. However, when it comes to field crops – the crops that are grown to the largest extent and arguably are most important for local subsistence – native crops dominate. In an overall perspective, it is within the minor crops of vegetables and herbs that Old World crops play the most important role. Few native species are cultivated for these purposes, and they are on average grown on a lower number of farms than Old World counterparts. This observation is related to the fact that Andean foods were traditionally prepared with the addition of wild and semi-cultivated/tolerated plants and weeds. On the one hand, the use of native plants as herbs and vegetables is thus likely slightly more prevalent than these numbers indicate, if also considering wild and weedy species. On the other, Old World vegetables and herbs have provided alternatives to these non-crop species, and have likely displaced some of their use.

2.2.3 Intracrop Diversity in Cotacachi

2.2.3.1 Overall Intracrop Diversity

Intracrop diversity was assessed for 18 of the field crops (corresponding to 20 species). Within these, a total of 367 varieties ("terminal taxa" – see next paragraph) were documented, of which the great majority (335) were registered during the survey. In addition, a total of 20 mid-categories between the crop and the varietal level were described. The Appendix (placed at the end of the dissertation) presents a detailed overview of all these subcrop entities, including their names and characteristics as well as the number of farms on which they were registered during the survey.

2.2.3.2 The Local Classification of Intracrop Diversity

In Cotacachi, classification of varieties resemble that documented in other parts of the world (section 1.4.2), encompassing morphology in addition to a set of other characteristics. The tables in the Appendix include an overview criteria used to distinguish and evaluate varieties identified during interviews and focus group discussions. For most crops, people employ the color and shape of the edible part (seed, tuber, fruit) to differentiate varieties. In addition, they often use the morphology of plants and plant parts, including plant height, and the shape, size and color of leaves, stalk, flowers, ears, husks or awns to distinguish them in the field. Varieties may further be evaluated by growth cycle length, their origin, and use criteria such as marketability, taste, cooking quality and suitability for different dishes.

In the classification system employed in Cotacachi, most crops are directly divided into a set of different subcrop entities or varieties (*clases*, *colores*, *variedades*), based on a set of criteria. However, within some of the crops (maize, beans, peas, faba beans, potatoes) people distinguish between main classes, within which further varietal divisions exist. In the case of maize (***sara***/*maíz*), ten main classes are distinguished between (Tables A2.2a-b in the Appendix). Some of these, but not all, are further subdivided into finer entities with different kernel and cob color (Table A2.4 in the Appendix). The ten main classes distinguished between by farmers roughly correspond to 12 Ecuadorian maize *races* identified by scientists (Table A2.3 in the Appendix). Six classes are identical, in a few cases farmers' classification is more detailed than scientists', and in another few, it is the other way around. Common beans (***purutu***/*fréjol*) are divided into short cycle non- or semi-climbing varieties (***allpa purutu***/*fréjol matahambre*) and longer cycle climbing varieties (***raku purutu***/*fréjol grueso*) – resonating with the distinction between bush beans and climbing beans common in other places and corresponding to differences in genetic makeup (CIAT nd). In the local classification system, common beans are also related to but, as a set, distinguished from runner beans and lima beans (Table A2.6 and A2.7, and Figure A2.1 in the Appendix). Peas are divided into five main classes, two of which are further subdivided into varieties of different color (Table A2.12 in the Appendix). Faba beans are classified into two main classes – short cycle small seeded ***chawcha hapas***/*haba chaucha* versus longer cycle larger seeded ***raku hapas***/*haba gruesa* (Table A2.13 in the Appendix). Both are again divided into finer entities. Potatoes are divided into three main classes corresponding to different scientific species, and all of these are further subdivided (Table A2.16 in the Appendix). The semi-cultivated ***ara papa*** (*Solanum* sect. *Petota*) and the short cycle ***chawcha papa***/*papa chaucha* (*Solanum chaucha*) are divided into varieties with different tuber skin color. The third main class, corresponding to the scientific species *Solanum tuberosum* subsp. *andigena*, encompasses all other cultivated potatoes. They are collectively usually just named ***papa***, but may also be called ***ali papa*** (good potatoes), when distinguished from ***chawcha papa*** and ***ara papa***[13]. Within all of these crops, color is an important distinguishing trait on the subdivision level, reflected in many variety names. However, farmers emphasize that color is not the only trait that vary between these varieties:

> For example the ***malva*** [a kind of climbing bean] climbs the plant, while the ***kijun ruana purutu*** extends below and does not climb much up the maize plants. And the ***suku azul*** winds itself up to the midpoint of the maize plant, flowers once, and pods in one go. But it is severely affected by the ***lancha*** [general term for plant disease/pest]. The ***toa*** as well is susceptible to the ***lancha***. The ***toa*** flowers all at once, pods all at once and yellows all at once, while the ***yana kara*** produces little by little. The ***hamzi wulun purutu*** is different in the lower and the higher parts, it ripens step-wise – below it is already dry when the upper parts are flowering. The ***toa*** has one single harvest, while the other has two. By color one distinguished which is good, which is bad. On the other hand, the

[13] The observation that potatoes of the subsp. *andigena* are called simply “potatoes” or “good potatoes” indicates that these are considered “prototype” potatoes – consituting the core of the potato category in the local classification system (Berlin 1992).

> ***rakupurutu suni*** – this one resembles ***wulun***, but it is ***suni*** [elongated] – is resistant toward the ***lancha*** and as well toward drought. It is persistent: if it is winter, no matter how dry it gets, when it rains again, it revives. Now, last Thursday, I went to harvest maize, and there it was, this bean, with new flowers after the rain we had. The ***yurak tawri purutu*** has a small plant, it does not climb, and with a stroke the flowers open, "pak" it pods, and all the pods lie on the ground. The ***yana purutu*** climbs some 30 centimeters, it is a round plant with dark purple flowers, it also flowers all at once and the pods are left there hanging. The ***lancha*** attacks this one more. We have every color, this way we do not lose everything. In the faba beans it is the same. The ***yana hapas*** are susceptible to the lancha, for this reason there aren't a lot of those. The ***killu chawcha***, on the other hand, is not much affected by the ***lancha***. It only bears pods on the upper part – from the middle to the top there are pods on its plant. On the contrary, the ***wirti hapas*** has pods from the ground to the top. And it is the same way with the peas. The ***luhana*** is a tall plant and needs more water than the ***chawcha***. The ***wirti chawcha*** needs only one rain. The ***suku chawcha*** is as large as the ***luhana*** but it needs little water. On the other hand, the ***killu chawcha*** has small pods, and tiny seeds. So, one differentiates all by color. But it is not only the color that varies; it is also the form of producing and extending.
>
> (Woman, 40 years old, Quitugo)

Such "metaclassification", where a crop is first divided into broad categories, which again are divided into varieties by traits, has also been observed for durum wheat (Taghouti and Saidi, 2002, cited in Sadiki, et al. 2007) and alfalfa varieties (Bouzeggaren, et al. 2002 cited in Sadiki, et al. 2007) in Morocco as well as potatoes in Peru (Brush 1992). In this work, "varieties" refer to the lowest level (and for most crops the only) local distinction of subcrop entities, while "main classes" refer to any mid-level subcrop distinctions, in the cases they exist. Variety counts in this study consist in counts of all "terminal taxa" (Berlin 1992), i.e., intracrop taxa that are not further subdivided in the local classification and management system.

2.2.3.3 Synonymy, Homonymy and other Fuzziness in the Local Classification System

Cotacachi farmers' intracrop classification contains a certain level of name-multiplicity. As described in the methods section, issues of synonymy, homonymy and inconsistency in variety naming and classification encountered during the farm survey was worked out through interviews and workshops with focus group discussions. For the total 367 varieties documented, there were altogether 499 variety names – 152 of which were synonyms and 18 of which were homonyms (See Tables in the Appendix for information on all varieties and variety names, Table 2.3 for summary data per crop and Tables 2.5-2.6 for information regarding homonyms). This corresponds to an average 1.36 names per variety. For the majority of varieties only one name was registered, but some had up to seven names. Small name variations, such as the exclusion of a pre- or suffix or the presence of both Kichwa and Spanish versions of a name were not counted – this would have substantially increased the number of names in use. Often, when the crop or crop main class is understood from the context, and in particular when the variety name is long, a pre- or suffix indicating crop or crop main class will be excluded from speech. Many names exist locally both in Spanish and Kichwa forms, adding another layer to the name complexity.

Some patterns can be teased out regarding the abundance of names. Synonyms are in general much less abundant within root and tuber crops, in comparison to grains, legumes and cucurbits (Table 2.3). This distinction may be related to the way the crop varieties are named. Varieties of those belonging to the former group are mostly known either by commercial name (*Solanum tuberosum* subsp. *andigena* potatoes) or by a term denoting skin color – the most salient morphological difference between varieties. And since these skin colors are rather unambiguous, not a whole lot of different names are applied. On the other end of the scale we find the grain crops – where the naming conventions are much more diffuse. Perhaps is this because the grain itself is hidden and small. Instead of only focusing on the color of the eaten part, a variety of other distinguishing characteristics is used to name the varieties. ***Hatun kinuwa***, for instance, is registered by a total of seven names (Table A2.19 in the Appendix). It is called “large quinoa” because its plant is taller and its seed is larger than those of other landraces. It is called “maize quinoa”, because it ripens at about the same time as maize does (later than other quinoa landraces). It is called “year quinoa”[14] for the same reason. Some call it ***pampa kinuwa***–translated to field/rural quinoa – as opposed to the other tall variety grown – which is a recently introduced MV. It is called “yellow quinoa” because its seed are more yellowish than those of the whiter ***chawcha kinuwa*** and the reddish ***puka kinuwa***. Finally, it is also called “white quinoa” because of the white powder on its leaves – different from the red or pink of other varieties. A related pattern is also found within crops; varieties that are unambiguously described by e.g. a unique color term are more frequently called the same by everyone, while those with a color pattern or morphology more inviting to let the fantasy play, inspire a set of different names. Thus, there is just one name for the only blackish maize type – ***yana sara*** or “black maize”, while there are four terms for the one with kernels colored red with yellow stripes; “placenta maize”, “mother earth maize”, “striped large tabled maize” and “yellow striped maize” (Table A2.4 in the Appendix).

Experienced farmers are cognizant of the existence of synonyms and sometimes provide different names of the same seed – and even indicate the geographical place where those other names are common. On the other hand, younger folks who do not have farming as their first occupation sometimes have no idea what variety of quinoa they have planted, nor do they know their beans by name. Further, even among the more knowledgeable the consensus is not 100%; during workshops and focus group discussions, there would sometimes be disagreement regarding the differentiation and naming of varieties. For instance, a certain kind of wheat (***puka triku***) was considered a distinct variety by the majority, but there were also those who insisted it

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[14] *Wata kinuwa* (quinoa of the year) is a term that is also applied to quinoa seeds from the previous year–generally having lost much of their ability to sprout.

was nothing but a "polluted" form of another variety. Even if great care has been taken to accurately understand, systematize and describe the agrobiodiversity perceived, cared for and employed by Cotacachi's farmers in the present work, this kind of "fuzziness" (Nazarea 1998) is a reminder that agricultural biodiversity is alive – in constant change and sometimes perceived differently even by neighboring farmers. Neither the nature of and the boundaries encompassing biological units nor people's perceptions and cognition regarding these categories and their constellations are fixed in time nor space. The picture provided here is approximate, but for sure not accurate according to all.

2.2.3.4 Differences in Varietal Diversity between Crops

There is great difference between crops in terms of the number of varieties present in the farming system (Table 2.3). Beans and maize decidedly represent the greatest varietal diversity registered during the research; close to one half (176 or 48.0%) of the registered varieties are common bean varieties, and maize varieties constitute another fifth (80 or 21.8%) of the total count (367). Between the three potato species there are 22 varieties (6.0%), and there are 15 runner bean varieties (4.1%). Within each of the remaining crops, there are eight or fewer varieties documented.

To what extent does the number of varieties within a crop correspond to the level of *genetic* diversity present in the area? The high varietal diversity documented within beans and maize in Cotacachi, both in terms of names and varietal characteristics, clearly reflects a wide genetic diversity as well. Maize from as much as 11 of the 17 highland races identified by Timothy et al. (1963) based on thorough documentation of maize from *the whole of Ecuador*, is present in Cotacachi, in addition to one lowland race[15]. This demonstrates presence of a broad genetic diversity. Maize and beans constitute agricultural and cultural core crops in Cotacachi – they are the main components of intercropped ***chakra*** fields (Chapter 3), and as in other parts of Latin America, their millennia long cultivation has fostered great varietal diversity. The crop with the third highest number of varieties, the potato, stands in a rather peculiar situation. On the one hand, much previous landrace diversity has been lost within this crop during the past generation, and modern varieties now make up most of the area planted with *Solanum tubersosum* subsp. *andigena*. These modern varieties encompass substantial genetic variation between them, as they are bred from diverse material. While the diversity represented by these varieties may be significant, concomitant is the near extinction of previously present landrace diversity. When it comes to runner beans, next in line, the rather high number of varieties (15) basically only show differences in color traits, and the genetic diversity found in the local populations of the crop is probably lower in comparison to several other crops with fewer varieties. For instance, different varieties of sambo and zapallo cucurbits exhibit variation within a number of different traits (Tables A2.26 and A2.27 in the Appendix), and the lower numbers of varieties identified by farmers within these crops likely harbor a rather high level of genetic diversity. Based on field observations, I further suspect that the lower number of varieties identified within some of the crops, such as lupine (3 varieties) and quinoa (4 varieties), actually contain wider genetic diversity than these numbers indicate. In sum, the results of this research suggest that while number of varieties might be a good, first indication of agromorphological and genetic diversity, this measure may, even within one site, mask greater or lower levels of

[15] The current presence of the lowland race Uchima (***muruchillu***/*morochillo*) is likely a product of farmers' adaptation of their agriculture to a warmer climate (See Chapter 11).

diversity, depending on the crop. Future research encompassing analysis at molecular and genetic levels would help further clarify these issues.

2.2.3.5 The Role of Modern Varieties

Even if MVs were introduced already from the beginning of the Green Revolution era in the 1960s and 1970s, landraces make up 90% of the currently cultivated varieties in Cotacachi, and 87% of the seed lots (Table 2.4). As shown in Table 2.4, the situation varies between crops. Many crops are exclusively planted with landrace material. This is mostly due to the simple situation that they are minor crops for which MVs have not been released. MVs are found within commercially important crops: maize, common bean, pea, potato, quinoa, wheat and barley. Farms that have a mainly commercially oriented production tend to plant exclusively MVs of these crops, but in contrast, subsistence-oriented farmers typically plant both MVs and landraces (Chapter 8). Within this general picture, there are further crop specific differences. In the case of maize, most subsistence-oriented farmers hold on to landraces, and plant MVs to a lesser extent. In the case of beans, most farmers plant a few MVs, but while these are typically the only beans planted by those with a commercial production, for subsistence-oriented farmers they are only an addition to a mixture of landraces. MVs of peas, wheat and barley have been integrated into the local seed system, and are planted alongside landraces. In fact, according to farmers' accounts they have been present and circulated in the local seed system for several decades. This seed might thus more aptly be categorized as *farmer varieties* – a category encompassing landraces "as well as former MVs that have been bred and were then released more than 15 years ago and that have since become incorporated into farmers' own seed production" (Almekinders and Louwars 1999). Only in the case of potatoes has the introduction of MVs led to a near-extinction of landraces – people explain that as the new varieties arrived several decades ago, they rapidly replaced landraces. After beginning bumper crops, yields decreased, and could only be upheld with the addition of agrochemicals. When asked today, many can hardly recount the names of those landraces. With the exception of one variety (***wata papa***) planted by one farmer in the survey, the only landraces that still are extant are those of other potato species – the faster maturing ***chawcha***/*chaucha* potatoes, and, to a much lower degree, the weedy ***ara papa***. The local diversity of quinoa is right now in transition – during the past decade the first modern variety was introduced, and this newcomer represents an impressive 43% of the current survey's seed lots. Even if this addition initially may have expanded local quinoa diversity, its rapid increase may potentially constitute a threat to local landraces (Chapter 7).

The data reveal that overall, the introduction of formally bred modern varieties into Cotacachi's farming system has not lead to a wholesale displacement of landrace diversity. The only instance where MVs have near completely displaced formerly grown landraces is in the case of tetraploid potatoes of the subsp. *andigena*.

2.2.4 A Summary of the Richness of Cotacachi's Crop and Intracrop Diversity

So far in this paper, we have seen that farmers in Cotacachi cultivate a remarkable amount of biological diversity: the sampled farms encompassed 103 crops, and within a subset of those, 335 varieties. In other contexts of the research, even a few more crops and varieties were documented, and if the investigation had continued, it is not unlikely that more would have been encountered. Old World crops do not seem to have eliminated large parts of native crop diversity, and overall, landraces still outnumber modern varieties. Can we thus conclude that biodiversity is alive and well in this area and fill our bowl of ***asuwa***/*chicha* [maize beer] for a celebrative toast to the past and future mutual nurturing between plants and people? Before doing so, it might be in its place to look a little closer at this diversity's *distribution*. Is everything present in roughly equal amounts and evenly spread among farms? Or is diversity concentrated on a few odd farms, while the rest are planted in monocultures?

2.3 Diversity's Distribution

In this next section, I will report on the commonness of crops and varieties as well as the amounts of diversity grown on each farm. These are two slightly different dimensions: the first looking from the perspective of crops and varieties at how many farmers grow them, and the second considering the level of diversity from the point of view of each farm. Combined, they will sketch an overall picture of diversity's distribution among Cotacachi's farms.

2.3.1 The Commonness of the Different Crops

Results regarding the commonness, or popularity, of the different crops are found in Figures 2.1a-d and the last two columns of Table 2.1. Figures 3.1a-d show graphical presentations of the percentage of farms (n=89) that cultivate each crop. Table 3.1 contains more detailed information regarding the numbers and percentages. A quick look at the bar charts show that the whole set of crops grown in Cotacachi is not present on each of the area's farms. In fact, this is not even nearly so. In the following section I will summarize and comment on these findings for each crop group (note that I here discuss crops and not species, although these categories mostly overlap).

2.3.1.1 Field Crops

Maize is decidedly the most popular crop – grown on 99% of the farms. This observation attests to its central role in the area's fields and food culture (Camacho 2006; Nazarea, et al. 2006; Ramirez and Williams 2003). Common beans are also grown by nearly all (88%); farmers living in the high altitude community of Ugshapungo constitute the exceptions – the climate of their farms is too cold for the plant. Other crops that are grown by a majority of farmers are potatoes, peas, sambo squash and faba beans. In the lower and intermediate zone of Cotacachi, peas and potatoes are mainly grown in the summer season, after the maize harvest, and before its next planting. These crops' adaptation to this season's dry weather likely contributes to their popularity. In the high zone, potatoes are a particularly important crop, because of their good adaptation to the colder climate experienced there. Sambo squash and faba beans are often intercropped with maize and common beans, although faba beans are also planted alone or intercropped in other combinations. All of the remaining crops are grown on less than half of the surveyed farms. Quinoa and lupines are grown on about one third, and winter squash on one fourth of the farms. These crops traditionally belong to the maize intercrop, although the two first are sometimes planted in monocrop. Farmers explain that they were more prevalent in earlier years, and so were barley and wheat, that are now planted by about 20%. Heavy labor requirements, especially during harvest and processing, are often referred to as a reason not to grow these crops. The relatively ready availability of store-bought alternatives, including bread, pasta, and rice, is likely also an important reason why not a larger number of farmers grow them. Finally, a number of roots and other minor crops are grown by less than 20%. While the native oca, melloco and arracacha (all root and tuber crops) still have a grip in the fields of 15-18% of farms, some that are grown by only a handful include the Old World immigrants lentils, chickpeas and rye, as well as native amaranth and lima beans. The former three seem to never have reached a central status in the local cuisine, perhaps with the exception of lentils, that are now often substituted with cheap imported ones. The perspectives for amaranth and lima beans may not be as bleak as the low numbers indicate; they have both been reintroduced to local farms in recent NGO led campaigns and might potentially increase their role in coming years (Chapter 5).

2.3.1.2 Vegetables

Vegetables are not grown by all, but an overall 65% of the surveyed farms cultivate one or more such crop. The most popular one is onion (grown by 45%), followed by cabbage (39%), carrot (28%), leaf beet (24%), red beet (22%) and Andean pepper (22%). The remaining vegetable crops are grown on 20% or less of the farms. With the notable exception of the Andean pepper, vegetable crops are for the most part Old World introductions that have risen in popularity during the recent past, connected to NGO and government campaigns to foster the cultivation and consumption of fruits and greens, better availability of planting material, as well as the development of a new farmers' market (See Chapters 5 and 6). They are used to season soups and stews, and also chopped finely for side salads. Andean pepper is almost exclusively processed into a traditional fresh pepper sauce (***uchu***/*ají*), served on the side to add spice and color to, in many homes, nearly every meal.

2.3.1.3 Fruits

In comparison to vegetables, the proportion of farmers growing fruits (72%) is slightly higher. The frequencies with which different fruits are planted resemble that of vegetables; the most popular, lemon, is grown by 46%, and tree tomato (36%), avocado (30%), blackberry (30%), capuli cherry (29%), orange (24%) and Andean walnut (24%) follow. The remaining 25 fruit crops are grown by 20% or less of the households. Even if some Old World immigrants enjoy high popularity, including citrus, peaches and apples, New World natives make up 7 of the 10 most common fruits crops. Like vegetables, fruit crops have recently increased their popularity in Cotacachi (Chapter 5). They are commonly eaten as snacks or processed into lemonades and fruit juices.

2.3.1.4 Herbs

Among the surveyed farms, 65% includes one or more herbs in their crop repertoire. The most widely cultivated herbs include chamomile (38%), lemon verbena (34%), oregano (33%), spearmint (26%), mint (25%), cilantro (25%) and lemongrass (24%). Except for lemon verbena, all of the top ten herbs are Old World introductions. The most common herb use is herbal teas, a daily drink in that far out-competes coffee. It is usually prepared for morning and evening meals, and sweetened with sugar or *panela* (raw cane sugar sold in bricks). People explain that in earlier generations, native wild herbs were in more frequent use for herbal teas. Herbs are also employed for remedial purposes (Gallaher and Fueres 2006), and the most species-rich herbal collections are found in the gardens of healers and midwives.

2.3.1.5 Forage

The single encountered forage crop, alfalfa, is grown by 25% of the surveyed farmers. This introduced plant is often grown in smaller plots in or near home gardens, and used to feed guinea pigs and other small domestic animals.

2.3.1.6 Crops' Commonness in an Overall Perspective

The preceding paragraphs have shown that the high crop diversity present at the level of the farm system in Cotacachi is not mirrored on every farm. There are a few more widespread crops both overall and within each crop group, but most are grown by a smaller portion of farmers. In total, only six of the total 107 crops are grown on more than half of the surveyed farms, and they all constitute important field crops. Thus, 94% of the crops are grown on less than 50% of the farms, and further, 70% of the crops are grown by 20% or less, 49% are grown by 10% or less, and 36% of the crops are grown by 5% or less of the surveyed farms (Table 2.7, see also Figure 2.2).

2.3.2 The Commonness of Different Varieties

Not all of the varieties are present in equal proportions among Cotacachi's farms. Tables 2.8-2.9 and Figure 2.3 give an overview of the commonness of varieties on the surveyed farms, broken down by crop. They show that most varieties are present on a low number of farms. Of the 335 total varieties found among the 89 farms, 150 (44.9%) were only found on a single farm, and as many as 260 (77.8%) were grown on five or fewer farms. Forty-one varieties were grown by between six and ten farmers, 15 varieties by between 11 and 15, and nine varieties were found on between 16 and 20 farms. Very common varieties, grown on more than 20 (22.5%) of the 89 farms, totaled only ten, and were varieties of maize, common beans, peas, faba beans, potato, lupine, and sambo squash – some of the most frequently grown crops (Figure 2.1a). These data clearly show that the varieties are unevenly distributed across the rural landscape of Cotacachi.

2.3.3 Diversity at the Farm Level

Does the uneven distribution reported on the last couple of pages imply that there are a few farms planted with the bulk of the documented crops and varieties, while a large majority grows only the well-represented handful? Or are the rarer crops and varieties spread out between a larger number of farms? The next paragraphs will investigate this question by looking into crop and varietal richness per farm.

2.3.3.1 The Crop Richness of Each Farm

Data on the number of crops grown per farm (found in Tables 2.10-2.11 and Figure 2.4a) show that farms are spread on a wide spectrum in terms of overall crop diversity. The total number of crops per farm ranges from 1 to 54 – indicating that there are indeed diversity poorer and diversity richer ones. The distribution depicted in Figure 3.4a is slightly right-skewed, meaning that there is a higher concentration of farms in the lower end of the diversity scale than in the higher. This is reflected in the mean (17.4 (SD 12.4) and median (14), that lie below the midpoint between 1 and 54. But on the other hand, the skew is not very strong; 50% of the farms grow more than 14 crops, indicating a substantial portion of relatively crop diverse farms.

Patterns of crop richness per farm vary according to crop type (Tables 2.10-2.11, Figure 2.4c-f). Every farmer grows at least one field crop, ranging up to 16 different crops. The average number per farm is 6.9 (SD 3.2), and the median is 6. In comparison to the other crops, the field crop distribution is closer to a normal distribution – the majority of the farms are clustered near the middle of the range. The mean number of vegetable crops per surveyed farm is 3.0 (SD 3.2), but this number ranges from 0 to 14. On average each farm household grows 4.5 fruit crops (SD 5.3), but some have up to 24. The mean number of herbs grown is 3.0 (SD 4.1), yet an exceptional garden contained as many as 28. For the three latter crop groups, the great majority of observations lie in the range between one and ten. Especially the fruit and herb distributions are skewed to the right; for these a few very diverse farms thus slightly elevate the average statistic in relation to the median.

2.3.3.2 The Varietal Richness of Each Farm

Tables 2.12-2.13 and Figure 2.5 give an overview of summary statistics as well as distributions of how many varieties are grown on each of the surveyed farms – by crop and overall. In Table 3.12, values per crop are calculated from the overall farm sample (n=89) and in Table 3.13, they are calculated when including only the farms where each crop is grown. Since many crops are just grown by a limited number of farmers (see preceding sections) the average number of varieties when dealing with the whole set of farms is below one for several crops. The calculations based only on the farms where at least one variety of the crop is grown give a better picture of the number of varieties likely to be found on farms growing the crop, and will be further commented on below.

The average number of varieties when considering the totality of the 18 crops is rather high (mean 26.7, SD 19.8), and close to the median (26). This corresponds to about 8% of the total varietal diversity documented during the survey. The range is very broad – the household with the highest varietal richness manages 105 varieties on their land (31.3% of the total), while the two farms with the least harbor just a single variety of one crop (0.3%). Figure 2.4b shows a frequency distribution of the total number of varieties per farm. The distribution is slightly skewed to the right; about 10% of the farms have more than twice the average number of varieties.

The pattern of skewness to the right is generally repeated when considering each crop separately (Figures 2.4g-x). Thus, for most crops, there is a concentration of farms in the lower end of the diversity scale. The average varietal richness per farm is highest for beans and maize – an observation resonating with the dominance of these two crops regarding the number of varieties present across Cotacachi's agrarian landscape. Farms have an average 3.2 (SD 3.8) maize varieties, the median is only 1, but the max value is 23. This indicates that half or more of the farms have only one variety, but among the other half there are quite a few with a high number. Common beans are more evenly distributed; among those that grow beans, the mean number is 16.3 (SD 11.7), the median 20 and the max 59. Those that grow runner beans on average plant 3.5 different ones (SD 1.4), the median is four and the max is six. Other crops that more often are planted with a set rather than a single variety are faba beans, potatoes, oca and melloco. The farmers growing these on average plant between 2 and 3 varieties of each.

For as many as 13 of the 18 crops, however, the median value of varieties planted per farm growing those crops is one. Thus, at least 50% of those farmers growing each of these crops plant only one variety. In fact, as shown in Figure 2.6 and Table 2.14, this figure ranges up to over 80% for some crops. Yet even for the crops of which most growers plant just one variety, the mean values of per farm varietal richness are well above 1.0, and the max values for several crops approach or reach the total varietal richness present among all surveyed farms. This shows that there are, for each of these crops, a small to large minority of diversity rich farms drawing up the average value.

Why do farmers tend to sow some crops with a set of varieties, while others are often just planted with one? A key explanation might be related to ease of seed management. All the crops that are most frequently planted with multiple varieties are highly self-pollinated or clonally reproduced. Most are also typically planted mixed in fields, as well as stored and cooked mixed. There is thus not much added cost in any respect with maintaining more than one variety. On the other hand, several of the crops that are often planted with a sole variety present challenges with outcrossing. Maize is a highly cross-pollinated crop, and special care must be taken to maintain different varieties on the same farm. Other crops among these "one-planters" that exhibit outcrossing are squashes (sambo and winter) (Whitaker and Bohn 1950), and to some extent also quinoa (Gandarillas 1979), wheat (Hucl 1996), and barley (Doll 1987). But some highly self-pollinated or cloned crops also belong to this group: peas, lentils, lupines, arracacha, mashua and sweet potatoes. Most of these, including arracacha, mashua, lentils and sweet potatoes, are quite uncommon. One reason why people tend to have just one variety of these might be that planting material is not so easily available, e.g. from neighbors and kin. Despite this tendency for many to plant just one variety, however, for every crop there are some farmers who plant several different ones. This attests to their appreciation of the different and often complimentary qualities exhibited by distinct varieties (Appendix). It also underlines that maintaining several varieties of any of the crops is indeed possible.

Do all these farmers planting just one variety plant different varieties? Or do they all tend to plant the same ones, implying that altogether these majorities of farmers plant only a small portion of the total varietal diversity present among all the surveyed farms? Table 2.14 shows that this pattern varies by crop. There is an overall tendency for the varieties that are overall most common, within each crop, to also appear in the fields of those growing only one variety. This tendency is most pronounced in the case of maize: 54.5% of its farmers planted only one variety, and altogether their varietal selection did not encompass more than five different ones (8.3% of the 60 found in the total survey). A column in Table 3.14 shows the percentage of farmers planting *only* the variety that was *overall* most common in the survey. Within most crops the portion of farmers growing only these widespread varieties is substantial, and for some it is quite high, including peas (39.7%), lupines (61.4%) and mashua (55.6%). For some crops, such as sambo squash, this trend is less pronounced; to a higher degree farmers growing just one variety of these tend to choose different varieties. Such crop-specific differences may be explained by how varieties of different crops are differentiated. For instance, in the case of maize, the five varieties grown by over half of the farmers are all yellow maize types, considered to be the most versatile. Other varieties are suited for special purposes, and such specialty maize types are apparently not prioritized by all. In the case of cucurbits on the other hand, there is no *one* versatile variety–instead the different ones have their distinct virtues and properties (Table A2.26 and A2.27 in the Appendix), and the decision of which to grow depends on the likes and preferences of the household members. This results in a more even distribution between varieties among those growing just one variety of squash in comparison to maize. Finally, the table also shows that the subsets of farmers growing only one variety collectively often grow a rather high portion of the total varieties found during the survey – in the case of several crops this portion reaches 100%. Thus, even if a subset of the farmers with just one variety plant cosmopolitan varieties, another few also plant rarer varieties.

2.3.4 A Summary of Diversity's Distribution

In the above we have seen that on a crop as well as varietal level, the great majority of the diversity present in the farming system is planted on just a small portion of the area's farms. Among the farms, there is great variation in the amount of crops and varieties grown. There are diversity hotspots as well as deserts, for overall crop and varietal diversity, and also when considering the intracrop diversity of each field crop. Among those that grow low diversity within a crop (one single variety), there is a tendency to grow the most widespread varieties, but this trend is more pronounced in some crops than others. Although there are more farms toward the lower end than toward the higher end, there are farms placed all along the scale from high to low diversity. This uneven or right-skewed distribution is not *as* pronounced as that observed for the commonness of crops and varieties. This means that despite observed tendencies of diversity-low farms to focus on popular varieties, *all* the rare crops and varieties are *not* concentrated only on a few diversity-rich farms – there are simply too many rare crops and varieties in relation to the proportion of remarkably diversity rich farms for that to be possible. Instead, the many rare plants are also dispersed in the landscape among those with mid-level diversity, growing differently composed sets of crops and varieties. A further analysis of farm and household factors associated with higher and lower levels of divesity is found in Chapter 8.

2.4 Cotacachi's Agrobiodiversity in a Comparative Perspective

How high or low is the diversity of Cotacachi's farms in comparison with that of other regions? And how common are the observed patterns of distribution? Table 2.15 gives an overview of summary data from previous studies of diversity of cultivated species, and Table 2.16 corresponding results at the varietal level. Below I will report and discuss them in relation to the present study.

2.4.1 Crop Species Diversity

Cotacachi exhibits higher overall, but somewhat lower average species richness than most previous studies (Table 2.15). Other research measuring this kind of diversity is relatively scarce, and has mainly been focused on home gardens in tropical lowland settings, so the grounds for comparison are not very broad. In comparison with most of these studies, the overall species richness found in Cotacachi is higher. The most species rich farm in Cotacachi (54 species) also counts more species than its counterparts in most previous studies. On the other hand, the majority of the previous studies report a higher average species richness per farm (ranging from 6.0 to 27.4) than what was found in the present work (17.4). This indicates a more uneven distribution between farms in the case of Cotacachi.

2.4.2 Varietal Diversity

Within most crops for which data is available, the varietal richness documented in Cotacachi is higher than or comparable with that found in other sites (Table 2.16). The diversity grown in Cotacachi in terms of beans and maize is exceptionally high, even in relation to other countries that belong to the crops' centers of diversity (Mexico, Peru), as well as in comparison with the communities with the highest reported varietal richness. The number of maize landraces managed by Cotacachi's farmers (58) is thus twice that found by Zimmerer (1996) in the Southern Peruvian Andes (27), and the number of bean landraces (162) is eight times as many as those found in by Jarvis et al. (2008) in Szatmár-Bereg, Hungary (20). Also *per farm*, the numbers of maize and bean varieties are clearly higher in Cotacachi than in any of the other studies. This attests to local farmers' appreciation of and willingness to maintain variability of these crops. As noted above, maize holds a particularly important cultural and agricultural role in Cotacachi. Different types are processed and prepared into a number of different dishes, and those that prioritize continuing to prepare these different dishes also maintain the crop's diversity. Except for certain MV beans that are grown in monoculture, beans are intercropped with maize. Since they typically are planted in varietal mixes, a high diversity is the rule rather than the exception; a relatively high diversity can be maintained without much extra work.

Potato diversity, on the other hand, is much lower than that cultivated in the Peruvian Andes. Basically, the only landraces that have made it are those that do not have any counterpart among modern varieties – the short cycle *chawcha* and the weedy *ara papa*. The ten landraces grown in Cotacachi constitute only one-seventh of the richness found in Peruvian research, and while Peruvian farmers grow an average 9.9 landraces, potato growers in Cotacachi on average grow just 0.5. There might be several reasons for this discrepancy. First, potato diversity has probably never been so high in the study area as in Southern Peru, since the latter site is closer to the crop's domestication center (Spooner, et al. 2005). Still, it is clear that more diversity once existed; this is also confirmed by elderly farmers. Further, the potato is not as important culturally as maize. Even if it is a common ingredient in a many everyday and festive meals, one does not find the same cultural value attached to it as that reported from Peru by Brush (1992; 2004), where different kinds of potatoes are valued for special uses including gifts, and native potatoes are considered culinary superior to improved ones. This difference may have resulted in that farmers in Cotacachi have been less avid in holding onto their native potato diversity than those of other crops. Finally, it may be that campaigns to introduce modern varieties were more aggressive in the case of potatoes than for other crops. Sweet potato diversity (3 varieties) is also much lower than that found by Nazarea (1998) in the Philippines (23-29 varieties). This is likely because sweet potatoes are best adapted to warmer climates than that of Cotacachi, where it is only a minor crop.

For other crops for which comparable data are available, varietal richness in Cotacachi is similar to that found in elsewhere in previous research, both in terms of overall and average numbers. These include faba bean (Morocco), wheat (Morocco), barley (Ethiopia, Morocco, Nepal), squash (Mexico, Nepal), melloco (Peru) and quinoa (Peru) (Jarvis, et al. 2008; Zimmerer 1996).

2.4.3 Distribution

The general pattern found in Cotacachi, where both at the crop and intracrop levels, a large part of the diversity is found in small frequencies, corresponds with some previous research from other areas. In a study of species diversity on 300 home gardens in the Peruvian Amazon, Perreault-Archambault and Coomes (2008) registered over one-third of the species only once. Zimmerer (1988, cited in Brush et al., 1992) classified 43% of the potato landraces found on 28 farms as uncommon. In an investigation of rice diversity in Nepal, Rana et al. (2007) in two different communities found that 63%-69% of the varieties were grown on five or less farms (total farm n=206/202) and that 34%-40% were grown with a frequency of only one farm. This consistency indicates that such an uneven pattern of diversity is a common phenomenon in contemporary agriculture.

2.5 Conclusion

During this research, Cotacachi's farms were found to encompass 103 crop species, and within 20 of these, a total of 367 varieties were documented. Crop species with origin in the Old and New World make up similar portions in terms of species number as well as farm registrations, and are thus both important contributors to local agricultural production. However, New World species are dominant within field crops and Old World species are most important within cultivated vegetables and herbs. Rather than displacing native diversity, Old World crops have become a complement and integral part of Cotacachi's agriculture. Modern varieties have been adopted within some crops, but far from all. Landraces make up 90% of the documented crop varieties and 87% of registered seed lots, and they continue to constitute the main source of seed.

Farmers in Cotacachi grow a remarkably high bean and maize diversity and a remarkably low potato diversity in comparison with other sites in these crops' centers of diversity. Within other crops, the diversity found in this study can be considered "normal" in relation to previous research in other areas. But, since most previous studies report diversity only within a single crop or only between crops, overall diversity in Cotacachi in relation to other sites is hard to evaluate. It is hoped that future research will expand in scope and also examine these different dimensions of diversity in the same site, in order to better be able to compare and evaluate the current state of biodiversity maintenance in different settings. One insight from the current study is that, on an overall community level, diversity within one crop is not necessarily correlated with diversity in another – patterns vary quite distinctively between crops.

The documented diversity is unevenly distributed, from every analyzed perspective. As much as 36% of the crops and 78% of the varieties are grown by five or less of the 89 surveyed farms. And farms vary widely in terms of the overall number of crops, the number of crops of each type, and the number of overall varieties as well as varieties of different crops. In general, the frequency distributions tend to be skewed to the right, indicating that the number of farms growing a high diversity is lower than those growing less diverse crops. There is a trend for farmers to plant lower diversity within the crops that entail a more demanding varietal management due to occurrences of outcrossing. And once the varietal suit is reduced to one, the tendency is often toward versatile, widespread varieties and away from the special-use rare. This might be an indication that diversity is more likely to be maintained by more people when less effort is needed to do so. The observed patterns of distribution coincide with previous studies that have found diversity to be unevenly distributed within rural communities.

These findings beg a new question to be asked: has the patterns of uneven distribution long been common, thus indicating that current levels of diversity are likely to be maintained also into the future, or is this a sign that diversity in Cotacachi and other rural sites across the world is crumbling? This is no straight-forward question, and the lack of baseline-data makes it very hard to paint an accurate picture of past changes in diversity levels (Guarino 1999). When asked, though, Cotacachi's farmers are unequivocal in claiming that yesteryear's fields were richer both in terms of traditional field crops and varieties within them (Chapter 3). It is not unlikely that the currently observed unevenness in diversity's extent is the result of a simplification process that has played out during the last generation.

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2.7 Tables and Figures

Table 2.1a: Field crops grown in Cotacachi 2009-2010. Based on survey of 89 farms.

Latin (Scientific name)	Kichwa*	Spanish	English	Origin	Nº farms	% farms
Zea mays	Sara	Maíz	Maize, corn	New World	88	99
Phaseolus vulgaris	Purutu	Fréjol, poroto	Common bean	New World	78	88
Phaseolus coccineus	Intag purutu	Popayan	Runner bean	New World	20	22
Phaseolus lunatus	Turtas purutu	Tortas	Lima bean	New World	2	2
Pisum sativum	Alwirha	Alverja	Pea	Old World	63	71
Vicia faba	Hapas	Habas	Faba bean	Old World	58	65
Solanum spp.	Papa	Papa	Potato	New World	64	72
Solanum tuberosum ssp. *andigena*	Papa	Papa	Potato	New World	56	63
Solanum chaucha	Chawcha papa	Papa chaucha	Chawcha potato	New World	15	17
Solanum sect. *Petota*	Ara papa	Ara papa	Wild potato	New World	3	3
Chenopodium quinoa	Kinuwa	Quínua	Quinoa	New World	33	37
Lupinus mutabilis	Tarwi	Chocho	Lupine	New World	26	29
Hordeum vulgare	Siwara	Cebada	Barley	Old World	20	22
Triticum aestivum	Triku	Trigo	Wheat	Old World	18	20
Oxalis tuberosa	Uka	Oca	Oca	New World	16	18
Ullucus tuberosus	Milluku	Melloco	Melloco, ulluco	New World	15	17
Cucurbita ficifolia	Sampu	Sambo, zambo	Zambo	New World	62	70
Cucurbita maxima	Sapallu	Sapallo, zapallo	Zapallo, winter squash	New World	22	25
Arracacia xanthorrhiza	Sanyura	Zanahoria blanca	Arracacha	New World	13	15
Tropaeolum tuberosum	Mashwa	Mashua	Mashua	New World	9	10
Ipomoea batatas	Kamuti	Camote	Sweet potato	New World	7	8
Polymnia sonchifolia	Hikama	Jicama	Yacon	New World	7	8
Lens culinaris	Lanteha	Lenteja	Lentil	Old World	4	4
Cicer arietinum	Hapasillu	Habacillo/barbanzo	Chickpeas	Old World	3	3
Amaranthus caudatus	Amarantu	Amaranto	Amaranth	New World	3	3
Secale cereale	Sintilina	Centelina, centeno	Rye	Old World	2	2
Total field crops					89	100

Table 2.1b: Vegetable crops grown in Cotacachi 2009-2010. Based on survey of 89 farms.

Latin (Scientific name)	Kichwa*	Spanish	English	Origin	Nº farms	% farms
Allium cepa		Cebolla larga	Onion	Old World	40	45
Allium cepa		Paiteña	Red onion	Old World	7	8
Brassica oleracea var. *capitata*		Col verde	Cabbage	Old World	35	39
Brassica oleracea var. *capitata*		Col morada	Red cabbage	Old World	8	9
Brassica oleracea var. *capitata*		Col de árbol	Tree cabbage (Andean variety)	Old World	7	8
Brassica oleracea var. *capitata*		Col morada de arbol	Red tree cabbage (Andean variety)	Old World	3	3
Brassica oleracea var. *italica*		Brócoli	Broccoli	Old World	7	8
Brassica oleracea var. *botrytis*		Coliflor	Cauliflower	Old World	7	8
Daucus carota		Zanahoria amarilla comun	Carrot	Old World	25	28
Beta vulgaris var. *cicla*		Acelga	Leaf beet	Old World	21	24
Capsicum baccatum	Uchu	Ají	Andean pepper	New World	20	22
Beta vulgaris		Remolacha	Red beet	Old World	20	22
Lactuca spp.		Lechuga	Lettuce	Old World	18	20
Raphanus sativus		Rábano	Radish	Old World	11	12
Cucurbita pepo subsp. *melopepo*		Zuquini	Zucchini	Old World	7	8
Lycopersicon esculentum var. *esculentum*		Tomate riñón	Tomato	New World	2	2
Cyclanthera pedata	Achokcha	Achogcha	Achocha	New World	1	1
Allium sativum		Ajo	Garlic	Old World	1	1
Asparagus officinalis		Esparrago	Asparragus	Old World	1	1
Brassica rapa		Nabo	Beet	Old World	1	1
Capsicum annuum		Pimiento	Bell pepper	New World	1	1
Total vegetables					61	55

Table 2.1c: Herbs grown in Cotacachi 2009-2010. Based on survey of 89 farms. (Continued on next page.)

Latin (Scientific name)	Kichwa*	Spanish	English	Origin	Nº farms	% farms
Matricaria recutita		Manzanilla	Chamomile	Old World	34	38
Aloysia triphylla, A. citrodora		Cedrón	Lemon verbena	New World	30	34
Origanum vulgare		Orégano	Oregano	Old World	29	33
Mentha spicata		Hierbabuena	Spearmint	Old World	23	26
Mentha x piperita		Menta	Mint	Old World	22	25
Coriandrum sativum		Culantro	Cilantro	Old World	22	25
Cymbopogon citratus		Limoncillo/ hierbaluisa	Lemongrass	Old World	21	24
Melissa officinalis		Toronjíl	Lemon balm	Old World	14	16
Petroselinum crispum		Perejíl	Parsley	Old World	14	16
Eucalyptus globulus		Eucalipto, eucalipto aromatico	Eucaliptus	Old World	11	12
Myrcianthes hallii		Arrayan		New World	9	10
Ruta graveolens		Ruda	Common rue	Old World	5	6
Iresine celosioides		Escancel	Juda's bush	New World	4	4
Rosmarinus officinalis		Romero	Rosemary	Old World	4	4
Aloe vera		Sábila	Aloe vera	Old World	3	3
Dianthus caryophyllus		Clavel	Carnation	Old World	3	3
Morella sp. *(M. parviflora* or *M. pubescens)*		Laurel	Laurel	Old World	3	3
Peperomia peltigera	Patakun			New World	2	2
Apium graveolens		Apio	Celery	Old World	1	1
Canna indica		Atzera	Canna	New World	1	1
Borago officinalis		Borraja	Borage	Old World	1	1
Fueniculum vulgare		Hinojo	Fennel	Old World	1	1
Dalea mutisii	Isun			New World	1	1

*

Latin (Scientific name)	Kichwa*	Spanish	English	Origin	Nº farms	% farms
Peperomia rotundata or *P. inaequalifolia*	Kunguna	*Congona*		New World	1	1
Plantago major		Llanten	Greater plantain	Old World	1	1
Chenopodium ambrosioides	Paiku	Paico	Wormseed	New World	1	1
Sambucus peruviana		Tilo		New World	1	1
Lantana camara	Tupirosa		Lantana	New World	1	1
Viola odorata		Violeta	Violet	Old World	1	1
Valeriana sp.	Wasilla	Valeriana	Valerian	New World	1	1
	Atallpa mikuna				1	1
	Lanta				1	1
	Pataku wanga				1	1
	Uyankilla				1	1
	Wamintsi				1	1
	Washwa				1	1
Total herbs					64	58

Table 2.1d: Fruit crops grown in Cotacachi 2009-2010. Based on survey of 89 farms. (Continued on next page.)

Latin (Scientific name)	Kichwa*	Spanish	English	Origin	Nº farms	% farms
Citrus medica var. *limon*		Limón	Lemon	Old World	41	46
Cyphomandra betacea		Tomate de árbol	Tree tomato	New World	32	36
Persea americana		Aguacate	Avocado	New World	27	30
Rubus glaucus		Mora	Blackberry	New World	27	30
Prunus capuli	Kapuli	Capulí	Capuli cherry	New World	26	29
Citrus x *sinensis*		Naranja	Orange	Old World	21	24
Juglans neotropica	Tukti	Nogal	Andean walnut	New World	21	24
Inga sp.		Guaba	Ice cream bean	New World	18	20
Citrus x *tangerina*		Mandarina	Tangerine	Old World	18	20
Passiflora cumbalensis/P. mollissima	Taksu	Taxo	Passionfruit	New World	17	19
Physalis peruviana		Uvilla	Goldenberry, cape gooseberry	New World	17	19
Prunus persica		Durazno	Peach	Old World	16	18
Malus domestica		Manzana	Apple	Old World	13	15
Passiflora ligularis		Granadilla	Passionfruit	New World	12	13
Ficus carica		Higo	Fig	Old World	12	13
Carica pentagona/Carica x *heilbornii*		Babaco	Babaco	New World	11	12
Erythrina edulis	Purutun, kastilla purutu, kiru purutu	Porotón	Basul	New World	12	13
Carica pubescens	Chiliwaka	Chilehuaca, chihualcán	Mountain papaya	New World	9	10
Annona cherimolia		Cherimoya	Cherimoya	New World	7	8
Fragaria x *ananassa*		Frutilla	Strawberry	New World	6	7
Citrus sp.		Lima	Lime	Old World	6	7
Vitis vinifera		Uva	Grape	Old World	6	7
Eugenia victoriana		Guayabilla		New World	4	4
Prunus sp.		Cereza	Cherry	Old World	3	3
Saccharum officinarum		Caña de azúcar	Sugar cane	Old World	4	4

Latin (Scientific name)	Kichwa*	Spanish	English	Origin	Nº farms	% farms
Prunus sp.		Claudia	Plum	Old World	3	3
Psidium sp.		Guayaba	Guava	New World	3	3
Eriobotrya japonica		Níspero, chupalón	Loquat	Old World	2	2
Musa sp.		Plátano	Banana	Old World	2	2
Coffea arabica		Café	Coffee	Old World	1	1
Citrus × *aurantium*		Naranja agria	Bitter orange	Old World	1	1
Pyrus communis subsp. c*ommunis*		Pera	Pear	Old World	1	1
Total fruits					71	64

Table 2.1e: Forage crop grown in Cotacachi 2009-2010. Based on survey of 89 farms.

Latin (Scientific name)	Kichwa*	Spanish	English	Origin	Nº farms	% farms
Medicago sativa		Alfalfa	Alfalfa		22	25

Notes to Tables 2.1 a-e
*When no Kichwa term is listed, the Spanish name is used in Kichwa as well.
Ara papa (*Solanum* sect. *Petota)* is a weedy plant.
Cabbage was introduced from by the Spaniards, but a peculiar "tree" form, with a long stem (up to about 1 m) has since developed in the Andes.
In addition to 30 identified herb species, one household had 6 further plants in their garden, which botanical species names remains to be determined.
Erythrina edulis is here listed under fruits because of its typical home garden cultivation together with fruit trees, but it is in reality a tree legume. In Cotacachi today, it is cultivated just as much for its ornamental value as for its food.

Table 2.2: Summary of origins and prevalence of crop species grown in Cotacachi. Based on survey data from 89 farms.

Table 2.2a: Numbers and proportions of crop species with origin in the New and Old Worlds.

	Number of species			Percentage of species		
Species origin	New World	Old World	Total	New World	Old World	Total
Field crops	18	7	25	72.0	28.0	100.0
Vegetables	4	11	15	26.7	73.3	100.0
Fruits	16	16	32	50.0	50.0	100.0
Herbs	11	19	30	36.7	63.3	100.0
Forage	0	1	1	0.0	100.0	100.0
Total	49	54	103	47.6	52.4	100.0

Table 2.2b: Numbers and proportions of registrations of crop species with origin in the New and Old Worlds. Table shows the sum of the number of times a species from each crop group was registered during farm survey (N=89).

	Number of registrations			Percentage of registrations		
Species origin	New World	Old World	Total	New World	Old World	Total
Field crops	476	168	644	73.9	26.1	100.0
Vegetables	24	241	265	9.1	90.9	100.0
Fruits	249	150	399	62.4	37.6	100.0
Herbs	52	213	265	19.6	80.4	100.0
Forage	0	22	22	0.0	100.0	100.0
Total	801	794	1595	50.2	49.8	100.0

Table 2.3: Summary statistics regarding the varietal diversity and names within 20 field crop species. Data from entire project (includes some more varieties than the survey).

Crop species	Nº main classes	Nº varieties	% of total varieties	Nº name synonyms	Nº name homonyms*	Total Nº variety names
Maize	10	80	21.8	23	-	103
Common bean	2	176	48.0	61	14	221
Runner bean	-	15	4.1	-	-	15
Pea	5	9	2.5	9	1	17
Faba bean	2	7	1.9	8	-	15
Potato	2	13	3.5	-	-	13
Chawcha potato	-	7	1.9	-	-	7
Wild potato	-	2	0.5	-	-	2
Quinoa	-	4	1.1	8	1	11
Lupine	-	3	0.8	2	-	5
Barley	-	5	1.4	15	1	19
Wheat	-	7	1.9	7	1	13
Oca	-	5	1.4	1	-	6
Melloco	-	6	1.6	2	-	8
Sambo squash	-	7	1.9	8	-	15
Winter squash	-	6	1.6	7	-	13
Arracacha	-	2	0.5	1	-	3
Mashua	-	5	1.4	-	-	5
Sweet potato	-	3	0.8	-	-	3
Lentil	-	5	1.4	-	-	5
Total	20	367	100	152	18	499

*All registered homonyms apply to two varieties, except for two of the homonyms for climbing beans that are used to denote three varieties each.

Table 2.4. Summary statistics of variety and seed lot numbers of 20 field crop species. Shows the relative distribution between MVs and landraces. Data from survey of 89 farms.

Crop	Varieties				Seedlots			
	Nº MVs	Nº landraces	*Total Nº varieties*	% landraces	Nº MVs	Nº landraces	*Total Nº seedlots*	% landraces
Maize	2	58	*60*	97	21	263	*284*	93
Common bean	8	162	*170*	95	110	1144	*1254*	91
Runner bean	0	15	*15*	100	0	70	*70*	100
Pea	3	6	*9*	67	51	56	*107*	52
Faba bean	0	7	*7*	100	0	129	*129*	100
Potato	12	1	*13*	8	101	1	*102*	1
Chawcha potato	0	7	*7*	100	0	30	*30*	100
Wild potato	0	2	*2*	100	0	4	*4*	100
Quinoa	1	3	*4*	75	18	24	*42*	57
Lupine	0	3	*3*	100	0	35	*35*	100
Barley	2	3	*5*	60	6	20	*26*	77
Wheat	4	3	*7*	43	12	19	*31*	61
Oca	0	4	*4*	100	0	33	*33*	100
Melloco, ulluco	0	6	*6*	100	0	42	*42*	100
Sambo	0	6	*6*	100	0	104	*104*	100
Zapallo, winter squash	0	5	*5*	100	0	25	*25*	100
Arracacha	0	2	*2*	100	0	15	*15*	100
Mashwa, mashua	0	5	*5*	100	0	16	*16*	100
Sweet potato	0	3	*3*	100	0	9	*9*	100
Lentil	0	2	*2*	100	0	5	*5*	100
Total	32	303	*335*	90	319	2044	*2363*	87

Table 2.5: Crop variety homonyms registered during the research.

Crop/Crop main class	Name	Number of varieties bearing name
Climbing bean	Gallo/kallu purutu	2
Climbing bean	Killu pintatu	3
Climbing bean	Muras purutu	2
Climbing bean	Pintatu	2
Climbing bean	Puka pintatu	2
Climbing bean	Suku kunihu	2
Climbing bean	Suku purutu	2
Climbing bean	Ullawanka purutu	2
Climbing bean	Waka purutu	2
Climbing bean	Yana pintatu waka	2
Climbing bean	Yurak purutu	3
Bush bean	Puka pintatu	2
Bush bean	Yana azul	2
Bush bean	Yurak pintatu	2
Pea	Wirti chawcha	2
Quinoa	Yurak kinuwa	2
Wheat	Hatun triku	2
Barley	Shampa siwara	2

Table 2.6: Names applied for both climbing and bush beans. Since these are different bean categories, the names are not strictly homonyms.

Name	Name
Golondrina	Suku kunihu
Killu pintatu	Suku kuy
Muratu	Suku pintatu
Pintatu	Suku purutu
Puka pintatu	Suku rayatu
Puka purutu	Yana pintatu

Figures 2.1a-d: The frequencies of different crops among surveyed farms. (Farm N=89)

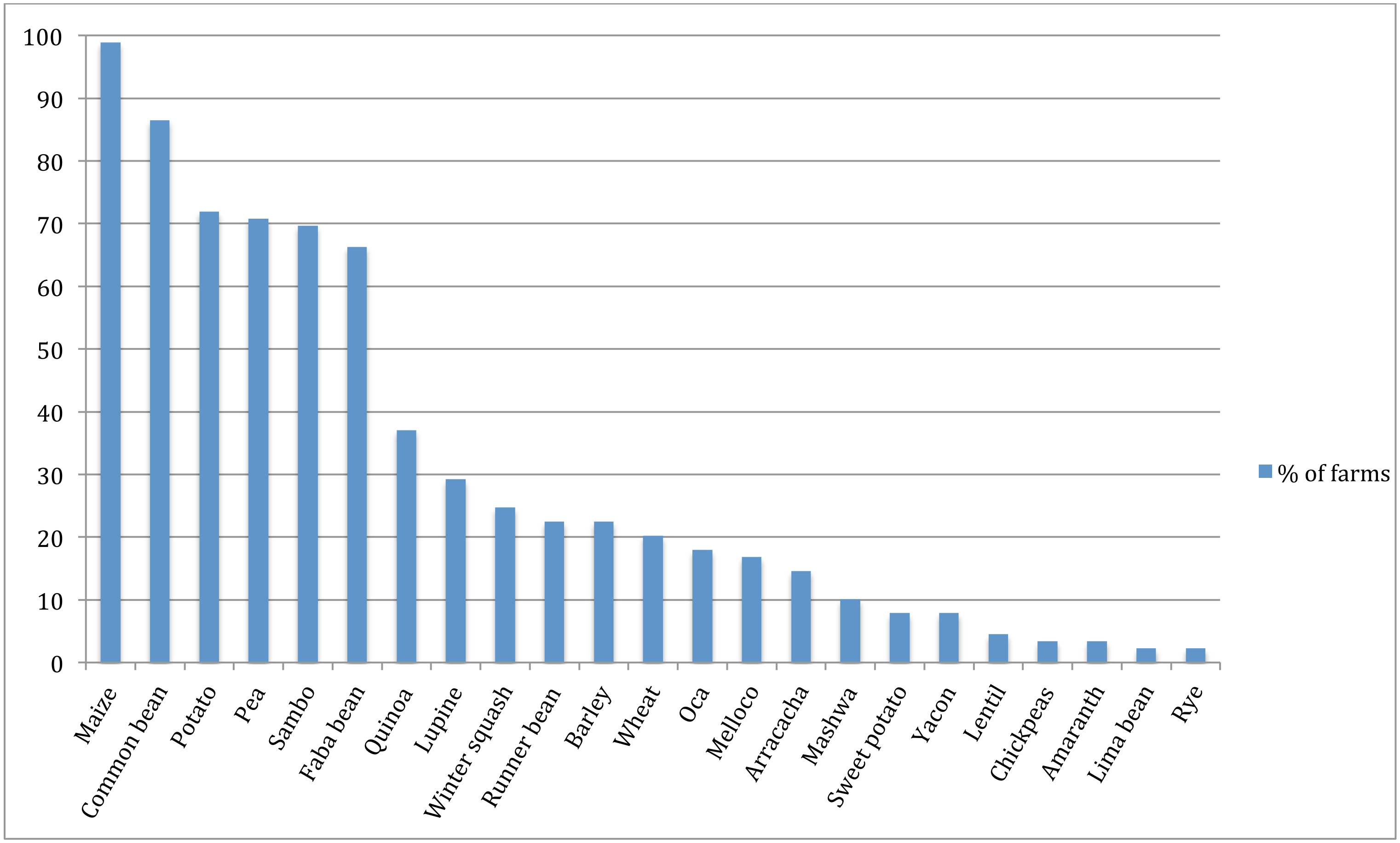


Figure 2.1a: The percentage of surveyed farms where different field crops were grown. (N=89)

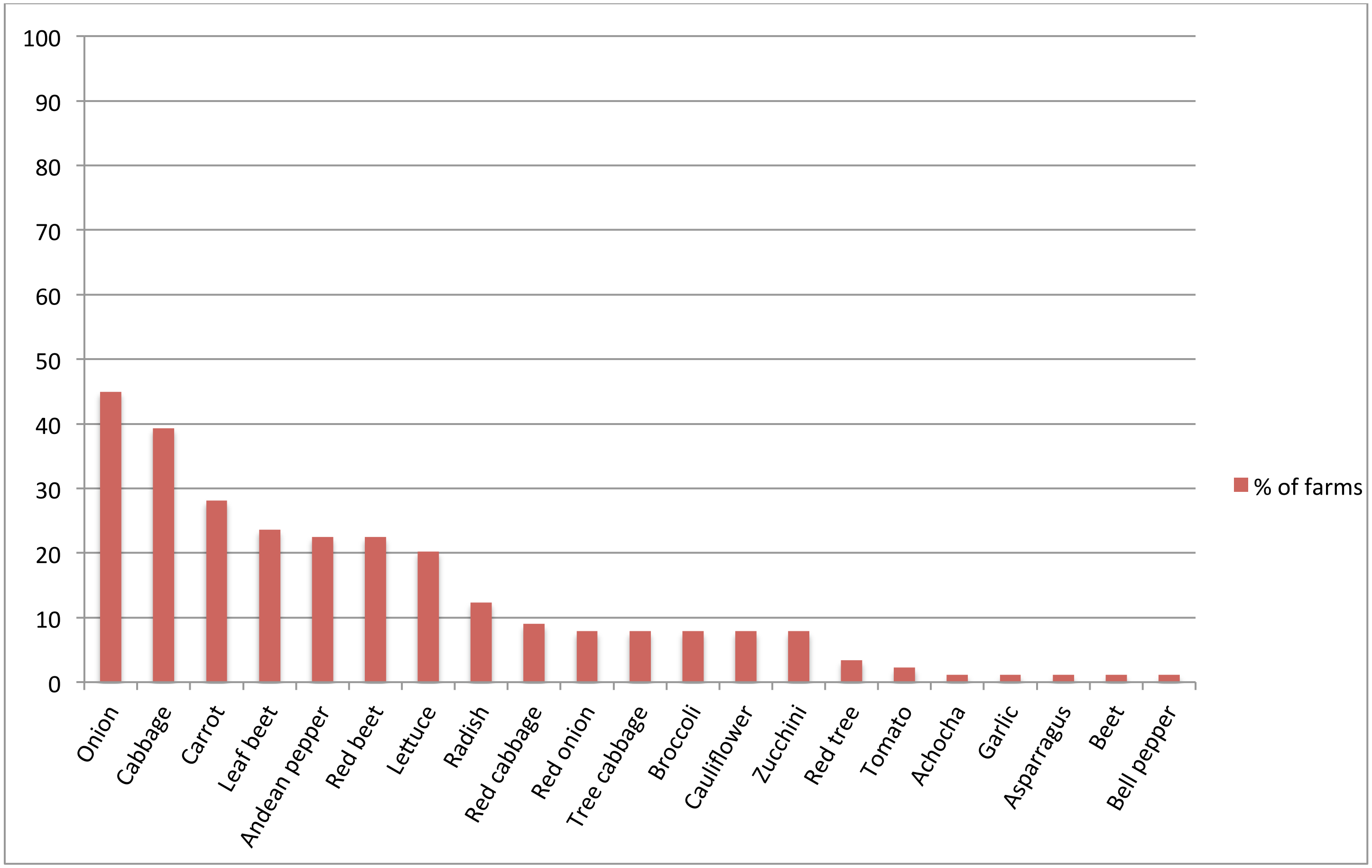


Figure 2.1b: The percentage of surveyed farms where different vegetables were grown. (N=89)

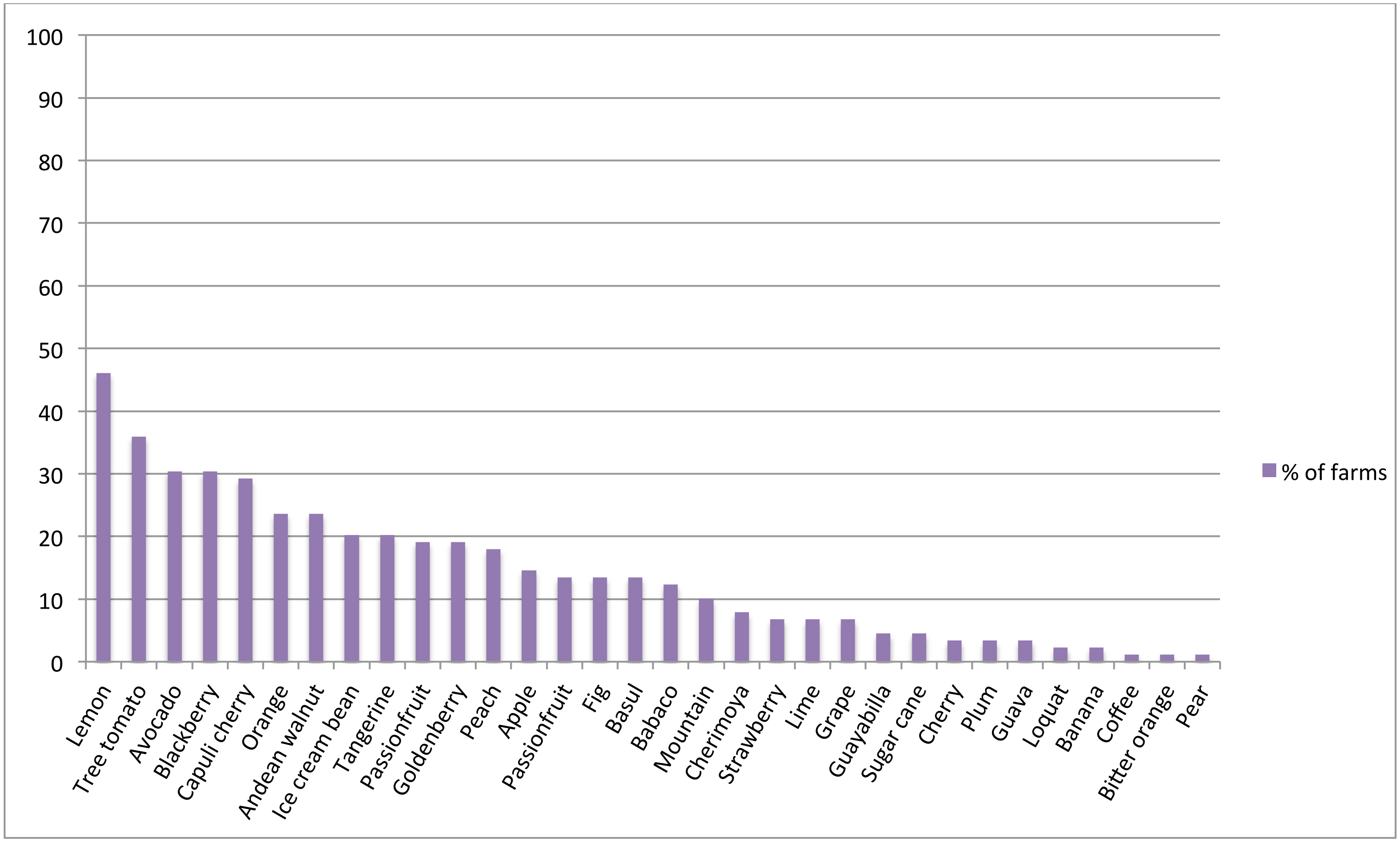


Figure 2.1c: The percentage of surveyed farms where different fruits were grown. (N=89)

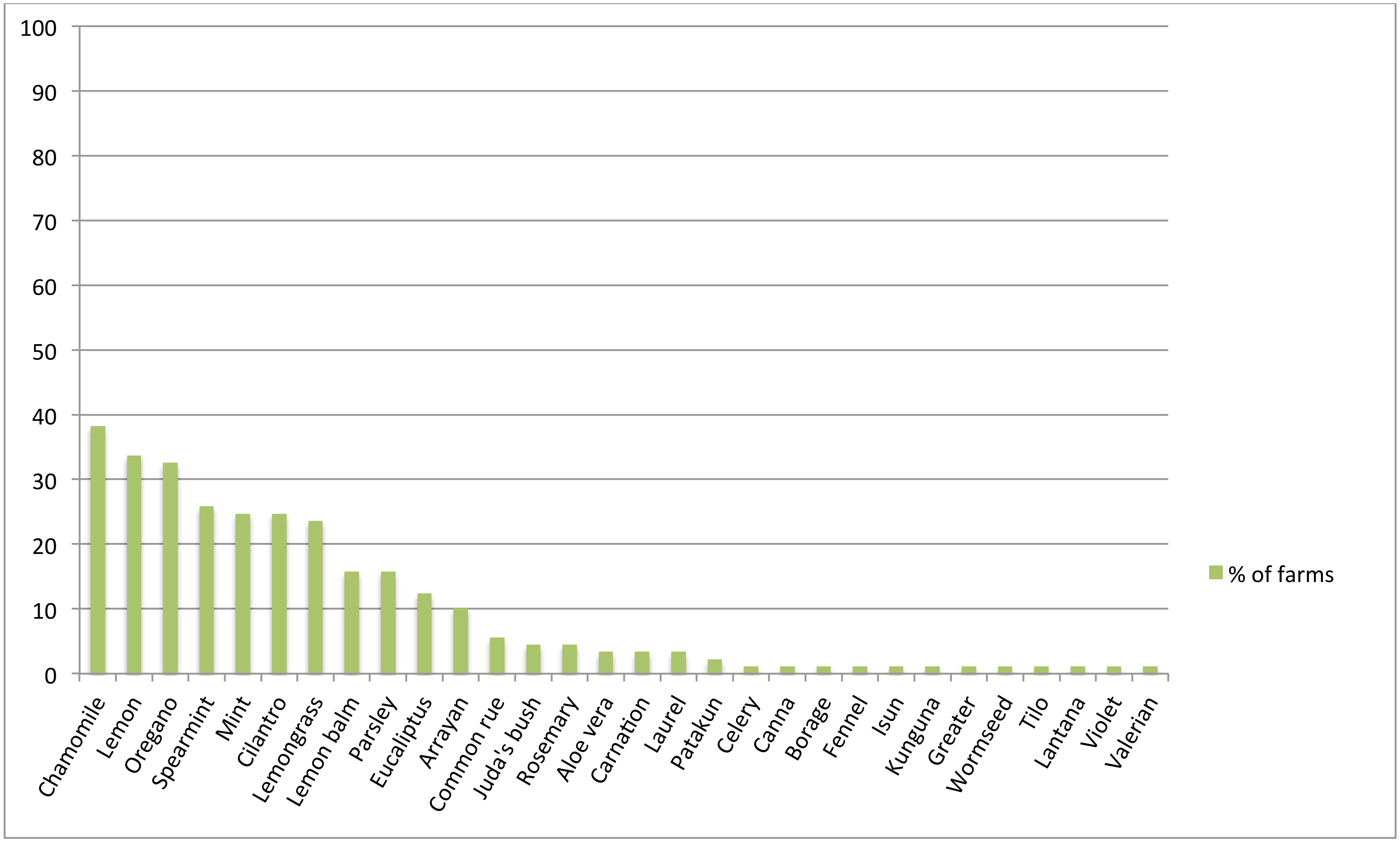


Figure 2.1d: The percentage of surveyed farms where different herbs were grown. (N=89)

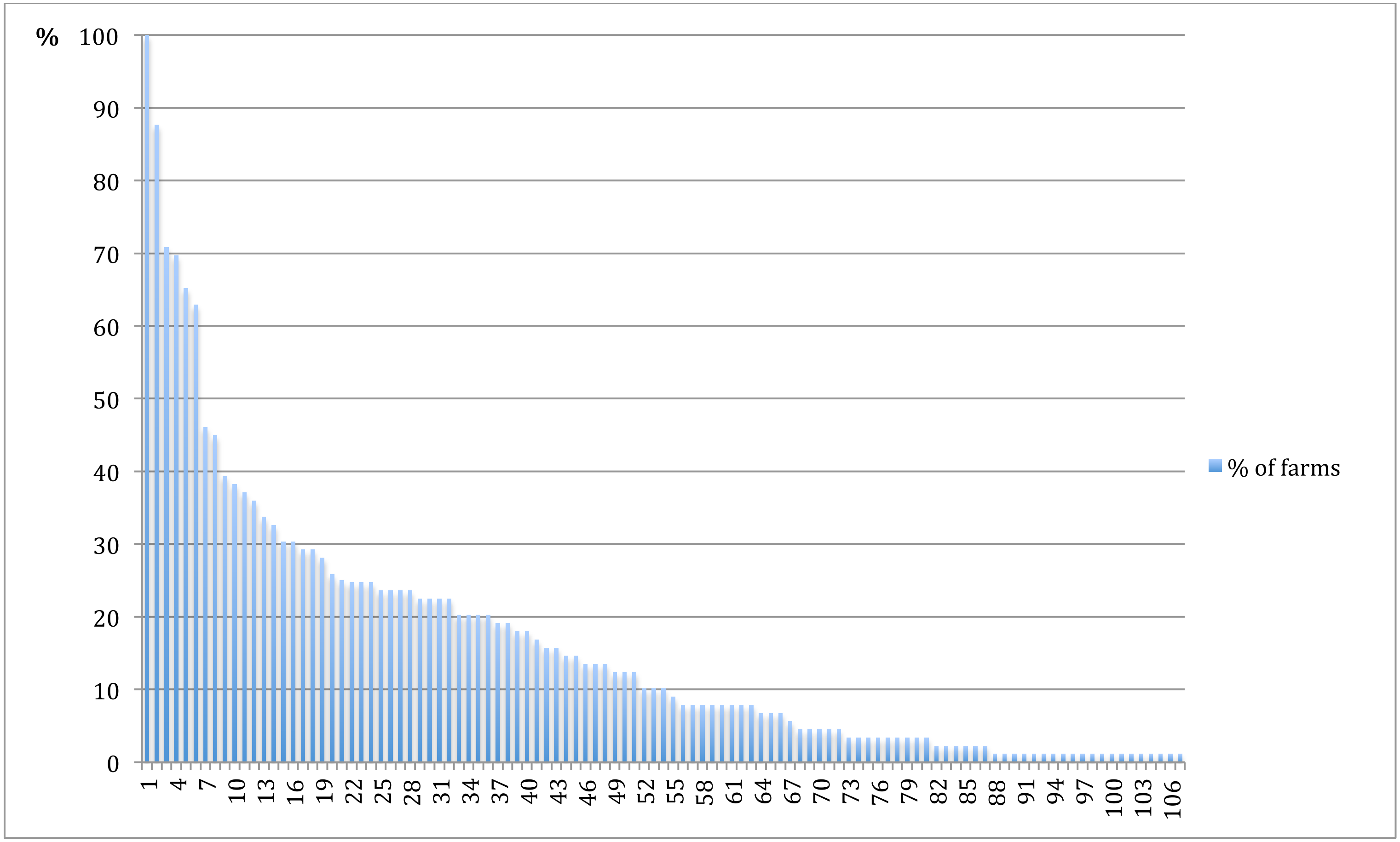


Figure 2.2: The commonness of different crops in an overall perspective. Chart shows the percentages of farm households (N=89) growing each of the 107 crops found during the survey, from the most to the least common.

Table 2.7: The number and proportion of crops grown by different proportions of farmers.

Proportion of farms (N=89)	Number of crops (N=107)	Proportion of crops
≤50%	101	94.4%
≤20%	75	70.1%
≤10%	52	48.6%
≤5%	39	36.4%

Table 2.8: The frequencies of the 335 varieties registered during the farm survey. Shows how many varieties are found on different intervals of farms, by crop. A breakdown of the first column (those grown on only 1-5 farms) is found in Table 2.9, and a simplified graphic presentation of the whole data set in Figure 2.3. (Farm N=89)

Crop/Number of farms	[1-5]	[6-10]	[11-15]	[16-20]	[21-25]	[26-30]	[31-35]	[36-40]	[41-45]	> 45	Total
Maize	49	7	1	1	1	0	0	0	0	1	60
Common bean	150	11	6	2	1	0	0	0	0	0	170
Scarlet runner bean	11	3	1	0	0	0	0	0	0	0	15
Pea	3	4	0	1	0	0	0	1	0	0	9
Faba bean	2	1	1	2	0	0	1	0	0	0	7
Potato	15	3	2	1	0	1	0	0	0	0	22
Quinoa	1	0	2	1	0	0	0	0	0	0	4
Lupine	1	1	0	0	1	0	0	0	0	0	3
Melloco	2	3	1	0	0	0	0	0	0	0	6
Oca	1	2	0	1	0	0	0	0	0	0	4
Lentil	2	0	0	0	0	0	0	0	0	0	2
Wheat	6	1	0	0	0	0	0	0	0	0	7
Barley	3	2	0	0	0	0	0	0	0	0	5
Sambo	3	0	0	0	0	2	0	1	0	0	6
Winter squash	3	2	0	0	0	0	0	0	0	0	5
Arracacha	1	0	1	0	0	0	0	0	0	0	2
Mashua	4	1		0	0	0	0	0	0	0	5
Sweet potato	3	0	0	0	0	0	0	0	0	0	3
Total	260	41	15	9	3	3	1	2	0	1	335

Table 2.9: The frequencies of the least common varieties. Shows the number of varieties that only were grown on 5 or less of the 89 surveyed farms, by crop.

Crop/Number of farms	1	2	3	4	5	Total [1-5]
Maize	25	14	7	3	0	49
Common bean	104	20	10	12	4	150
Scarlet runner bean	4	4	1	1	1	11
Pea	0	2	0	1	0	3
Faba bean	0	1	1	0	0	2
Potato	6	5	2	0	2	15
Quinoa	0	1	0	0	0	1
Lupine	1	0	0	0	0	1
Melloco	1	0	0	0	1	2
Oca	0	1	0	0	0	1
Lentil	0	1	1	0	0	2
Wheat	1	0	4	0	1	6
Barley	1	1	0	1	0	3
Sambo	2	0	1	0	0	3
Winter squash	0	1	0	2	0	3
Arracacha	0	1	0	0	0	1
Mashua	3	0	0	1	0	4
Sweet potato	2	0	0	1	0	3
Total	150	52	27	22	9	260

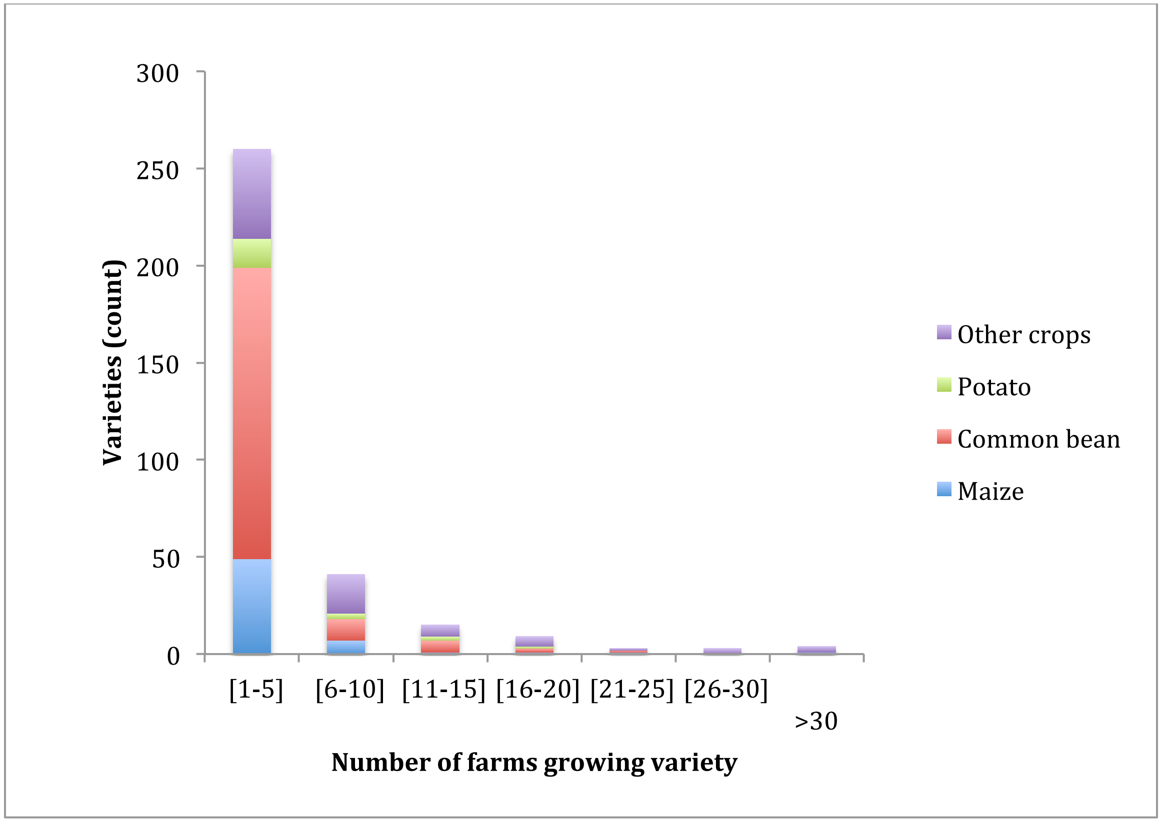


Figure 2.3: Graph showing the frequencies of crop varieties. Bars represent the number of varieties grown on on different intervals of farms. Data from farm survey (N=89).

Table 2.10: Number of crops grown per farm, by crop type and overall (subset of farms). Statistics for each crop type are based on data from only those farms growing at least one such crop, among a total of 89 farms.

Crop type	Mean	SD	Min	Median	Max
Field crops	6.9	3.2	1	6	16
Vegetables	4.8	2.8	1	5	14
Fruits	6.3	5.3	1	5	24
Herbs	4.7	4.2	1	3.5	28
All crops	17.4	12.4	1	14	54

Note: Alfalfa (forage crop) is here counted as a vegetable.

Table 2.11: Number of crops grown per farm, by crop type and overall (all farms). Statistics based on all surveyed farms (N=89), including those not growing some of the crop types.

Crop type	Mean	SD	Min	Median	Max
Field crops	6.9	3.2	1	6	16
Vegetables	3.0	3.2	0	2	14
Fruits	4.5	5.3	0	3	24
Herbs	3.0	4.1	0	2	28
All crops	17.4	12.4	1	14	54

Note: Alfalfa (forage crop) is here counted as a vegetable.

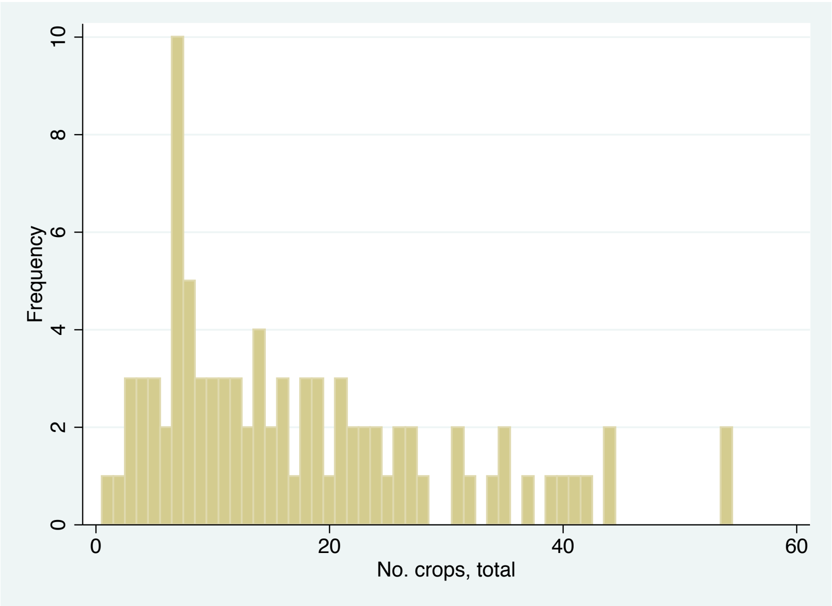
Table 2.12: Number of varieties grown per farm (subset of farms). Statistics for each crop are based on data from only those farms growing that crop, among a total 89 surveyed farms.

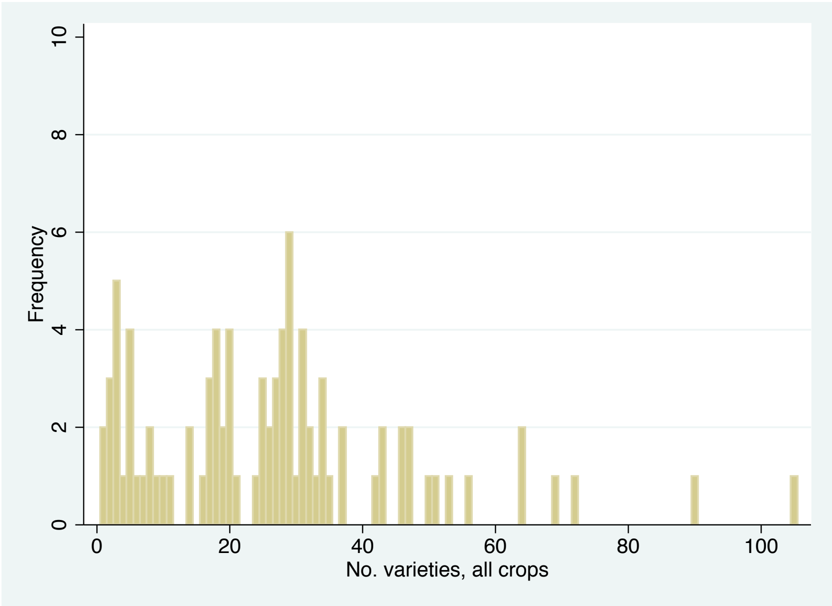
Crop	Mean	SD	Min	Median	Max	Max, % of varieties in survey	Skewness	Kurtosis
Maize	3.2	3.8	1	1	23	38.3	2.50	11.03
Common bean	16.3	11.7	1	20	59	34.7	0.74	4.19
Runner bean	3.5	1.4	1	4	6	40.0	-0.58	2.81
Peas	1.7	1.1	1	1	5	62.5	1.57	4.63
Faba bean	2.2	1.2	1	2	6	85.7	1.04	3.78
Potato	2.1	1.9	1	1	9	40.9	1.92	6.22
Quinoa	1.3	0.6	1	1	3	75.0	2.08	5.81
Lupines	1.3	0.6	1	1	3	100.0	1.32	3.77
Barley	1.3	0.7	1	1	3	60.0	1.92	5.15
Wheat	1.7	1.0	1	1	4	57.1	1.27	3.44
Oca	2.1	1.0	1	2.5	3	75.0	-0.13	1.08
Melloco	2.8	1.0	1	3	4	66.7	-0.02	1.69
Sambo squash	1.7	0.9	1	1	4	66.7	0.82	2.28
Winter squash	1.1	0.4	1	1	2	40.0	2.12	5.49
Arracacha	1.2	0.4	1	1	2	100.0	1.92	4.68
Mashua	1.8	1.3	1	1	5	100.0	1.87	5.37
Sweet potato	1.3	0.5	1	1	2	66.7	0.95	1.90
Lentil	1.3	0.5	1	1	2	100.0	1.15	2.33
All crops	26.7	19.8	1	26	105	31.4	1.27	5.46

Table 2.13: Number of varieties grown per farm (all farms) Statistics based on all surveyed farms (N=89), including those not growing some of the crop types.

Crop	Mean	SD	Min	Median	Max
Maize	3.2	3.8	0	1	23
Common bean	14.1	12.3	0	13	59
Runner bean	0.8	1.6	0	0	6
Peas	1.2	1.2	0	1	5
Faba bean	1.5	1.4	0	1	6
Potato	1.5	1.8	0	1	9
Quinoa	0.5	0.7	0	0	3
Lupines	0.4	0.7	0	0	3
Melloco	0.5	1.1	0	0	4
Oca	0.4	0.9	0	0	3
Lentil	0.1	0.3	0	0	2
Wheat	0.3	0.8	0	0	4
Barley	0.3	0.6	0	0	3
Sambo squash	1.2	1.1	0	1	4
Winter squash	0.3	0.5	0	0	2
Arracacha	0.2	0.4	0	0	2
Mashua	0.2	0.7	0	0	5
Sweet potato	0.1	0.4	0	0	2
All varieties	26.7	19.8	1	26	105

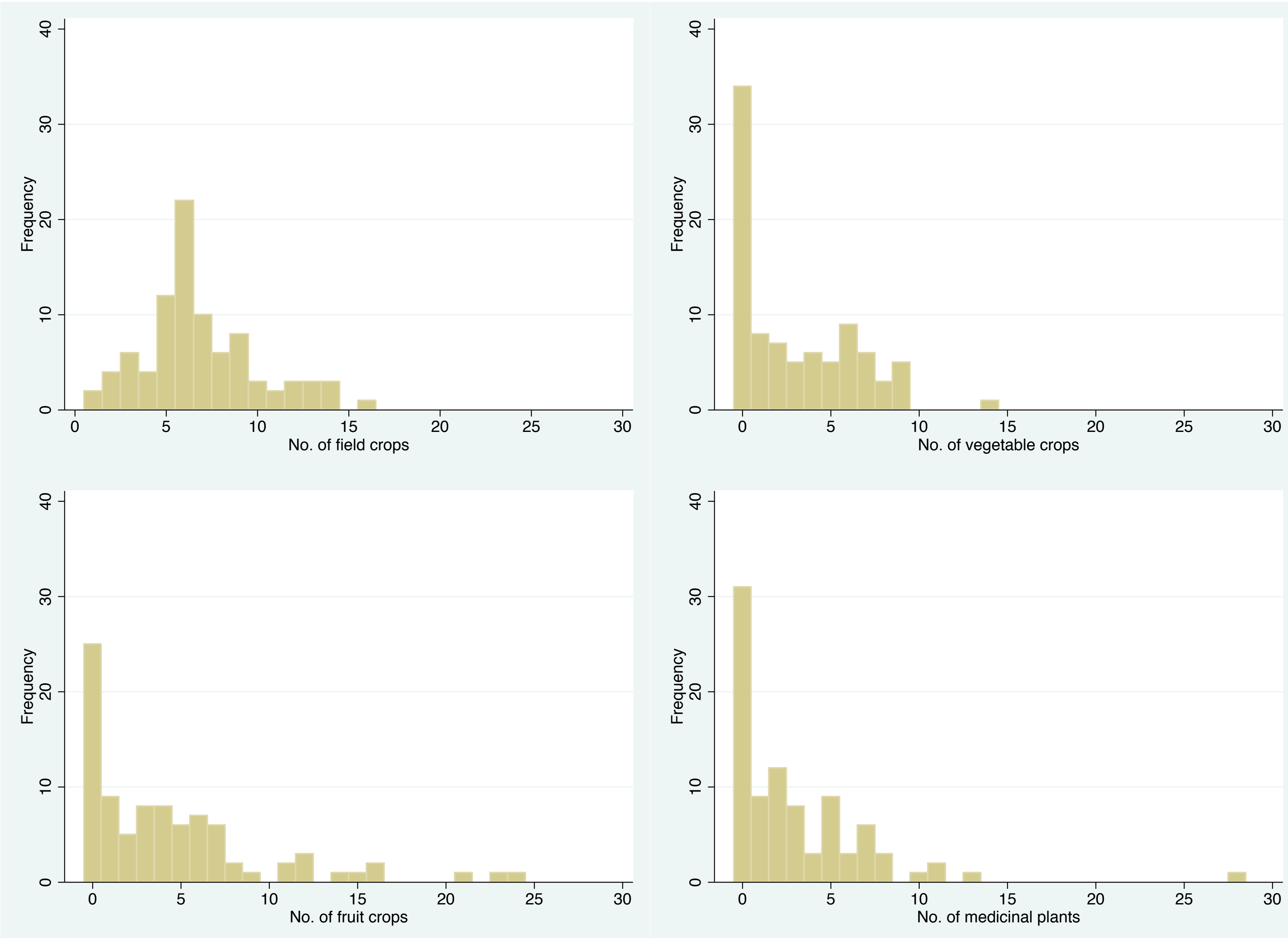
Figure 2.4a-x: Histograms of the number of crops and varieties grown per farm. Frequencies indicate number of farms out of a total of 89 surveyed farms. Note some variation in axis scale between the figures.

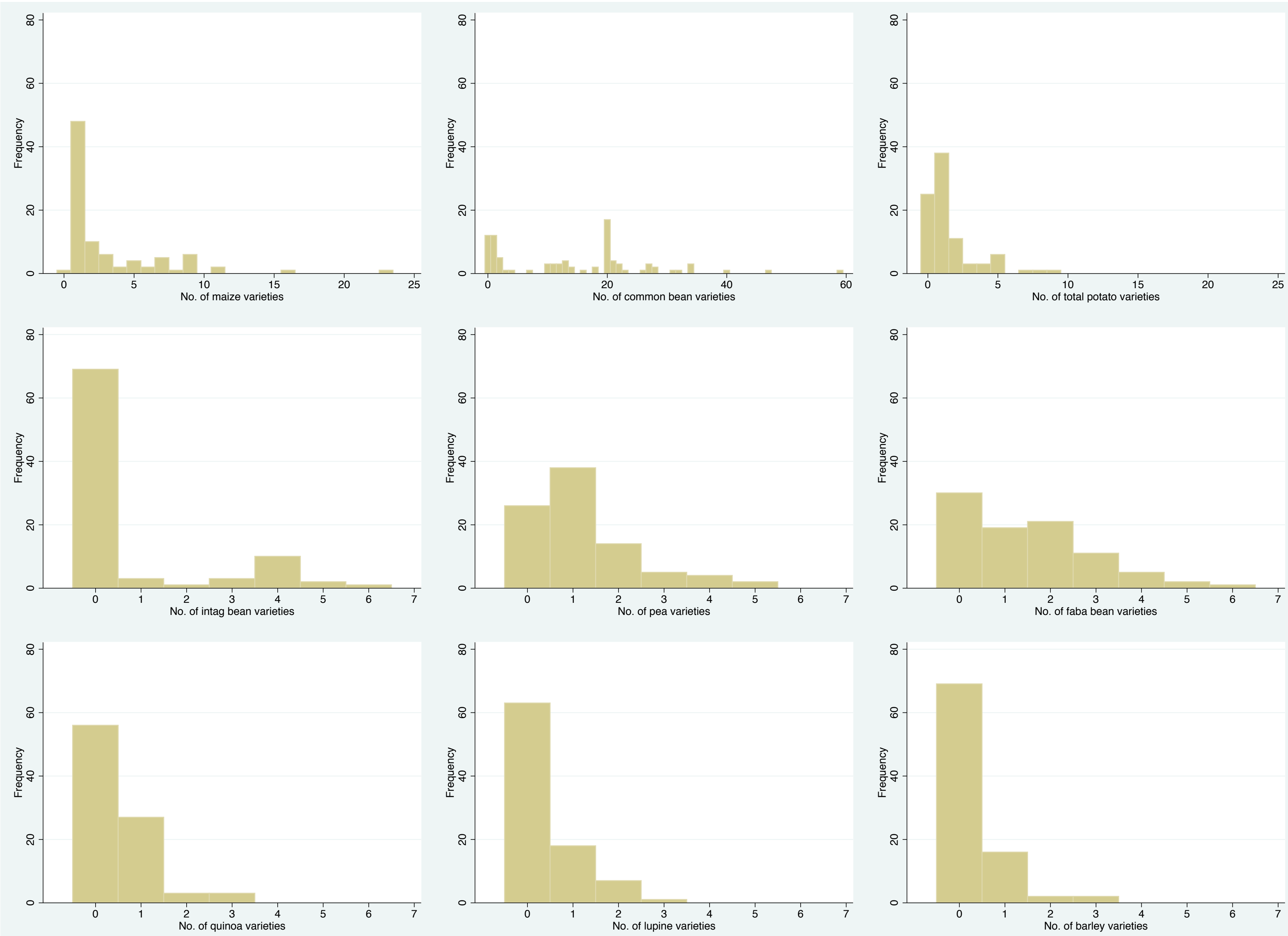


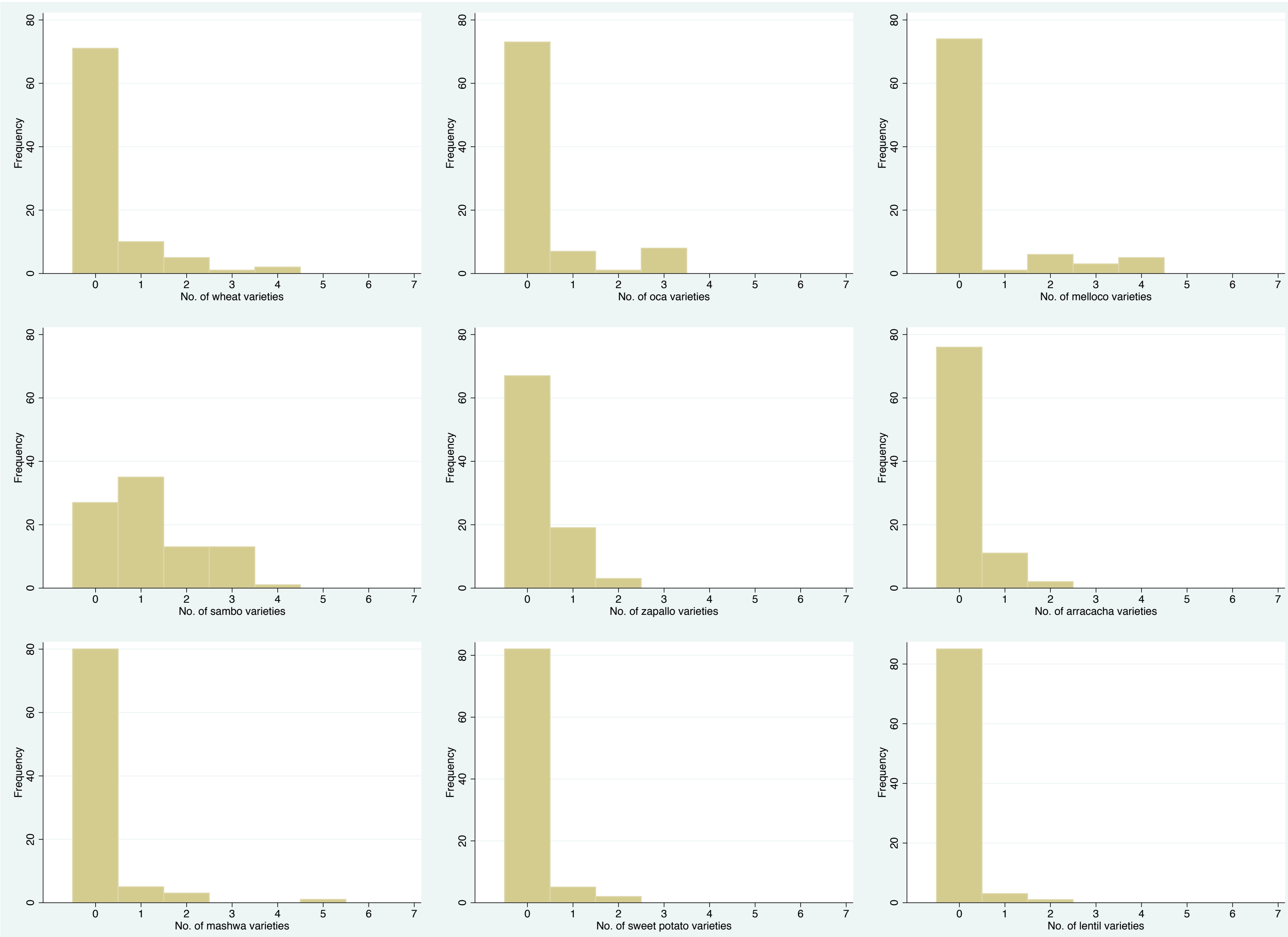


Above:
2.4a Histogram of the number of crops grown per farm (all crops included).
2.4b Histogram of the number of total varieties grown per farm (sum of 18 field crops).

Below:
Next page:
2.4c: Histogram of the number of field crops grown per farm.
2.4d: Histogram of the number of vegetable crops grown per farm.
2.4e: Histogram of the number of fruit crops grown per farm.
2.4f: Histogram of the number of herbs grown per farm.
Following two pages:
2.4g-x: Histograms of the number of varieties grown per farm, for each of 18 different field crops.


Frequency
0
10
20
30
40
0
5
10
15
20
25
30
No. of field crops
No. of vegetable crops
No. of fruit crops
No. of medicinal plants


Frequency
0
20
40
60
80
0
5
10
15
20
25
No. of maize varieties
0
20
40
60
No. of common bean varieties
No. of total potato varieties
0
1
2
3
4
5
6
7
No. of intag bean varieties
No. of pea varieties
No. of faba bean varieties
No. of quinoa varieties
No. of lupine varieties
No. of barley varieties


Frequency
No. of wheat varieties
No. of oca varieties
No. of melloco varieties
No. of sambo varieties
No. of zapallo varieties
No. of arracacha varieties
No. of mashwa varieties
No. of sweet potato varieties
No. of lentil varieties

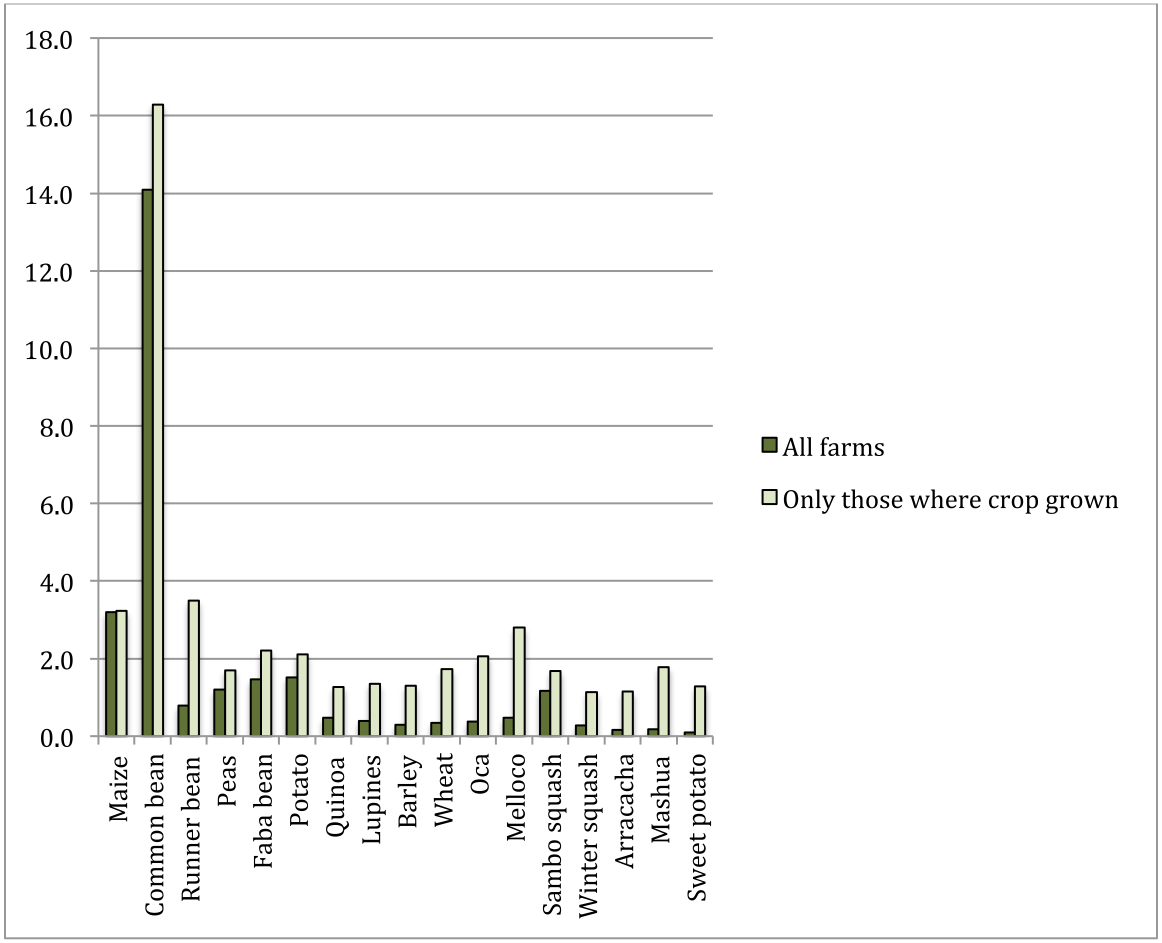


Figure 2.5: Mean number of varieties grown per farm, by crop. Dark green bars (to the left) show mean values when all farms (n=89) are considered, while pale green bars show the mean number of varieties on the farms where the respective crop is grown.

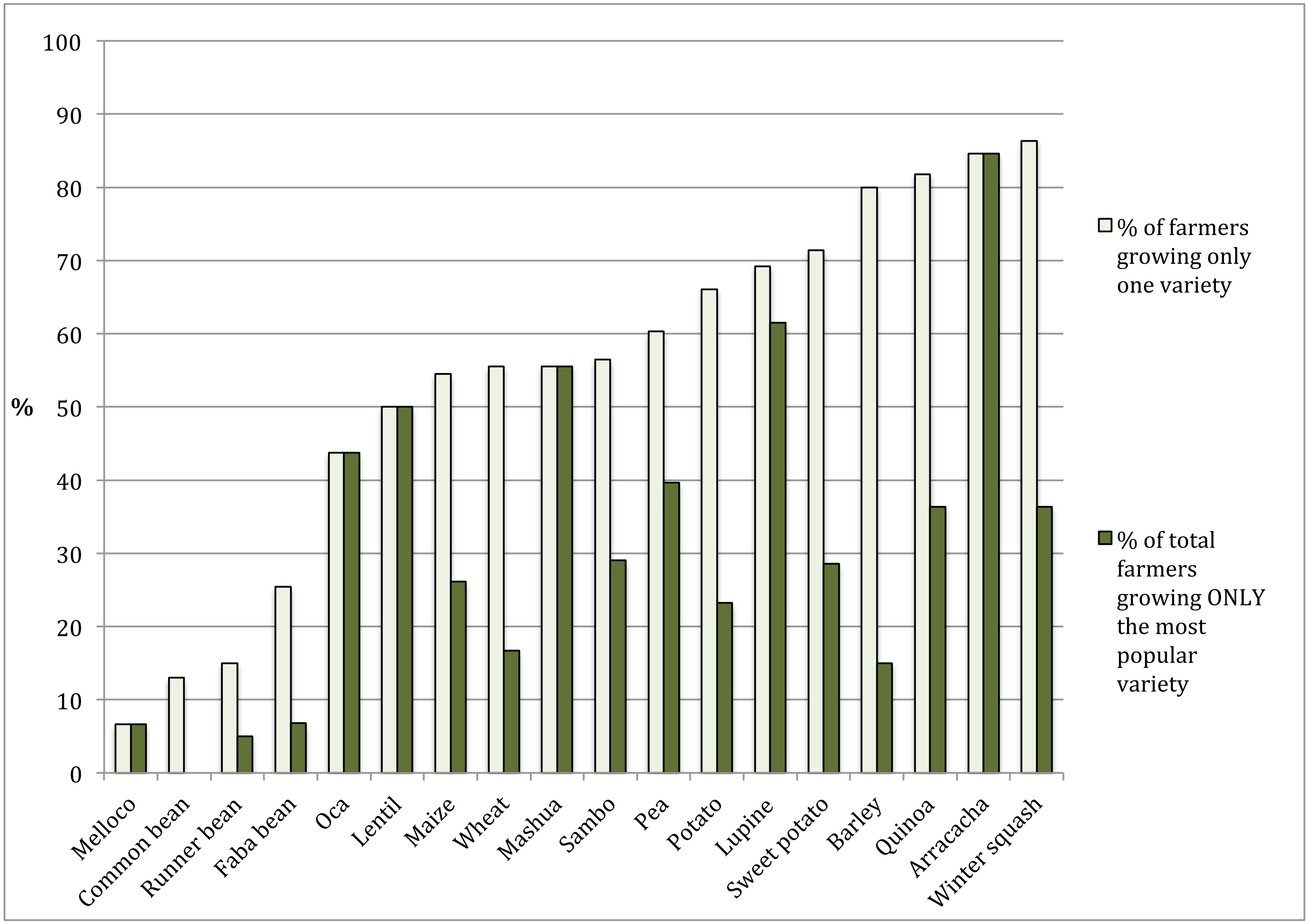


Figure 2.6: The percentage of farmers growing low diversity, by crop. Light green bars (to the left) show percentage of farmers growing crop that only planted one single variety. Dark green bars show percentage that only grew the single most popular variety.

Table 2.14: Summary statistics showing patterns of varietal distribution.

Crop	% of farmers growing only 1 variety (="subsample")	% of total varietal diversity grown by subsample	% of subsample growing the most popular variety	% of subsample growing MV
Maize	54.5	8.3	47.9	41.7
Common bean	13.0	1.8	0.0	100.0
Runner bean	15.0	20.0	33.3	0
Pea	60.3	66.7	65.8	76.3
Faba bean	25.4	71.4	26.7	0
Potato	66.1	50.0	35.1	89.2
Quinoa	81.8	100.0	44.4	44.4
Lupine	69.2	33.3	88.9	0
Barley	80.0	100.0	18.8	12.5
Wheat	55.6	57.1	30.0	10.0
Oca	43.8	25.0	100.0	0
Melloco	6.7	16.7	100.0	0
Sambo	56.5	83.3	51.4	0
Winter squash	86.4	80.0	42.1	0
Arracacha	84.6	50.0	100.0	0
Mashua	55.6	40.0	100.0	0
Sweet potato	71.4	33.3	40.0	0
Lentil	50.0	100.0	100.0	0

Table 2.15: Summary statistics on species richness from different studies.

Country	Community	Ethnicity	Nº villages	Nº farms	Mean farm species richness	SD	Min	Max	Comm. species richness	Source
Bolivia	Tsimane, Maniqui river, Beni province, Bolivian Amazon	Tsimane	13	215	6.0	1.96	1	11		Reyes-García et al. 2008
Ecuador	Mondayacu, Ecuadorian Amazon	Kichwa, lowland	1	51	26.1	8.13	8	41	48	Perreault 2005
Brazil	Manaus, Brazilian Amazon	Various	8	16	27.4	10.48	7	44	79	Major et al. 2005
Peru	Corrientes River, Northeast Peruvian Amazon	Various	15	300	25.8	13.5	2	78	309	Perreault-Arch and Coomes 2008
Peru	Nuevo Triunfo, Northeast Peruvian Amazon	*Ribereños*	1	24	16.3	8.86	1	32	82	Coomes and Ban 2004
Brazil	Madeira River, Manicoré, Brazilian Amazon		16	63					86	Fraser et al. 2011
Average, previous studies			*9*	*112*	*20.3*	*8.6*	*3.8*	*41.2*	*120.8*	
Ecuador	**Cotacachi, Northern Ecuadorian Andes**	**Kichwa, highland**	**5**	**89**	**17.4**	**12.4**	**1**	**54**	**103**	Skarbø, this study

Table 2.16: Summary statistics on varietal diversity from different studies. (Continued on next pages.)

Crop	Country	Community/ region	Ethnicity	Nº farms growing crop	Farm landrace richness	Comm. landrace richness	Comm. MV richness	Comm. total variety richness	Source
Maize	Mexico	Ichmul		100	1.9	9	2	11	Jarvis et al. 2008
Maize	Mexico	Sahcaba		90	1.4	5	1	6	Jarvis et al. 2008
Maize	Mexico	Yaxcaba		67	2.3	14	1	15	Jarvis et al. 2008
Maize	Peru	Aguaytia Valley		67	1.3	8	1	9	Jarvis et al. 2008
Maize	Peru	Ucayali Valley		68	1.2	8	1	9	Jarvis et al. 2008
Maize	Peru	Pichis-Pachitea Valley		57	1.4	7	0	7	Jarvis et al. 2008
Maize	Peru	Paucartambo	Quechua	67*		27			Zimmerer 1996
Average, previous studies					*1.6*	*11.1*	*1*	*10*	
Maize	**Ecuador**	**Cotacachi**	**Kichwa**	**88**	**3.0**	**58**	**2**	**60**	Skarbø, this study
Common bean	Burkina Faso	Pobe		12	2.4	14	2	16	Jarvis et al. 2008
Common bean	Burkina Faso	Thiougou		18	1.6	8	0	8	Jarvis et al. 2008
Common bean	Burkina Faso	Tougouri		15	1.6	9	0	9	Jarvis et al. 2008
Common bean	Hungary	Dévaványa		36	1.6	12	2	14	Jarvis et al. 2008
Common bean	Hungary	Őrség		58	1.4	13	3	16	Jarvis et al. 2008
Common bean	Hungary	Szatmár-Bereg		74	1.8	20	3	23	Jarvis et al. 2008
Common bean	Mexico	Ichmul		89	2.4	8	0	8	Jarvis et al. 2008
Common bean	Mexico	Sahcaba		73	2.9	6	0	6	Jarvis et al. 2008
Common bean	Mexico	Yaxcaba		66	2.5	7	1	8	Jarvis et al. 2008
Common bean	Peru	Aguaytia Valley		31	1.1	3	1	4	Jarvis et al. 2008
Common bean	Peru	Ucayali Valley		36	1.2	4	0	4	Jarvis et al. 2008
Common bean	Peru	Pichis-Pachitea Valley		16	1.3	3	0	3	Jarvis et al. 2008

Crop	Country	Community/ region	Ethnicity	No. farms growing crop	Farm landrace richness	Comm. landrace richness	Comm. MV richness	Comm. total variety richness	Source
Common bean	Ecuador	Loja	Mestizo	60		12	7	19	Abbott 2005
Average, previous studies				*44.9*	*1.8*	*9.2*	*1.5*	*10.6*	
Common bean	**Ecuador**	**Cotacachi**	**Kichwa**	**77**	**14.9**	**162**	**8**	**170**	Skarbø, this study
Faba bean	Morocco	Ourzagh		58	2.0	7	0	7	Jarvis et al. 2008
Faba bean	Morocco	Ghafsai		29	1.6	6	0	6	Jarvis et al. 2008
Average, previous studies				*43.5*	*1.8*	*6.5*	*0.0*	*6.5*	
Faba bean	**Ecuador**	**Cotacachi**	**Kichwa**	**59**	**2.2**	**7**	**0**	**7**	Skarbø, this study
Potato	Peru	Paucartambo	Quechua	85	10.1	69			Brush et al. 1992
Potato	Peru	Tulumayo	Mestizo	85	9.7	65			Brush et al. 1992
Potato	Peru	Paucartambo	Quechua	30*		79			Zimmerer 1996
Average, previous studies				*64.8*	*9.9*	*71*			
Potatoes	**Ecuador**	**Cotacachi**	**Kichwa**	**64**	**0.5**	**10**	**12**	**22**	Skarbø, this study
Durum wheat	Morocco	Ourzagh		50	1.5	3	4	7	Jarvis et al. 2008
Durum wheat	Morocco	Rich		37	1.5	4	0	4	Jarvis et al. 2008
Average, previous studies				*43.5*	*1.5*	*3.5*	*2*	*5.5*	
Wheat	**Ecuador**	**Cotacachi**	**Kichwa**	**18**	**1.7****	**3**	**4**	**7**	Skarbø, this study
Barley	Ethiopia	Ankober		16	1.1	5	1	6	Jarvis et al. 2008
Barley	Ethiopia	Mojanawadera		16	1.1	6	1	7	Jarvis et al. 2008
Barley	Ethiopia	Tarmaber		16	1.7	12	0	12	Jarvis et al. 2008

Crop	Country	Community/ region	Ethnicity	No. farms growing crop	Farm landrace richness	Comm. landrace richness	Comm. MV richness	Comm. total variety richness	Source
Barley	Morocco	Bouhrazen		37	1.4	5	3	8	Jarvis et al. 2008
Barley	Morocco	Ourzagh		44	1.5	6	2	8	Jarvis et al. 2008
Barley	Nepal	Jumla		179	1.6	4	0	4	Jarvis et al. 2008
Average, previous studies				*51.3*	*1.4*	*6.3*	*1.2*	*7.5*	
Barley	**Ecuador**	**Cotacachi**	**Kichwa**	**20**	**1.3****	**3**	**2**	**5**	Skarbø, this study
Squash	Mexico	Ichmul		93	1.6	3	0	3	Jarvis et al. 2008
Squash	Mexico	Sahcaba		81	1.7	3	0	3	Jarvis et al. 2008
Squash	Mexico	Yaxcaba		66	1.5	3	0	3	Jarvis et al. 2008
Squash	Nepal	Bara		134	1.2	16	0	16	Jarvis et al. 2008
Squash	Nepal	Kaski		188	1.6	15	0	15	Jarvis et al. 2008
Average, previous studies				112.4	1.5	8.0	0	8.0	
Sambo squash	**Ecuador**	**Cotacachi**	**Kichwa**	**62**	**1.7**	**6**	**0**	**6**	Skarbø, this study
Winter squash	**Ecuador**	**Cotacachi**	**Kichwa**	**22**	**1.1**	**5**	**0**	**5**	Skarbø, this study
Melloco	Peru	Paucartambo	Quechua	20*		5			Zimmerer 1996
Melloco	**Ecuador**	**Cotacachi**	**Kichwa**	**15**		**6**	**0**	**6**	Skarbø, this study
Quinoa	Peru	Paucartambo	Quechua	20		5			Zimmerer 1996
Quinoa	**Ecuador**	**Cotacachi**	**Kichwa**	**33**		**3**	**1**	**4**	Skarbø, this study
Sweet potato	Philippines	Salvacion	Various					23	Nazarea 1998
		Intavas	Various					29	Nazarea 1998
Sweet potato	**Ecuador**	**Cotacachi**	**Kichwa**	7				3	Skarbø, this study

Notes:
* Number of fields sampled.
** Some of these varieties are FVs - advanced generations of MVs. If omitting them, the figure would be slightly lower.

CHAPTER 3

CULTIVATING QUITUGO:

PATTERNS IN SPACE AND TIME AND 20TH CENTURY RECONFIGURATIONS[16]

[16] Skarbø, K and R. Ramos. To be submitted to *Agriculture and Human Values*.

Abstract

This study examines patterns structuring traditional agriculture in Quitugo, Ecuador, and their reconfiguration during the latter part of the 20th century. Drawing on observant participation, farmer interviews and community workshops, we describe how prescriptions laid down in the local traditional knowledge system have guided agricultural work, contributing to the sustainable production of a diverse portfolio of crops. Yet during the last decades of the past century, a host of sociocultural changes, including the entry of new values and priorities, ultimately reduced the demand for home-grown foods, the faith in old beliefs and the dedication to field labor. This process led to simplifications in field patterns, and erosion of crop diversity and traditional knowledge. Still, new developments around the present century's inception indicate that there are prospects for a revitalization of the area's cultural and agricultural heritage.

3.1 Introduction

During the millennia that agriculture has sustained human life in the Andes, an extensive body of agricultural knowledge has evolved, enmeshed with religious and cultural beliefs and practices. Farming has proven resilient, yet adaptive to change. It has continued to provide livelihoods for local people through shifting empires and regimes in a dynamic manner – incorporating new ideas, plants and animals into former patterns, a process eventually leading to reconfigurations of fields and lives. While agricultural pattern shifts in former periods have been reported and discussed elsewhere (Crosby 1972; Hernández Bermejo and León 1994; Moates and Campbell 2006; Pearsall 2008), this chapter will focus on some reconfigurations that took place in the last part of the 20th century. We shall argue that as rural livelihoods in some senses grew more complex during this period, agriculture was in several ways simplified.

We examine agricultural patterns and their shifts through a case study in the community of Quitugo, located in Cotacachi *cantón* in the Northern Ecuadorian Andes. The community sits on the bottom of the Inter-Andean Valley at an elevation of about 2500m and encompasses 63 households (UNORCAC 2007). Most households own and cultivate land, and production is mainly subsistence-oriented. Our survey of 20 community households indicate that in 2009, average area cultivated per household was 0.44 ha (standard deviation=0.27, range: 0.03-1.05). The same survey showed that 95% of households have members who engage in some kind of off farm wage work in addition to agricultural activities.

Our main methods are observant participation, farmer interviews and community workshops. We also report results from a survey of 20 of the community's households. Kristine Skarbø, author 1, carried out anthropological fieldwork in Cotacachi including Quitugo over a total of 16 months during 2003-04 and 2009-10. During both periods Rosa Ramos, author 2, collaborated and assisted with the research. She is a native of Quitugo, and the information and insights put forth below also draw on her life-long experience as a member of the community. We recorded, transcribed and translated interviews and workshop discussions, which were carried out by in a combination of Spanish and Kichwa.

The text below is divided into two parts. In the first part, we review three basic patterns structuring agriculture in Quitugo in the mid-20th century: the design and work of a *chakra,* the yearly agricultural calendar, and the weekly work schedule. These three will stand as examples of the complexity of the agricultural system of the area. In the second part, we report how each of these patterns were simplified through the end of the past century and discuss the developments triggering these simplifications. We conclude that even though the observed changes indicate a profound erosion of knowledge and crop diversity, countertrends evolving through the first decade of the present century provide prospects for the recuperation of a vital local agriculture.

3.2 Patterns

3.2.1 The Chakra

At the center of Quitugo's agriculture, symbolically and materially, stands the *chakra*[17] – the planted field. Even though some crops, including barley and wheat, have sometimes been grown as monocrops[18], intercropping has and continues to be the dominant planting pattern. The "archetype" *chakra* is a field planted with maize, common beans, cucurbits, peas, faba beans,

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[17] Most words placed in italics in this paper are Kichwa, although when Spanish terms are regularly used by Kichwa speekers, they are given in Spanish. *Chakra* is originally Kichwa, but also used in local Spanish speech.

[18] Wheat and barley were a generation ago also regularly intercropped with lentils or chickpeas. However, this practice has receded and today very few farmers grow lentils, and even fewer chickpeas (Chapter 3).

quinoa and lupines[19]. This might perhaps sound like a chaotic medley of plants, but in fact, it is carefully structured. In the following section we shall review its structure and the stages involved in its preparation and care.

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3.2.2 The Work of a Chakra

Explained by RR and transcribed, translated and edited by KS. Figures 3.1-3.4 illustrate the text.

3.2.2.1 Sowing

One prepares furrows from the foot (*chaki*; lower part) to the head (*uma*; higher part) of the chakra for the work and weeding to be comfortable. The sides of the field are called shoulders (*rikrakuna*). The most common is to sow on the side of the furrow (*chawpi wachu*). But if the terrain is very wet, one might also plant on the top of the furrow (*wachu lumu*). And, in dry terrains, one might sow at the bottom of the furrow (*wachu uku*), where the humidity is better maintained.

The first that one plants is maize together with climbing beans. In the furrows one makes a hole of about five centimeters for each long step (of about a meter), adds two or three maize seeds and two beans, and covers with earth. The holes are made with a *palentra* – a wooden tool especially designed for this purpose. Afterwards one takes another round through the *chakra*, carrying faba beans, bush beans, and peas. Like before, one makes a hole for each step, in between the holes for maize, and one places there about one faba bean and three bush beans, and covers. In some of the holes one places a couple of peas as well. The next step is to sow lupines. The lupines one places in between the other seeds in the two first and two last furrows, and also at the beginning and end of each furrow. In each hole one places about four or five lupine seeds,

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[19] In this chapter, plant names are given in vernacular English terms. Please see Chapter 2 for Kichwa, Spanish and Latin names.

as it is a little more difficult to make it grow than the other crops. This way, the lupines make a fence around the *chakra*. At last one plants quinoa, forming stripes that cross all the furrows. Normally it is not necessary to add seeds of sambo or winter squash, as these sow themselves, at least if one is throwing kitchen waste in the field. If one sows seed of those, it is enough to put a few, one of sambo and one or two of winter squash. But they fight amongst themselves, so if both sprout, one has to separate them, preferably in different fields.

3.2.2.2 Weeding and Ridging

After one month, one weeds the chakra with a hoe. Both men and women participate in this task. The time until the weeding depends on which part of the furrow one has sown. If it is on the side, one waits a month before weeding. If one has sown at the bottom, one waits more, to avoid burrowing the plant – one month and 15 days. If one has sown at the top, one might weed before one month has passed, since there it is more difficult that the plant is being covered while weeding.

After two or three more months, one ridges, adding soil at the plants' base. There are two ways of doing this – with the hoe, or with the *yunta* (plow for animal traction) and cattle. If it is with the hoe, women as well as men might do it, but if it is with cattle, men are more likely to do it. One might do it either way, or first one way, and then the other.

3.2.2.3 The Harvest

The first thing one harvests is the pea, while one is ridging. There is not much, so it is only for eating fresh – one adds it to the soup. When one finishes the ridging, after about four months, the bush beans are ready, and these one harvests in quantity, both for eating fresh and for drying and saving for seed and eating at a later point. About five or six months after the planting, depending on the maize variety, the fresh maize (*chukchu*) starts to ripen. This one harvests to use in its fresh state, according to necessity, during about a month. If one has planted *chawcha* quinoa, it will ripen together with the *chukchu*, and one cuts and collects it. If it is *hatun* quinoa[20], it will ripen together with the [dry] maize, and one cuts it before the maize harvest. But before that, the faba beans and climbing beans will ripen, and one harvests both products. The maize is harvested after all the above, about seven months after the planting. One might also leave it more time for it to dry better on the plant, but there one also runs the risk that it might rot. The last product to collect are the lupines from the edges.

3.2.2.4 After Harvest: Cattle Feed and Field Preparation

When all the harvest is finished, the next is to cut the leaves of the maize, and make a *sara parva* – a heap of maize stalks in a corner of the field, which later will serve as feed for the cattle. This is like *kamcha*[21] for the cattle – one gives it to them each morning. Still there will be some greens and herbs in the field (called *lastrojo*), and one binds up the cattle for it to graze on these plants.

After the cattle have eaten all of the greens in the field, one makes the first plowing (*rumpihun*) in the same direction as the furrows. On the third day, one "crosses" (*cruza*) the first plowing by plowing in the other direction. If one wants to sow peas, one then makes furrows, of about 20 centimeters, and plants peas, making holes with about 20 centimeter distance with a *palentra*. (Alternatively, potatoes are also commonly grown during summer.) If one does not

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[20] See Chapters 2 and 7 for a description of different quinoa varieties.

[21] *Kamcha,* or *tostado* in Spanish, are toasted maize kernels. It is a traditional mainstay in the local diet, which may be served every day as a side dish or snack. However, during recent years lower production and smaller land holdings have contributed to a decline in its prevalence.

plant peas, but prefers to let the land rest, one plows one time in the same direction as the furrows, and lets it rest for a month. Then one "crosses", and lets it rest for another month. After this time has passed, one "corners" (*esquina*), pulling with the plow from the bottom of the field and toward one side. After three days one then makes furrows (*wachay*), and again, one sows maize and all the other *granos*[22].

3.2.2.5 Fallowing the Fields

Earlier, lands were quite extensive. For example, my grandparents had six or seven parcels. In those times, people said, "this field I won't plant this year, I will bind up here the sheep, the cattle, the pig, for the animals to fertilize, and next year I will plant." Our grandparents considered which of the fields they planted was without fertilizer – for example, a field here, quite green, everything well, and then one over here, yellowish – and so they would say that the coming year we have to let it rest and fertilize it.

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3.2.3 Pattern in Space: Notes on the Chakra's Design

The Andean *chakra* described above constitutes a highly efficient design for producing food. In the words of RR's grandparents, planting a *chakra* as described above was to "make the most of the land". It is an extended version of the "three sisters" maize/beans/squash intercropping system common in many parts of the New World. This field design, frequently called *milpa* in Central America, has been referred to as a prime example of traditional agroecology (Altieri, et al. 2011; Francis, et al. 2003). In Quitugo and Cotacachi, the maize/bean/squash trio also forms the backbone of the *chakra*, but farmers have developed a

[22] *Granos* is an originally Spanish term that strictly stands for all the local crop products that can be shelled (*desgranado*; i.e. grains and legumes), but it is also frequently used to encompass locally grown tubers, roots, squashes, and in some contexts even wild greens. It corresponds to *murukuna* in Kichwa.

design that further includes native Andean plants (lupines, quinoa) and crops of Old World origin (peas, faba beans). Such diverse intercropping enhances weed and pest management, and may contribute to maintaining soil fertility, as the different plants draw on different nutrients, and nitrogen-fixing plants add this element to the earth (Netting 1993). In the *chakra*, different plants use and extend in different vertical layers of the field and soil, for an efficient use of the space. For instance, the bottom layer is constituted by either sambo (*Cucurbita ficifolia*) or winter squash (*C. maxima*). The scientific explanation behind the fight farmers observe amongst these plants – prohibiting their planting in the same *chakra* – is that different *Cucurbita* species may cross-pollinate, resulting in few fruits that rarely bear viable seed (Castetter 1930). In several ways, plants also support each other. Not only are climbing beans literally supported as they grow clinging to maize stalks (Figure 3.4); lupines planted at the field's edges protect it against animal or human intruders, and the rows of quinoa sown perpendicular to the furrows shelter against frost.

In the time when the first products start to ripen, around Easter, the green, bushy lupine plants will gather plenty of night-time humidity, causing anyone trying to enter a field to thoroughly wet their clothes. Passer-bys are thus discouraged from snapping fresh and tempting maize cobs. Later in the harvest season, the lupines will dry, and if anyone touches the plant, the dry seed rattle loudly in their pods, providing a natural security alarm. Farmers in Quitugo have considered the quinoa as a particularly frost-resistant plant – a property they have linked to the snow-like powder dotting the quinoa plant. Not only does it tackle night frosts well itself, but they have known that it also protects other *chakra* plants against frost "burns". Scientists have in recent years began to examine quinoa's frost resistance (Jacobsen, et al. 2007; Jacobsen, et al. 2003), and research from Bolivia shows that within quinoa monocrops, the canopies of larger plants function as a shelter for lower plants, reducing night-time radiative temperature loss, and protecting them against frost (Winkel, et al. 2009). This canopy-effect may explain the sheltering role of quinoa in Quitugo's intercropped fields.

The *chakra*'s multi-crop structure also shields against climate variability, since the crops (and, at a finer level, the mixture of varieties within each one) develop and mature at different speeds. Finally, and importantly, the varied crop (and varietal) composition yields the raw materials for a diverse diet. These are not ripening all at once, but in successive stages, providing fresh food over an extended period of time.

3.2.4 Farming through the Year: the Agricultural Calendar

Rosa's explanation above reveals a *chakra*'s pattern through space, but also through time, as its work completes a yearly cycle. That year is not initiated anywhere, but in a quite specific time period. Agricultural scheduling in Quitugo has traditionally been structured in relation to religious celebrations, again coinciding with seasonal weather patterns. Figure 3.5 shows a calendar drawn during a workshop with farmers from the community, giving an overview of the year as it used to be. Below we provide a summary of the participants' explanation of weather and agricultural patterns through the year.

3.2.5 Yearly Weather Patterns

The year in Cotacachi is divided into two main seasons: a shorter summer from May to August, and a longer winter from September to May. The summer would be dry, warm and windy, and last until *Mama Tránsito siriri* and *Mama Tránsito hatari* (The lying down and getting up of Mother Tránsito) in August. These were three days of strong winds[23]. After this, rains would begin. During the coming months, the weather would alternate between rain and sun, typically with rain two or three days a week, sometimes coming in the morning, sometimes in the afternoon, and sometimes at night. The weather would dry up for briefer periods during the *veranillo de las almas* (little summer of the Souls) around *finados* (All Soul's Day) and the *veranillo del niño* (little summer of the child, referring to Jesus) around *warmi pascua* (Christmas). From a couple of weeks after *mushu wara* (New Year) and in the following time through *carnaval* (in February) and *kari paskwa* (Easter), rains would again begin, lasting until May. Then the weather would dry up, and the summer anew set in, with the fiestas of *Corpus*, *San Juan*, *San Pedro*, and *Santa Lucía*.

3.2.6 Yearly Agricultural Schedule

The agricultural calendar was fixed around the above described climate pattern. With the onset of rains after the days of *Mama Tránsito*, people would plant intercrops of lupines, early maturing bush beans (*allpa purutu*), and peas. Then, *San Francisco* in the beginning of October would mark the first planting of *chakras* with maize intercrops, as described above. Successive plantings in different fields of this intercrop would take place in the following time, with the last planting date being *Imantag fiesta* on December 15. Even though the *veranillo del niño* might have started before that, there would be enough humidity in the soils for seeds to germinate. *Carnaval* was a time for planting wheat, barley and lentils. Around carnaval, oca was harvested. In the time that followed different plants started to ripen in turn. First, a month before Easter, early maturing bean varieties were harvested. Easter was also a time for planting wheat and

[23] On the first day Mother Tránsito, a virgin Saint, would give birth. She then rested three days, as the winds were whirling. On the third day she stood up again, and the winds would calm.

barley. At Easter there would be a diversity of ripe products: fresh maize, fresh beans, fresh lupines, sambo and zapallo, all to enter the typical Easter meal, *fanesca*, a thick and hearty soup containing twelve different fresh *granos*. But all was not harvested in its fresh state – crops were also left to dry in the field, and matured successively, as explained above. The final harvests took place close to *San Juan* in the end of June. The maize planted in December would be still be fresh at this point and ensure that fresh *chukchu* cobs also could be served in the *San Juan* celebrations. Wheat, barley and lentil crops planted in *carnaval* were also brought in now. As fields were harvested in the time leading up to *San Juan*, the drought resistant crops of peas and potatoes were planted. The last planting of these took place in *San Pedro* (June 28). Small plots of oca were also planted around this time. When *Mama Tránsito* returned with winds in August it was a good time to harvest and clean the peas in the moving air. Around this point the wheat and barley planted at Easter were also harvested. And at the end of summer and onset of new rains, a new cycle of planting was begun.

3.2.7 Farming through the Week: a Day for Everything

Within the yearly pattern of crops and fields, more detailed structures have been in place. One of them is that of the week. Each day is suited to a specific set of tasks, as explained by Rosa Ramos below, and summarized in Table 3.1.

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3.2.8 A Weekly Work Schedule

Explained by RR and transcribed, translated and edited by KS

On Tuesdays one might sow, it is a day for sowing. Friday as well is a day for sowing. Sundays are also days for sowing. There is a belief that if one prepares the land on a Tuesday, Friday or Sunday, the earth will tire. Because there is a belief that exists within the communities, that those days Mother Earth (*Pacha mama*) receives. They are days of reception, so if someone prepares the land, it is like they are confusing Mother Earth. Then she says: "What is going on? Today is not a day of plowing, why are you plowing me today?" So, the days for plowing are Wednesday, Thursday and Saturday. Those days one may plow. They say that Tuesday is a day of sprouting, *wiñay puncha*. So anything that one sows, will grow. It is like saying that Mother Earth is fertile. She is productive those days, Tuesdays. Friday is also *wiñay puncha*. As if Mother Earth is ready to get pregnant, like a woman, as if you were in your time ready for pregnancy. So, those days are Tuesdays and Fridays. And Sunday, they say that if I want to sow, Sunday is good. Because Sundays birds leave for mass, and they don't see what is sown, and they don't eat the seed. So, for that reason, it is also good to sow on a Sunday. But if one sows on a Monday, Monday is soul day, *alma puncha*, and one should not work Mother Earth. One should not make furrows, nor sow. It is a day of the deceased, and one has to dedicate oneself completely, Mondays. If I were to sow on a Wednesday – Wednesday they say is plant disease day, *lancha puncha*, so one should not sow on Wednesdays. But one might prepare the land, because they say that the plant diseases will be confused.

And Thursday they say is *aya puncha,* Devil day. One may plow this day, but not sow. When one sows on a Thursday, my grandmother used to say that all the grains will turn blackish, or that they will rot rapidly.

Saturday one should not sow, because they say it is *yarkay puncha*, hunger day. They say that a very hungry woman was out walking this day. And, I don't know if you have heard this, but what I have heard is that, at least here in Ecuador, the *ferias* (markets) are arranged everywhere on Saturday. And they say that it is a day when Mother Earth is very hungry. And they say that because of this, women, since we are identical to Mother Earth, on a Saturday, no matter how things are, we go out, because we need a lot to eat. So, they say that because of this, markets are arranged on Saturdays. It is because it is a day of hunger, *yarkay puncha*, they say. For example myself at home, from Sunday to Friday, I might have everything, but Saturdays I say, "now there is nothing", and no matter how, I have to go to the market. So, they say that because of this, Saturday is a day of *yarkay puncha*, when we are all searching for a lot of things to bring back home. Because of this they say that Saturdays we should not sow. If we plant on a *yarkay puncha*, this day when Mother Earth is hungry, she eats the seed, and it does not grow beautifully, it grows bad, the plants grow malnourished.

Sunday we call *pishku puncha*, bird day. Sunday all the birds go to mass, and there are no birds, and we can sow and sow without the birds eating the seed. The birds usually eat much of the seed when one sows. At least during the late plantings, they just eat everything.

Wednesday they call *kari puncha*, man day, because there the men start to work, preparing the land. It is also *lancha puncha*, plant disease day, as it is as if the *lancha* is likely to attack. We should harvest Tuesdays and Fridays, which are days dedicated to God's health. They are days of health, those days. Those days one should harvest. But we should do it while watching the moon[24]. They say that when one harvests a Saturday, the maize will run out rapidly, since it was harvested on a *yarkay puncha*, a hunger day. For the weeding, they say that one has to do it Mondays. Because it is soul day, and they say that there the weeds will die. For the weeds to wilt.

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[24] According to local costum, moon phases constitute important guides for steering agricultural labor activities as well. In our 2009 survey of 20 households in Quitugo, 70% report that moon phases are applied in the household's timing of at least some tasks.

3.2.9 Patterns in Time: Notes on the Year and Week

The successive plantings of different crop combinations at different points during the year was patterned upon seasonal changes in patterns of sun, rain and wind, in a manner that provided suitable growing conditions for each crop. At the same time, labor activities would be spread throughout the year, permitting a limited number of people to manage many different crops and tasks. The conventions guiding weekly activities created both relief and compromise; every task had its own time. One could not do anything and everything at once, but on the other hand, one should do the things the day was dedicated to, since postponing it implied perhaps having to wait a whole week. When it comes to the tending of growing plants, a long delay may have dire consequences.

In the weekly schedule we may also note another pattern in Quitugo's agriculture: the gendered division of labor. Agricultural activities have traditionally engaged entire households, with men and women largely taking care of different tasks. Men would primarily be responsible for field preparation and plowing, while women would be in charge of sowing, harvesting, seed management and cooking. Both men and women could carry out weeding and ridging. Children would be in charge of grazing animals, in addition to helping with fieldwork and kitchen tasks. The dedication of different activities to different days also created compromise between men and women to carry out their designated duties.

3.2.10 Interlocking Patterns

The interlocking patterns of crops and work described above are crafted from a fusion of species, knowledge and ideas that have come to the region from many sources, at many points in time. Maize, migrating southwards from its original Mexico several millennia ago (Pearsall

2008), maintains a key role in the *chakra*, but this “mother grain”, as it is called in Quitugo, is surrounded by Andean domesticates as well as Old World immigrants. The importance of Saint’s days in structuring the year reflects Catholic influences, while the dialogue with Mother Earth displays a deep appreciation of human dependence on the good will of the natural environment with pre-Columbian roots (Chapter 9).

The patterns draw up the contours of a largely self-sufficient food system. A diverse portfolio of crops provided fresh products during parts of the year, and surplus production is dried and stored for the remaining periods. The diversity of crops and cropping cycles meant that if something failed, something else was still likely to yield. The most food insecure period would be between New Year’s and the onset of the next harvest around Easter; this time also used to be called *yarkay tiempu* – hunger time. If stores went low and the year did not “cross” (meaning that the previous year’s stores would last well into the new harvest), people would then recourse to wild potatoes (*ara papa*; *Solanum* sect. *Petota*) and greens (*yuyukuna*).

3.3. Reconfigurations

3.3.1 Sociocultural Changes

During the second half of the 20th century, life in Quitugo changed in many ways. Through national reforms of the 1960s and 70s, community members were relieved from forced work on nearby haciendas, and gained rights to their land (Becker 2008; Moates and Campbell 2006). But over time the number of inhabitants grew, and since, according to local norms, a family’s land was redistributed between all descendants at each generational shift, land holdings per household declined. The availability of alternative foods for purchase increased; in addition to the stores and markets of the nearby towns of Cotacachi, Quiroga and Otavalo, some community households opened up small shops in one of their rooms, selling pasta, rice, flour, sugar, candy and bottled soft drinks. Such items – associated with urban and mestizo high prestige – gained ground in community kitchens. But, of course, buying foods required cash: along with this development people began to seek wage work, and today nearly all households have members working off farm[25]. Several of the community's male members began migrating weekly to Quito for construction work. Some sons and daughters moved as far as to Spain. Children began going to school in the town of Cotacachi, some continued on in farther towns. TV sets and cell phones were common by the end of the century. In many ways, life branched out – the connections to and dependences on farther places grew stronger. But all these new connections left less time and energy for engaging in agriculture and brought competing ideas and worldviews that rendered the old beliefs guiding agriculture as "superstition". In conjunction, these developments contributed to reconfigurations in the patterns of agriculture.

3.3.2 Reconfigurations in the Design of a Chakra

By the millennium shift, a "full" *chakra* (Figure 3.1), was a seldom sight in Quitugo. Most people had stripped the crop portfolio down, scratching the labor demanding quinoa and lupines (Figure 3.6), or even also faba beans, peas and bush beans. Many *chakras* were thus left with only maize, climbing beans and squash (Figure 3.7). Lack of land made it hard to fallow – a household with only one parcel could not, if they were to harvest anything at all. The solution for many became to let the land rest during summer instead of growing peas or potatoes in between the harvest of the maize intercrop and its next planting. This, of course, implied a further

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[25] Our survey showed that in 2009, 95% of Quitugo's households had at least one member working off farm (N=20).

simplification of the diversity of crops grown by the household. Also, fewer planted fields of other crops such as oca, wheat, barley and lentils.

3.3.3 Reconfigurations in the Yearly Calendar

The reductions in the number of fields and the number of crops grown decreased the labor pressure through the year. The result is a much simplified and less eventful agricultural calendar (Figure 3.8) when one compares it to that practiced when today's grandmothers were young (Figure 3.5). Concurrently, the number of religious holidays observed and celebrated was reduced.

3.3.4 Reconfigurations in Scheduling and Division of Labor

By the year 2000, the strict conventions patterning field work through the week were no longer observed as they once had been. The beliefs were no longer given as much weight, and people would fit the tasks into their schedules "when they could", in between off-farm work, organizational duties, the follow-up of children's education, more frequent journeys to town. Gender roles were also somewhat blurred, as men's longer-distance off farm work left women with more of their responsibility. Neighbors joined together to rent tractor entrepreneurs to come plow their fields[26], and they indeed "came when they could" and not when Mother Earth called them to. Tractors did not work according to former patterns of field preparation (Fig. 3.4), but worked the fields in broad, heavy strokes.

[26] In the year 2009, 95% of households (N=20) hired tractors for field preparation.

3.4 Discussion and Conclusion

The agricultural patterns we have sketched above illustrate the intricacy of former days' farming in Quitugo – as it was practiced at the past century's high noon. By carefully laying out seeds and work in space and time, farm families maintained a sustainable, highly diverse food production system, covering most of their nutritional needs. As we have explained more in detail elsewhere (Chapter 9), this system was embedded in a world view – or *cosmovision* – instilling a strong awareness of agroecological interdependencies. Over time, practical experiences have been cemented in knowledge and beliefs, and even though scientific inquiries may explain phenomena by different rationales, the practices implied by local beliefs remain valid and effective. The ecological soundness and sustainability of agriculture in Quitugo resonates with ethnoecological research from a range of settings (Anderson 2011; Berkes 1999; Conklin 1957; Nazarea 1999; Rappaport 1968; Rhoades 2007).

We have further pointed to how several sociocultural developments contributed to reconfigure agriculture's patterns during the 20th century's last decades. As communitarians' lives became more interlinked to external places and processes, the structures of Quitugo's agriculture were simplified. Diverse *chakras* were converted to simpler ones composed of fewer crops. The number of successive plantings through the year was reduced, and with it subsequent work sessions with tending and harvesting crops also decreased. Former guides regarding which days were suited for what tasks were no longer followed by all. While processes of genetic erosion – or the loss of crop diversity from farmer's fields – often have been linked to agricultural modernization and the spread of modern varieties (Fowler and Mooney 1990), the simplification occurring in Quitugo can for the most part only be related to this development indirectly, via a growing accessibility of cheap food alternatives derived from external large-scale agricultural production. The simplifications of Quitugo's fields should be understood in relation to changes in the knowledge, beliefs and values guiding people's lives: new livelihood sources required different kinds of knowledge, and education and mass media provided alternative beliefs and values. In the light of these alternative ways of viewing the world, the lessons of elders lost credibility and the earth-derived diet was deemed unworthy – rather people were attracted to urban, modern, mestizo habits and convenient, store-bought foods. The demand for home-grown diversity and the dedication to field labor accordingly waned, ultimately resulting, not in the abandonment of agriculture altogether, but, in simpler forms.

This paper started out by asserting the resilience of Andean agriculture through the past millennia. Are the simplifications shown above a sign that this deep-rooted practice is about to be dissolved in Quitugo? That the knowledge and seeds sedimented by the work and life of countless generations are about to erode and be swept away in the favor of a full engagement with other, urbanized lifestyles and livelihoods? If it were not for some recent developments at the entry of the new millennium, we might have felt forced to conclude so. Despite the simpler patterns, most households in Quitugo today continue to grow their fields out – and they express that they value growing at least part of their own food. Our further research shows that even if many farmers of Quitugo and neighboring communities maintain rather scant crop portfolios in comparison to former generations, some grow out more than others, and collectively, the diversity present is still substantial (Chapter 2). The entry of the new millennium marked the inception of countertrends, through which the indigenous, rural, and locally grown rose in esteem and value (Chapter 4). Thus, through the very recent years, some traditional crops have actually grown in extent, and new ones have been added (Chapter 5). Although former patterns are unlikely to reappear, the current simpler ones may again grow more complex.

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3.6 Tables and Figures

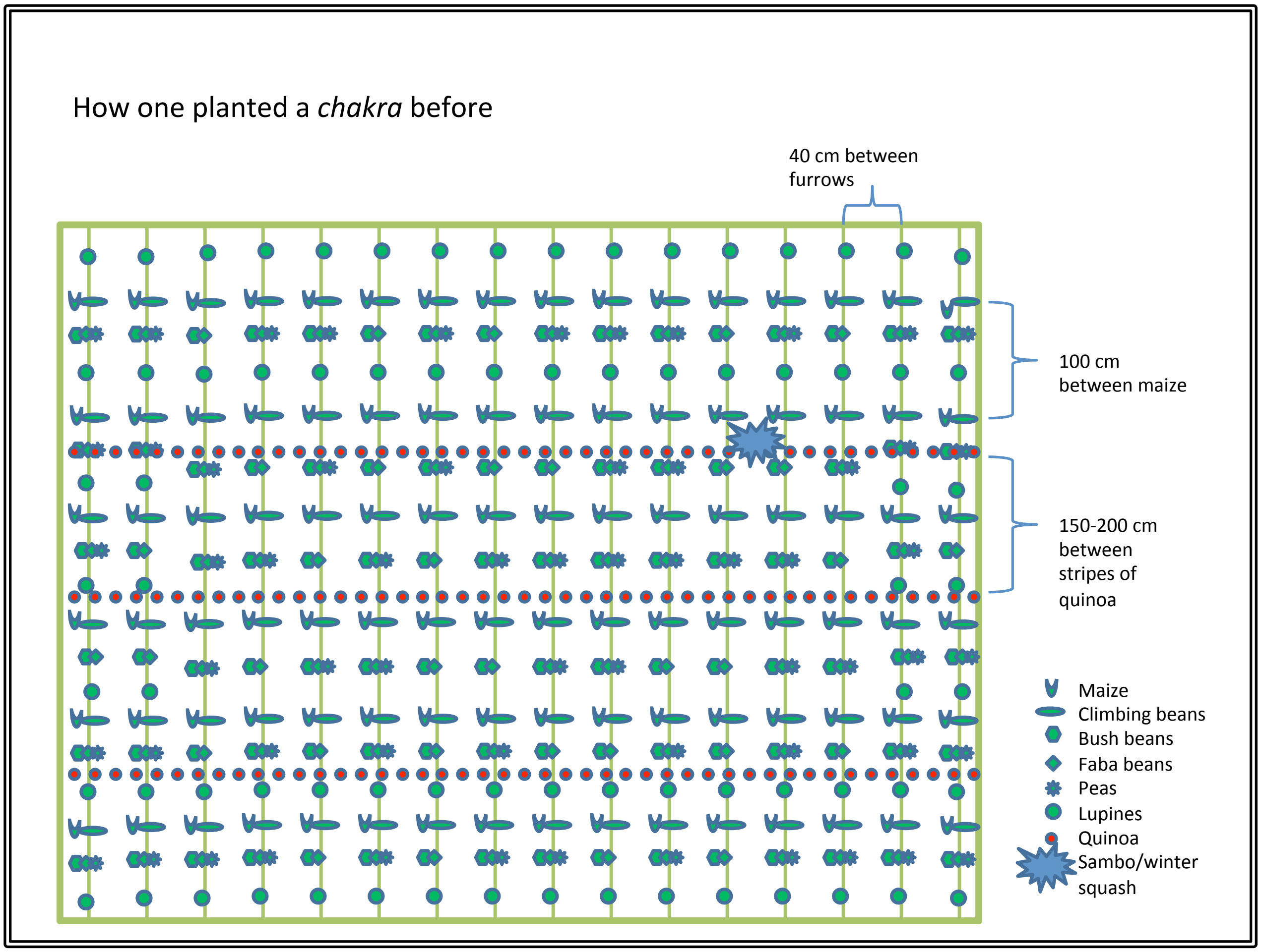

Figure 3.1: A schematic overview of how an "archetype" *chakra* was planted in the mid-20th century.

Figure 3.2: Rosa Ramos and her son Yoel planting a *chakra.* Holes are made with the wooden *palentra*, she plants maize seed carried in a cloth tied around her waist and he throws in seeds of climbing beans carried in a pot.

Figure 3.3: Beans climbing on maize stalk.

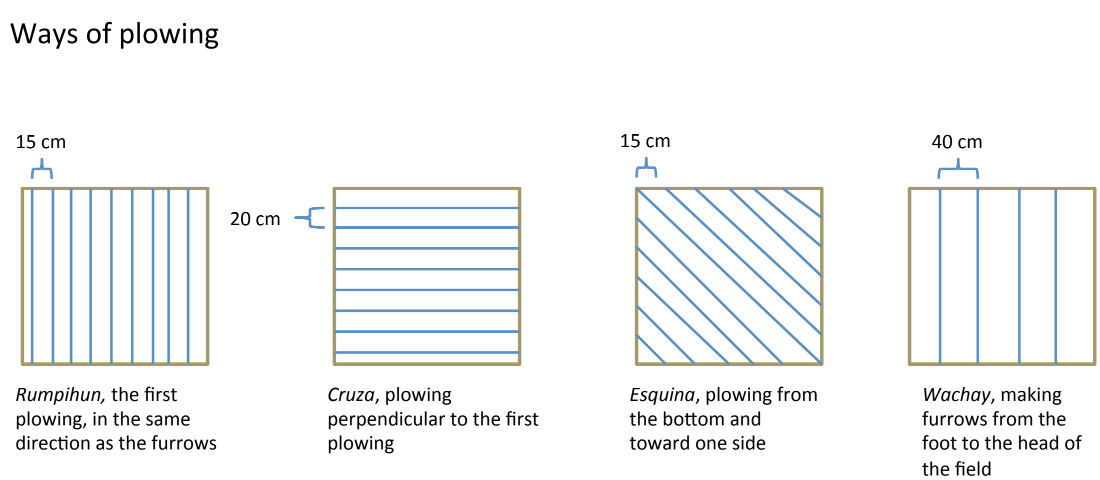

Figure 3.4: Schematic overview of different stages in the preparation of a field, using either hoe and hand power or a cattle-powered plow. See text for further explanation.

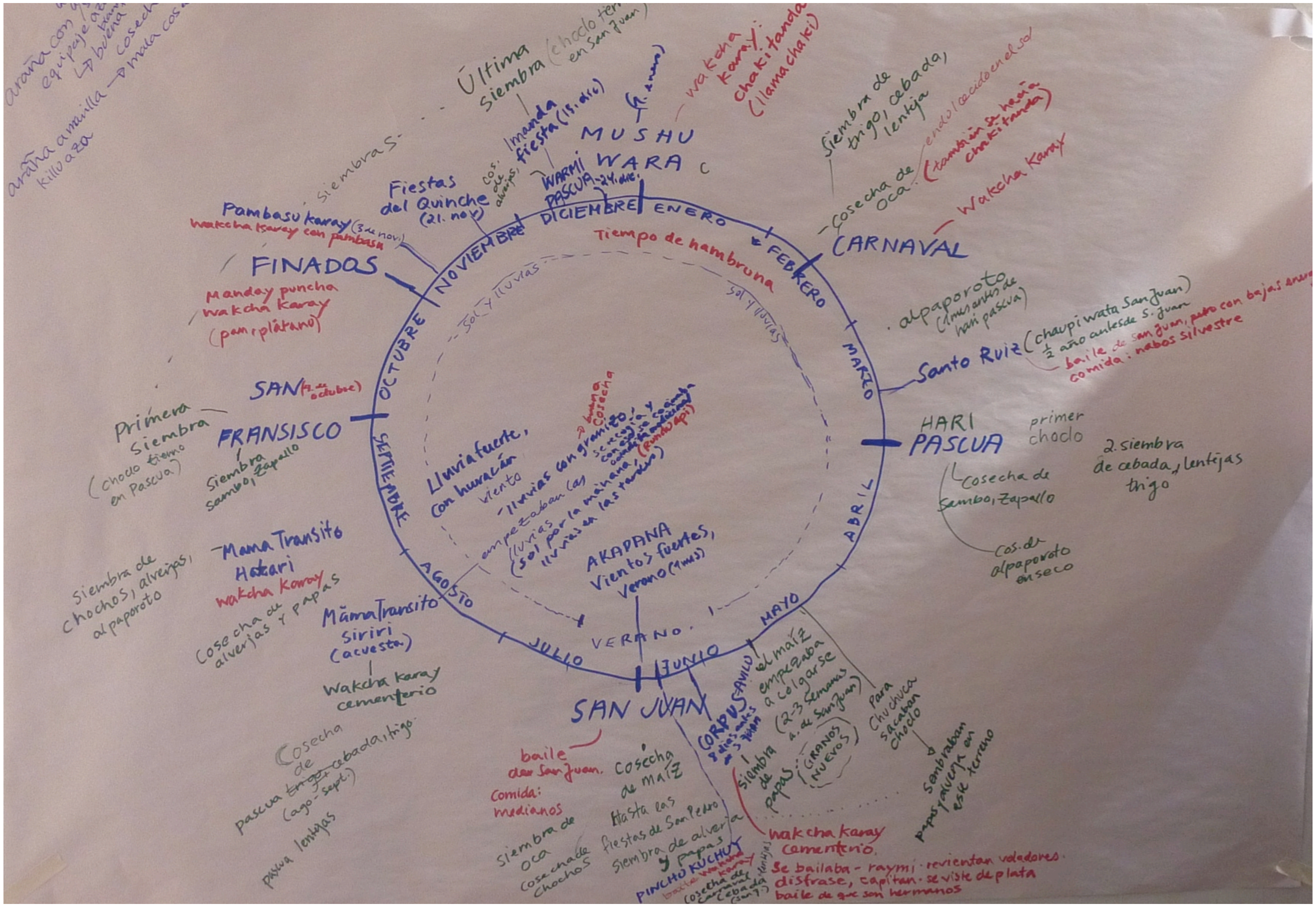

Figure 3.5: The "traditional" agricultural calendar, as it was practiced in Quitugo in the mid-20th century. Key: Blue letters: religious holidays, red lower-case letters: religious-cultural activities, green letters: agricultural activities. (Text inside of the circle denotes normal climate patterns during this period)

Table 3.1: Agricultural activities through the week, according to the beliefs of Quitugo's elders.

Day English	Day Kichwa	Translation	Field activities	Explanation
Monday	Alma puncha	Soul day	One should not plow, sow, nor harvest. The only thing one may do is weed and ridge.	This day is dedicated to the deceased. If one weeds, the weed will wilt rapidly.
Tuesday	Wiñay puncha	Sprouting day	One may sow. One may harvest.	Mother Earth is fertile. This day is also good to harvest, because it is a day dedicated to the health of God.
Wednesday	Lancha puncha, kari puncha	Plant disease day, man day	One should not sow, but one may plow.	Plant diseases will attach plants. This day is the day of the week when the men start working (plowing).
Thursday	Aya puncha	Devil day	One should not sow, but one may plow.	One should not sow because all the grains will turn dark, or rot.
Friday	Wiñay puncha	Sprouting day	One may sow. One may harvest.	Mother Earth is fertile. This day is also good to harvest, because it is a day dedicated to the health of God.
Saturday	Yarkay puncha	Hunger day	One should not sow, nor harvest, but one may plow.	Mother Earth is hungry, and so what one sows does not grow well. If one harvests, the *granos* will rapidly be spent.
Sunday	Pishku puncha	Bird day	One may sow.	All the birds have gone to mass, so they will not eat the planted seeds. This day is also a day of reception, and it is good to sow.

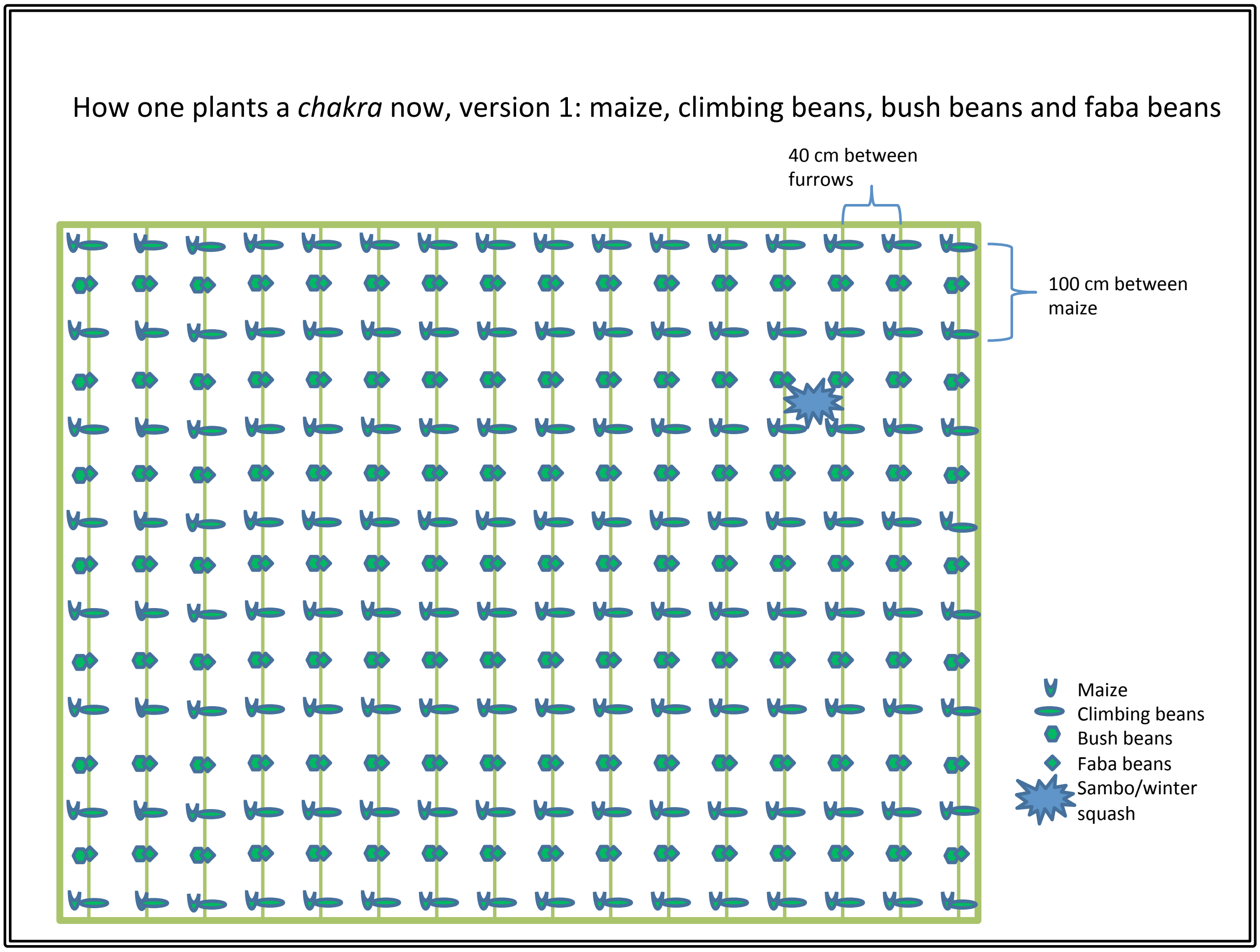

Figure 3.6: A schematic overview of how a typical *chakra* was planted at the end of the 20th century.

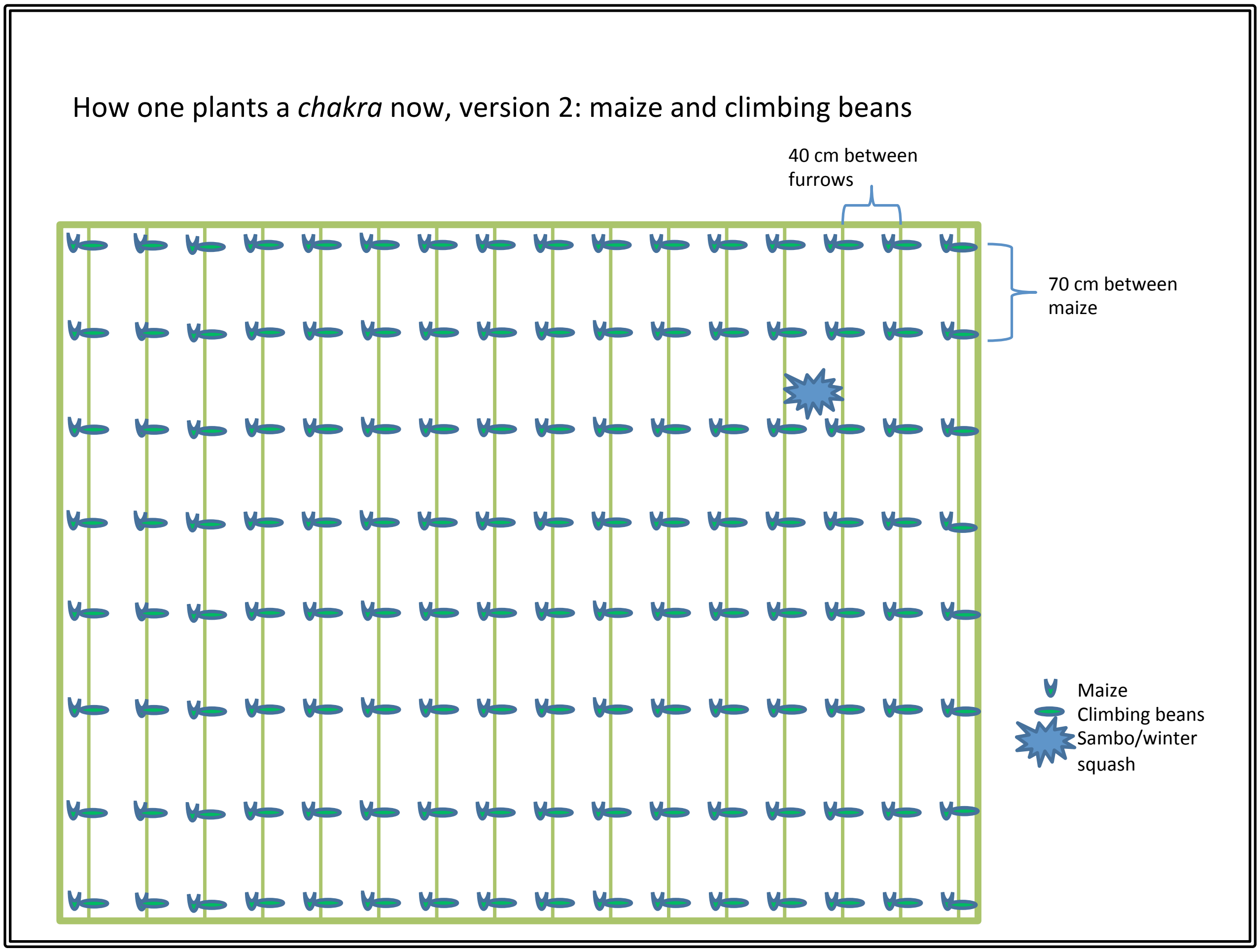

Figure 3.7: A schematic overview of how an even simpler *chakra* was planted at the end of the 20th century.

Figure 3.8: The “modern” agricultural calendar, as it has been practiced in Quitugo since the 1990s. Key: Red upper-case letters: religious holidays, red lower-case letters: religious-cultural activities, green letters: agricultural activities. (Text inside of the circle denotes weather during 2008-2009.)

CHAPTER 4

BITING IN AND EATING BACK:

FORMER AND CONTEMPORARY CURRENTS IN COTACACHI'S FOODSCAPE[27]

[27] Skarbø, K. To be submitted to *Food and Foodways*.

Abstract

This study examines reconfigurations in the foodscape of Cotacachi, Ecuador. In the Andes, certain kinds of foods have been denigrated due to their association with discriminated rural and indigenous parts of the population. However, recent years have witnessed earthquakes in long dominant sociopolitical structures, and in this process, the meaning and value of the rural and indigenous is being recast in a more positive light. The present study asks whether this recasting also extends to people's thoughts about and choices of food. Data are drawn from interviews, dietary recalls and participant observation during 12 months of fieldwork in Cotacachi in 2009 and 2010. The study shows that non-local foods have gained a prominent place in the diets of rural residents during the past generation, a process partly related to the prestige linked to these kinds of foods. Yet, as of recent, both rural and urban parts of the local population look at local and traditional foods in a new perspective, and seek to include more of them in their diets. This shift in the values attributed to different food types is linked to the build up of indigenous and peasant movements locally as well as internationally.

4.1 Introduction

The present study sets out to examine recent reconfigurations in the foodscape of Cotacachi, Ecuador. Research from diverse geographical regions has demonstrated food's powerful role as a marker of sociocultural difference and group identity (Appadurai 1988; Gabaccia 1998; Goody 1982; Moisio, et al. 2004; Roseberry 1996). From the Andes, Graham (2003) explains how in Ura Ayllu in Southern Peru, locally grown foods are referred to as *yana mikhuy* (black foods), whereas those brought in and sold in stores are called *yuraq* or *misti mikhuy* (white or *mestizo* foods). A related kind of food conceptualization has also been noted in Ecuador (Weismantel 1988). The former category has typically been associated with indigeneity and rural backwardness in contrast to the latter foodstuffs' symbolic link to mestizoness and urban sophistication, echoing the discrimination of and inferior status allotted indigenous and rural populations in other contexts of Andean society (Orlove 1998). It has been suggested that, among other factors, the growing importance of non-local foods in rural areas might also be related to the high prestige with which they have been associated; since, in the Andes, ethnicity is very much a fluid and relative concept, people may move toward mestizoness through changing their clothing, their hairstyle, their lifestyle, and, through ingesting store-bought foods (Orlove 1987). Foods' symbolic meanings, then, again affecting people's choices of what to eat, have been layered upon sociopolitical structures of a region that population-wise has been dominated by poor Indian peasants, but politically and economically directed by wealthier white or mestizo landowners and city dwellers.

During the recent past, however, the Andean sociopolitical landscape has been drastically shaken. After centuries of discrimination and exclusion from political arenas, indigenous and peasant groups have consolidated grassroots social movements, and their leaders have entered government bodies on all levels (Laurie, et al. 2005; Selverston-Scher 2001). Studies have shown how this broad process also extends to cultural dimensions, provoking a creative revival of things indigenous in rituals and celebrations (Wibbelsman 2009), dance performances (Mendoza 1998), beauty pageants (Rogers 1998), clothing (Van Vleet 2005) and language (Viatori 2007). Yet, little research attention has been devoted to examining possible related changes in the realm of food. Paulson's (2003; 2006) recent work from Bolivia represents an important exception. She describes the emergence of intensified ritual meals during town fiestas and national politicians' newfound public identification with and embracement of regional foods, indicating a departure from the above described deep-held negative casting of indigenous and rural food, toward new and more positive symbolic values.

In the present study, I seek to examine whether recent sociopolitical restructuring has had any effects on the foodscape in the Ecuadorian Andes. To shed light on this question, I seek insight into changes during the past generation in both how people think about food and what they actually eat.

Below, I will start with a brief description of the study area and the methods employed. Following this, I will present results on how food is conceptualized in Cotacachi, beginning with an account of changes in diet through the past generation. I go on to discuss how people have "bitten into" not only mestizoness but also the opposite poles of other dimensions through changing their food habits through the past decades. I then report current reactions to this process, and explain how both mestizos and indigenous people today are beginning to "eat back" the other way. I finally discuss the background for this countertrend, and conclude that while the concepts ordering the realm of food have remained rather stable through these processes, the values attached to the different foods have changed. In the epilogue I invite the reader to cook up some good old potatoes with watercress.

4.2 Study Area and Methods

4.2.1 Study Area

The fieldwork for this study was carried out in the *cantón*[28] Cotacachi, located approximately 80 km north of Quito in Ecuador's northern highlands. While the *cantón* also encompasses a subtropical region, the research was focused on Cotacachi's Andean part, and area covering 219 km^2 and an altitudinal span of 2080-4939m. Of this area's approximately 25,000 inhabitants, close to 15,900 reside in 43 rural communities situated on the eastern slopes of the dormant Cotacachi volcano (INEC 2011; UNORCAC 2007). There are also three urban centers, the largest of which also bears the name of Cotacachi. The majority of rural residents identify as indigenous Kichwa, while the most common ethnic identification in the urban areas is mestizo. Some rural households carry out commercially oriented agriculture, while the majority's production is subsistence-oriented. Many households have members that also engage in off farm work, either in nearby towns or in more distant places on a migratory basis.

4.2.2 Methods

This paper draws on 12 months of fieldwork in Cotacachi during 2009 and 2010. Main methods include food-centered life history interviews (n=10), semi-structured interviews with farmers, including dietary recall exercises (n=89), interviews with representatives from governmental and non-governmental organizations (n=12), and participant observation. Food-

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[28] *Cantón* is the second level geographical administrative unit in Ecuador. The country consists of 24 *provincias*, each of which is comprised of a number of *cantones*.

centered life history interviews (Counihan 2004; Nazarea 1998) with mestizo and indigenous men and women focused on how food had changed during the past generation, from people's childhoods and until today. Semi-structured interviews with 23 male and 66 female farmers of different ages from five communities selected to represent different geographical and agroecological zones of the study area gave a broad base for understanding how people conceptualize and consider food. Dietary recall exercises (Lee and Nieman 2007) in the same farm households provided data on what people actually eat. Interviews with representatives from different institutions working in the region provided information on their agendas, activities and observations of the present food situation. Finally, throughout the year I lived with a family in the community of Turuco, and both there and in other communities participated in a variety of food-related activities in fields, compounds, kitchens and community buildings. I also took part in meetings, markets and meals in Cotacachi's urban areas. These experiences were documented in daily field notes and provided a wider lens through which to interpret Cotacachi's foodscape.

4.3 Conceptualizing Food in Cotacachi

In the research it became clear that, like what has been found in other Andean areas (see section 4.1), different foods conceptualized as representing or belonging to different ethnic groups – they can be mestizo or indigenous. Yet is is not the sole domain of dietary distinction; interviews, discussions and conversations revealed that the local foodscape contains a host of partly overlapping and subtly differing dichotomic categories, existing at the poles of different conceptual axes. Some of the most common ways to conceptualize the realm of food are listed in Table 4.1. Each line represents a contrasting pair of categories. Thus, "the food of before" is contrasted with "the food of now", and "the food of the indigenous" or "our food" is juxtaposed to “the food of the mestizos”. Further, “rural food” is opposed to “town food”, and “home-grown food” to “purchased food”. “*Granos*” or “*murukuna*[29]”– a term strictly standing for all the local crop products that can be shelled (i.e. grains and legumes), but which is also frequently used to encompass locally grown tubers, roots, squashes, and even wild greens – may, depending on the context, be contrasted with “*karishina* (man-like) food”, “treats”, “light food”, “store food”, or “center *granos*” (non-locally produced starches). Finally, as has been found in previous studies (Camacho 2006; Weismantel 1988), foods are conceptualized as either wet or dry. As we shall see in what follows, the foods contained in the categories listed in each of the two columns in Table 4.1a-c tends to be similar. Thus, the food of before bears closer similarity to indigenous food, to rural food, home-grown food, grandmother’s food, *granos* and liquid foods. On the other hand, the food of now is more related to mestizo food, town food, store food, center *granos*, *karishina* food, treats, light food, modern food and dry food.

Each of these contrasting pairs represents a different dimension (Table 4.2). Thus, food is conceptualized in relation to time, ethnicity, geography, mode of obtainment, properness, quality and substance. In the pages that follow I will, aided by quotes from a range of interviewed people, provide a more detailed description of some of food’s most central conceptual dimensions in Cotacachi. I start with the time dimension, including a detailed account of common dietary patterns one generation ago and today.

[29] *Granos* is an originally Spanish term corresponding to *murukuna* in Kichwa. In this text I will refer to *granos*.

Table 4.1a: Contrasting pairs of food categories (English).

Dichotomy A	Dichotomy B
Food of before	Food of now
Indigenous food	Mestizo food
Our food	Mestizo food
Rural food	Town food
Rural food	Store food
Granos	Store food
Granos	Center *granos*
Granos	*Karishina* food
Granos	Treats
Granos	Light food
Traditional food	Modern food
Soup	Dry food

Table 4.1b-c: Contrasting pairs of food categories (Kichwa to the left and Spanish to the right).

Dichotomy A	Dichotomy B
Ñawpa mikuna	Kunan mikuna
Runa mikuna	Mishu mikuna
Ñukanchik mikuna	Mishu mikuna
Pampa mikuna	Llakta mikuna
Pampa mikuna	Tienda mikuna
Murukuna	Tienda mikuna
Murukuna	Llakta murukuna
Murukuna	Karishina mikuna
Murukuna	Hillu mikuna
Murukuna	Pankalla mikuna
Alli mikuna	Mushu mikuna
Api	Chakishka mikuna

Dichotomy A	Dichotomy B
Comida de antes	Comida de ahora
Comida de indigena	Comida de mestizos
Comida de nosotros	Comida de mestizos
Comida del campo	Comida de la ciudad
Comida del campo	Comida de la tienda
Granos	Comida de la tienda
Granos	Granos del centro
Granos	Comida de karishina
Granos	Golosinas
Granos	Comida liviana
Comida tradicional	Comida moderna
Sopa	Seco

Table 4.2: Dimensions of food.

Dimension	Dichotomy A	Dichotomy B
Time	Before	Now
Ethnicity	Indigenous	Mestizo/white
Geography	Rural/periphery	Center, city
Origin	Land, earth	Store
Obtainment	Self-grown	Purchased
Age	Grandmother	Young woman
Properness	Proper	*Karishina*
Quality	Food	Treat, sweet (*golosina*)
Substance	Substantial food	Light food
Tradition	Traditional	Modern
Wetness	Wet	Dry

4.3.1 Time: Before and Now's Foods

4.3.1.1 The Food of Before

> I grew up with my grandparents on both sides. (…) In that time, the food was…better. Because my grandmothers did formerly to buy either rice nor noodles, they did not know them. They thought those foods were only for the mestizos. And furthermore, in those times, I remember that it ripened in quantities in the community. All kinds of granos, everything there is, everything. The maize, the beans, peas, faba beans, sambo squash, winter squash, lentils, oh, various things, melloco, oca, barley, wheat, oh, quantities ripened there. (…) And the quantities there were we cooked, and we did not buy anything.
>
> Carmen Cumbas, 47, Tunibamba

Four decades ago, most of what was eaten by the Kichwa populating Cotacachi's rural communities was home grown: a diet based on whole grains (maize, wheat, barley, quinoa), legumes (beans, lupines, peas, lentils), roots and tubers (potatoes, melloco, oca, sweet potatoes, mashua, mauka), squashes, wild greens, chili peppers and an occasional festive hint of meat[30]. Planted fruit trees were few, but wild ones (passion fruits, goldenberries) were enjoyed by children, and sometimes blueberries would be gathered in the páramo. Crops would ripen at different points in the agricultural cycle (Chapter 3), and one by one be brought home to be shelled, sorted, stored, washed, soaked, ground, sifted, peeled, chopped, for then to be transformed into food. The main form of preparation was the soup (*api*/*sopa*)[31], ranging from a thick *api*/*colada* to a brothy *mishkichi*/*caldo,* always slow-cooked in large pots over wooden fire, and often accompanied by toasted maize kernels (*kamcha*/*tostado*), popcorn (*kankil*/*canguil*) or sometimes hominy (*muti*/*mote*). Soups could be savory or sweet, depending on the ingredients and seasoning. In addition to the main ingredient (a grain, legume, squash, tuber or root), savory

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[30] See Chapter 2 for an overview of Kichwa, Spanish and botanical crop names.

[31] Many terms exist locally in both Kichwa and Spanish versions. In this text, terms from both languages are written in italics. When two subsequent terms are separated with a slash (/), the first one is Kichwa and the second Spanish.

soups could be added wild greens, and perhaps a little lard, some beans, and peeled, chopped potatoes or other tubers. Sweet soups would be seasoned with aromatic herbs and milk. Table 4.3 gives an overview of some common soups. On the other hand, non-soup "dry foods" (*chakishka mikuna*/*secos*) would be prepared when one needed to take food away from home: to bring to the field during harvest time, to bring to the cemetery[32] or to serve visitors during the long celebration of the harvest festival *Inti Raymi*/*San Juan* in June. Such *secos* were also commonly served during March and April when many crops became ready for harvest in a fresh, immature state. They consisted of toasted or boiled and drained grains, legumes or tubers, boiled wild greens, sauces made from ground squash seeds and sometimes grilled meat. Table 4.4 shows a list of *secos*. Often a sauce made from fresh, ground chili pepper (*uchu*/*ají*) would be offered with both soups and dry dishes. Breads and bread-like products were prepared from maize or wheat (Table 4.5). These were steamed, grilled or toasted in a dry clay vessel (*kallana*/*tiesto*), without the addition of any cooking fat. An additional ingredient was *machka*/*máchica* – toasted barley ground into flour and mixed with hot water or milk and sometimes shredded *panela* (raw sugar product) for a snack or breakfast food. What was not grown by the household was obtained through in-kind recognition of labor or through exchange – either through non-ritualized direct exchange of goods (*trueque*), or through more complex ritualized relationships typically tied to the establishment and maintenance of fictive kin bonds. The better-off keeping cattle or pigs would also be self-sufficient with lard; salt was the only product that would have to come from afar.

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[32] According to local rite, people visit their passed-away family members on the cemetery on certain days. This act is called *wakcha karay*, and was a couple of generations ago practised at different religious dates throughout the year. The most important *wakcha karay,* still practiced by many Cotacacheños, is on All Souls' Day (Nov. 2); like in other parts of Ecuador and the rest of the Catholic world, people from all over Cotacachi flock to the cemeteries on this date. They bring food with them, which is handed out to friends, relatives and acquaitances, turning the graveyards into sites for festive celebrations.

Table 4.3: Traditional soups (*apikuna*/*sopas*).

Kichwa	Spanish	English
Aminda apikuna	*Sopas de sal*	*Savory soups*
Uchu api	Mazamorra	Soup based on flour of toasted maize, faba beans and/or peas
Alwirhas mishkichi	Locro de alverjas	Pea soup
Purutu mishkichi	Locro de fréjol	Bean soup
Papa kaldu	Locro de papas	Potato soup
Chuchuca	Chuchuca	Soup based on maize harvested when it is "*kao*" (on the midpoint between its fresh and dry stage), boiled, dried in the sun and ground lightly.
Aminda/mishki apikuna	*Sopas de sal/de dulce*	*Sweet/savory soups*
Sampu (aminda/mishki) api	Locro/colada de sambo	Sambo squash soup
Sapallu (aminda/mishki) api	Locro/colada de zapallo	Winter squash soup
Kinuwa (aminda/mishki) api	Sopa de quinoa	Quinoa soup
Arus siwara (aminda/mishki) api	Sopa de arroz de cebada	Crushed barley soup
Triku (aminda/mishki) api	Sopa de trigo	Wheat soup
Muruchu (aminda/mishki) api	Morocho	Soup made from a special flint type maize (*muruchu*/*morocho*), ground lightly
Mishki api	*Sopa de dulce*	*Sweet soup*
Champus	Champus	Soup made from fermented raw maize flour

Table 4.4: Traditional dry dishes (*chakishka mikuna*/*secos*).

Kichwa	*Spanish*	*English*
Purutu kamchawan	Fréjol con tostado	Beans with toasted maize
Alwirhas kamchawan	Alverjas con tostado	Peas with toasted maize
Papa yuyuwan	Papas con berro	Potatoes with wild greens
Kamcha yuyuwan	Tostado con berro	Toasted maize with wild greens
Hapas kamchawan	Habas con tostado	Faba beans with toasted maize
Muti papawan	Hominy con papas	Hominy with potatoes
Kuy (kusana)	Cuy asado	Grilled guinea pig
Wakra aycha	Carne de res asado	Grilled meat

Table 4.5: Traditional bread products (*tantakuna*/*panes*).

Kichwa	*Spanish*	*English*
Chukchu tanta	Humitas	Steamed bread made from fresh, ground maize wrapped in maize husks
Chaki tanta	Pan de patas	Steamed bread made from dry, ground maize wrapped in maize leaves
Turtillas	Tortillas	Tortillas (flat bread from either wheat or maize flour, cooked in a dry ceramic vessel over wood fire [*tulpa*])
Muzi kitarra	Muzi guitarra	Bread made from fresh, ground maize wrapped in leaves of *atzera* and grilled

Four decades ago, this was the *food of the indigenous*, sustenance for toiling bodies, but low class, devalued and denigrated along with other symbols of indigenous identity (cf. Orlove 1998; Weismantel 1988). At its opposite symbolic pole stood the food of the mestizo-whites – rice, fried meat, bread – light, urban and prestigious.

4.3.1.2 The Food of Now

> Later, I remember that my sisters left to work, and the mestizos came to exchange products. They brought rice or noodles, and they exchanged it for fresh maize, for winter squash, for potatoes, like that. The mestizos came to exchange. There they took and ate. But my grandmother did not know how to cook rice, she did not know, and she asked the mestizas, 'how do you do it?' Because she did not know how to cook it.
>
> Carmen Cumbas, Tunibamba

> Now they don't eat like before anymore – *chuchuca*, beans, potatoes. Now it is only noodles and rice. Beans with rice, lentils – *buying* they eat – fried eggs.
>
> María Dolores Rosero , 67, Peribuela

Over the years, people tell, things began to change. New and initially mysterious and alluring foods began to come within reach, either through exchange relationships with mestizo town dwellers, many of whom were bound to rural households through ties of *compradrazgo* (ritual kinship), or through government programs of food aid. Young girls went off to Quito taking posts in wealthy households and came back with new cooking skills and ideas about food. Populations grew, land became scarcer, and expenses requiring cash appeared: education, consumer goods, even new cooking tools. People began to engage in off farm wage work and buy part of their food. Looking back in time today, people point out several concurring changes, when it comes to ingredients, cooking, and kitchen space.

4.3.1.2.1 Ingredients

In terms of ingredients, people first and foremost point to the decreasing role played by *granos*. There are less *granos*, and in their place there are other, new ingredients – most importantly rice, noodles and spaghetti[33]. But the list of novel foods is longer: Table 4.6 gives an overview of ingredients that have entered kitchens during the past decades, compiled from life history interviews, participant observation and a survey. In the survey, 36 people were asked to list some newer foods. As many as 32 of these 36 listed rice and 26 mentioned rice first, underlining the central role of this food item among "new foods". The other most frequently mentioned foods were noodles (26), spaghetti (11) and oatmeal (5). These are all ingredients that replace locally grown *granos* in people's food. Rice is perhaps the most versatile newcomer; it is a common main ingredient in savory soups, but it may also be used to make a sweet, milk-containing soup. Most often, though, it is boiled and drained and served as a *seco* accompanied by one or more of a variety of ingredients, such as boiled and drained lentils, beans, potatoes or spaghetti, sometimes fried potatoes or eggs, or even some canned tuna or sardines. This kind of rice dish may once in a while also be combined with a dash of salad (*ensalada*), typically

[33] Two main type of wheat-based pasta products are commonly used in Cotacachi: *fideo* and *tallarín*. The first is a thinner, shorter type used in soups, and the second is thicker, longer and served boiled and drained. Here I translate *fideo* as noodles and *tallarín* as spaghetti.

consisting of red onions and tomatoes chopped finely and seasoned with lemon, salt and cilantro. Except for boiled potatoes, all of these side dishes are also new figures on the food scene. Noodles are used as the main ingredient in savory soups (*sopa de fideo*). Spaghetti is boiled and drained and served as a *seco*, often together with one or more of those listed above. Oatmeal is most often prepared as a sweet soup (*colada*), but may also be used as the base for savory soups.

People also point to the incorporation of vegetables in their food; items such as carrots, red onion, tomato, leaf beets, red beets, cauliflower and broccoli are now *relatively* common, while they were not before. They are most often used in soups, finely chopped and in limited quantities. As mentioned above, they may also be prepared raw in salads. These vegetables have in many cases replaced formerly more common wild and semi-cultivated/tolerated weeds and plants[34]. Vegetables are either purchased or planted. Over the past couple of decades, several non-governmental organizations (NGOs) have distributed seeds and promoted the establishment or expansion of home gardens with vegetables, fruits and herbs.

Fruits have also become more commonplace, eaten raw as snacks, or processed into juices (*jugos*) and lemonades (*limonadas*). Their high price makes them a luxury food and their consumption is more common among those with more cash. However, they are now increasingly planted in home gardens, augmenting their accessibility. Fruit juices to a limited extent replace *grano*-based *coladas*.

Another group of ingredients that have entered are new seasonings. Most important, perhaps, are the monosodium glutamate (MSG)-based flavor boosting powders including *maggi*, *aji-no-moto* and *sabora*, that are frequently added to soups. Spices such as cinnamon and cumin

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[34] Local wild and weedy greens include *yaku yuyu*/*berro* (*Nasturtium officinale*; watercress), *ataku/bledo (Amaranthus quitensis), paiku/paico (Chenopodium abrosioides), aliyuyu/nabo (Brassica rapa), ñawiyuyu/rábano (Raphanus raphanistrum), sapiyuyu/rábano (Raphanus raphanistrum),* as well as *ara papa* (*Solanum* sect. *Petota*; wild potatoes).

are today also common. These replace wild herbs that were more frequently added earlier. Fresh onions have been used for a longer time, but people explain they were less common before. Cilantro and garlic are newer additions. Mayonnaise and ketchup are found in some homes. And sugar is a ubiquitous addition to herbal teas and *coladas*. The less refined sugar cane product *panela* is also used. People explain that before they either used *panela* or simply no sweetener.

Bread is another item that was not very common a generation ago. Purchased breads come in as breakfast and sometimes supper foods, replacing former bread-type products and soups. There are two main types of leavened breads: one denser, whole-grain containing type produced in adobe-ovens in rural communities, and a lighter, white flour based type made in downtown bakeries. The former is considered more indigenous and rural than the latter.

Two quite important new ingredients are cooking oil (*aceite*) and shortening (*manteca*). They replace the formerly more common lard, but they are used to a much larger extent than the latter because frying has become a more common way of cooking. Finally, cookies, candy and chocolate are now savored especially by kids; replacing wild fruits as special treats.

Data from dietary recall exercises confirm that new food ingredients now play a substantial role in the kitchens of Cotacachi's communities (Appendix at end of chapter). The most common breakfast food is bread (44%), and in lunch and dinner meals, the most often served soup is the noodle soup (19%), while the dominant *seco* ingredient is rice (contained in 70% of *secos*). Soups still outnumber *secos* in terms of proportion of lunch and dinner dishes, but considering people's explanations regarding the earlier peripheral and highly seasonal use of dry foods, the current relatively high portion of *secos* (37% of home-cooked meals) points toward a movement through the past decades from liquid toward dry meals. If one considers food also common prior to one generation ago "traditional" and those that have entered afterwards "non-traditional", and categorize the registered meals into one or the other depending on main component, about one fourth (23%) of breakfasts and a little less than half (44%) of lunch and dinner meals fall into the "traditional" category. However, if considering also side dishes, traditional foods play a larger role. In sum, present cooking combines elements of "the food of before" with "the food of now" in roughly equal amounts.

Table 4.6: New ingredients added to the kitchens of Cotacachi's communities during the second half of the 20th century.

Spanish	English	Use	Replacing
Ingredientes principales:	*Main ingredients:*		
Arroz	Rice	Seco	Grano-based secos
Arrocillo	Crushed rice	Soup	Grano-based soups
Fideo	Noodles [thin pasta type]	Soup	Grano-based soups
Tallarín	Spaghetti [thicker pasta type]	Seco	Grano-based secos
Avena	Oatmeal	Sweet soups	Grano-based soups
Lenteja	Lentils	Seco	Grano-based secos
Atún	Tuna [canned]	Seco	Grano-based secos
Sardinas	Sardines [canned]	Seco	Grano-based secos
Pan	Bread	Breakfast, supper	Other bread-products, soups
Grasas:	*Fats:*		
Aceite	Cooking oil	Frying/seasoning	Nothing/lard
Manteca	Shortening	Frying/seasoning	Nothing/lard
Azúcar	Sugar	Sweeten soups, herbal teas	Nothing/*panela*
Condimentos:	*Seasonings and sauces:*		
Maggi, aji-no-moto, sabora	Monosodium glutamate stock brands	Season soups	Wild greens, herbs
Culantro	Cilantro	Season soups, salads	Wild greens
Ajo	Garlic	Season	
Mayonesa	Mayonnaise	Sauce	Nothing/squash seed sauce
Salsa de tomate	Ketchup	Sauce	Nothing/squash seed sauce
Hortalizas y frutas:	*Vegetables and fruits:*		
Hortalizas	Vegetables	Soup, salads	Wild greens
Frutas	Fruits	Snack, juices	Wild fruits
Golosinas:	*Sweets:*	Snack	Wild fruits
Galletas	Cookies		
Caramelos	Candy		
Chocolates	Chocolate		

Table 4.7: New dishes added to the kitchens of Cotacachi's communities during the second half of the 20th century.

Spanish	English
Salchipapas	French fries with sausages
Papipollo	French fries with fried chicken
Hamburguesa	Hamburger*
Pizza	Pizza*
Carne al jugo	Stewed meat
Empanadas	Empanadas [deep fried wheat-based dough crust filled with cheese or meat sauce]*
Ensalada de frutas	Fruit salad*
Platos de arroz	Rice based dishes
Sopa de fideos	Noodle soup
Sopa de avena	Oatmeal soup
Sopa de maggi	*Maggi* powder packet-based soup

Note:
*Hamburgers and pizza are not prepared in community homes, but available for purchase in local towns. Although they are not commonly eaten by people from the communities, they were pointed out in workshops and interviews as "new foods". *Empanadas* are usually eaten as purchased snacks and typically sold at fairs, markets, football games, etc. Fruit salads are also not very commonly prepared in homes, but are sometimes purchased as a town snack. The other dishes are prepared in community homes.

4.3.1.2.2 Cooking

It is not only ingredients that have changed; people hold that the way of preparing food is also different today from what it used to be. The most radical addition in this regard may be that of gas-powered stoves. Up until recently a cooking set-up with deep roots dominated Cotacachi's communities: the *tullpa*. A fire is made between three stones, and the pot placed on top. Another version consists of a metal rack held up by stones on each side. Today gas-stoves are just as common, and most households have one. Even though gas must be purchased, many find it more convenient as firewood is scarce. The limited flame of the gas burner is not as powerful as that of the *tullpa*, however, and is more inviting for quick-made dishes. Consequently, the entry of the gas-stove change has fueled the increased role of pasta and rice in diets – they are much quicker to cook than their *grano* counterparts. On the other hand, this limited power of the new stoves lead many to many maintain a *tullpa* as well, necessary when large meals are to be prepared.

As mentioned above, frying has become a more common way of cooking. Nothing was really fried before; things such as *tortillas* were rather toasted in dry ceramic vessels (*kallana*/*tiesto*), meats were roasted or grilled, and vegetables and *granos* were boiled. When people talk about this change, a frequently cited example is toasted maize kernels (*kamcha*/*tostado*). This is an important food, many hold that it should accompany every meal, be it soup or *seco*. It is also a convenient food to bring along if one leaves for a trip. In reality, most people do not eat it so frequently, though. This is much due to failed harvests and high prices if one is to purchase maize. Toasted maize was earlier prepared by toasting it in ceramic vessels without any addition of cooking fat. Today it is commonly prepared in metal pans with oil or shortening and the addition of salt. The other example of change in the realm of cooking techniques people often point to is the decreased use of grinding stones. Two types exist: the large *kutana* (lit. grind) used primarily to grind flours, and the smaller *uchu rumi* (lit. chili pepper stone) used to grind chili peppers. Even if they still are in use, the reduced role of home grown *granos,* new cooking techniques and the entry of hand-powered mills and electric blenders (*licuadoras*) have decreased their importance. Despite these changes, some of the food patterns do remain the same: the day normally contains three main meals, and women now like before have the main responsibility for cooking and serving food.

4.3.1.2.3 Spatial Movements

Cooking has also moved spatially. The *tullpa* is typically placed in a separate kitchen hut away from the living quarters. Newer houses contain built-in kitchens with gas-powered stoves.

Still, the *tullpa* shed may be kept, since, despite all the convenience in the world, occasions like ritual celebrations and fiestas require large quantities of food that can only be prepared in wood-fired pots that are so big that a gas flame is just not enough. Another change involving both movement and implement is how food is eaten. Meals used to be eaten around the *tullpa*, where people would sit down close to the floor on benches or stools or woven *totora* mats. Now some houses are equipped with dining tables and chairs where meals are served.

In sum, new items that began to enter rural kitchens about a generation ago, and among them most notably bread, rice and noodles, play a central role in contemporary cooking in Cotacachi. At the same time, a variety of locally produced foods and traditional dishes are maintained. New cooking techniques and practices have been added, partly linked to the incorporation of new kitchen utensils. Finally, food is to a larger extent cooked and eaten inside the main house today, in contrast to earlier more common arrangements in separate kitchen huts.

4.3.2 Ethnicity: Indigenous and Mestizo Foods

> Most [indigenous] people eat only granos – faba bean flour, peas, beans, maize, wheat flour. The mestizos eat more meat, and in the town they eat more salads.
>
> Luis Gilberto Cavascango, 25, Peribuela

> They [the mestizos] eat more rice, potatoes, noodles, spaghetti, every day they have coffee, bread, every day. They no longer cook with firewood, everything with gas, and because of that too they no longer want to cook beans.
>
> Nicolas Chavez, 38, Peribuela

> The mestizos prepare with seasonings, and they add meat to every soup. The soup of the indigenous is very different.
>
> Francisco Guitarra, 41, El Batan

> Here we eat with *bledo* [*Amaranthus quitensis*, wild plant], wild radish. The mestizos only eat meat, and they only buy.
>
> Delia Sanchez, 47, San Pedro

> The mestizos, as they have a more facilitated economy, every day they eat meat, juices, fruits. And the food is always soup and seco.
>
> Humberto Chavez, 30, Peribuela

> The mestizos serve small dishes, with less food. We indigenous eat more, we cook more and we eat more.
>
> Maria Francisca Chavez, 88, San Pedro

Many of the factors people note separate indigenous (*runa mikuna/comida indígena*) from mestizo (*mishu mikuna/comida mestiza*)[35] food closely resemble comments on the differences between food before and now. For example, in relation to indigenous people, mestizos eat less *granos* and more purchased foods. Mestizos do not cook with firewood, but use only gas-fired kitchens. They use other seasonings: packaged spices and MSG flavor enhancers, garlic, cilantro. They eat more rice, noodles, fried potatoes and bread. They eat purchased food, rather than home-grown. All of these distinctions echo changes that, often by the same people, are identified to have occurred in indigenous kitchens over the past generation. Thus, as indicated in previous analyses from other Andean regions (Orlove 1987; Weismantel 1988), by adopting these ingredients and ways of cooking, Cotacachi's indigenous people have moved closer toward a more respected and prestigious mestizo identity.

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[35] *Runa/indígena* and *mishu/mestizo* are the ethnic categories most commonly referred to today in the Andean part of Cotacachi (in its lowland zone there are also many afro-ecuadorians). Sometimes, though, people also speak with other terms including *longos*, *indios* (both considered more derogatory and indigena more appropriate) and *blancos*.

There are, however, further differences – items and practices that fewer indigenous households have taken in. Some point out that mestizos eat more meat, more vegetables and more fruits. While vegetables and fruits have incremented their role in the indigenous foodscape as well, few say they now eat more meat. Mestizos "add meat and milk to the soup every day", while "we add meat only once a week" (Blanca Guandinango, 28, El Batan). And they eat *both* soup *and seco* for lunch – not just one or the other, as is the rule in indigenous households. Some say that they would indeed wish to eat more like the mestizos, but their economic situation does not allow them to. In this perspective, mestizos' food is richer, reflecting this group's relative economic affluence.

On the other hand, mestizo cooking is also presented as more skimpy, in contrast to abundant pots of indigenous kitchens. Well may there be only one dish, but there is enough food for everyone present. A farmer explains:

> The mestizos, it almost seems as they…because they don't *have*, it seems that they are only eating purchased things. Because of that it is different. We, on the other hand, since we *have*, we always cook what there is, and we cook plenty. About the mestizos, we say that they cook quite little, it must be because they buy everything. We, with workers, we prepare a *quintal* [sack of 100 pounds] of potatoes for two days. With the people, you know. That's it, people always like that one gives them a lot to eat. And if there are left-overs, we give them to the pigs. We have pigs, and dogs too. Because of this, we cook a lot.

Antonio Fueres, 51, Ugshapungo

According to this view, coming from a farmer used to working with own but also hired labor force, the mestizos are the have-nots – they have no own production, and thus are not able to cook generously. Others pointing in the same direction figure that it must be because they only cook with (expensive) gas that they cook such small quantities.

4.3.3 Geography: Campo *and Town Foods*

> In the *campo* they eat above all grains, legumes, and above all they eat what they themselves produce. There they eat above all soups. In the city, on the other hand, people eat hamburgers, sandwiches, something quick for the evening meal. But people in the campo continue eating soups for dinner.
>
> Hector Palacios, 39, Cotacachi

Close to the ethnic dichotomy between mestizo and indigenous food is the distinction between food in the *campo*[36] and food in the town. This is of course related to the fact that most rural dwellers are indigenous and most townspeople identify as mestizo. Although there are plenty of exceptions in both directions – rural mestizos and towndwelling indigenous folks – people sometimes use spatial references interchangeably with ethnic divisions. This is related to what Orlove (1998) found in his Peruvian research: Indian identity was perceived as closer to the earth and more rural, while mestizoness was linked to urban separation from the earth.

This dichotomy, though, is, like ethnicity, rather an axis: one's food can be situated closer to or further away from town. Thus, a woman living in a community near downtown Cotacachi commented: "We cook for instance rice, we cook potatoes, we prepare meat, we'll make a meat stew. So, when we go further into the *campo*, they give us a soup, some toasted maize, and they say: 'we don't eat like you do. We have no rice, no meat', like that. It as if they believe that we eat like…like kings'" (Woman, 55, Turuco). In this case, far out in the *campo* is equated with lack of cash causing inability to purchase meat and even rice.

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[36] The Spanish term *campo* corresponding to the Kichwa word *pampa* translates to "rurality", "countryside" and "field".

4.3.4 Properness: Proper and Karishina *Cooking*

Between and within indigenous kitchens, food regimes also vary in *properness*. There are women who maintain a more proper cooking and there are *karishinas*. *Karishina* is a Kichwa term composed of *kari* (man) and *shina* (like) – literally meaning man-like. A *karishina* is a woman who does not know or care to cook well – she likes to roam far away from the kitchen and household chores, and time-taking *grano* soups are not a mainstay in her home. This is not, however, because she is tending toward mestizo or city manners, she is just tending away from the common woman's role. *Karishinas* of former generations probably cooked other things, but the ultimate current example of *karishina* cooking is the noodle soup, thrown together in brief moment: water, noodles, a small package of *aji-no-moto* flavor enhancer, and perhaps a handful of chopped vegetables. Such *karishina* soups may also appear on the menu of normally more "properly" cooking women. When my host mother had been busy taking her children to the doctor or with other errands, she would rapidly cook a noodle-based soup for supper and excuse herself as she served it: "sorry, but today there is nothing but *karishina* soup – I was running all afternoon!" Husbands might not appreciate such rapid solutions to the fullest, but children are usually happy for these *golosinas*.

4.3.5 Quality: Granos and Golosinas

> Oh, this girl does not eat anything – since she lived in the center, since she was used to eating only *golosinas*. And I cannot give her spaghetti, and I cannot give her rice, I cannot give her meat, and she doesn't want to eat.
>
> Woman, 56, Turuco

The new foods that have entered indigenous kitchens – rice, noodles and spaghetti in particular – are also referred to as *golosinas* or treats, in opposition to the more "real food"-like *granos*. In the above quote, a woman paraphrases her mother-in-law's reaction to her limited appetite when she entered the household. The woman was pregnant when she moved in with her in-laws, and that was why she hardly ate, she explains, but her mother-in-law interpreted it as spoiled behavior of a town-raised girl. Noodles and rice are usually well-liked by children, and they are often referred to as a kind of excuse for cooking these things: "they do not want anything else! Now they are accustomed to this food. What can we do?"

4.3.6 Substance: Granos and Light Foods

> It used to be only *granos*, but now it is nearly only light foods.
>
> Rosalena Conde, 40, El Batan

The new foods – epitomized by rice or even a package of powdered consommé – are also referred to as *light foods*, again opposed to the more substantial *granos*. Earlier doctors would recommend a "lighter" diet, instead of the "heavy" and indigestable *granos*, and rural dwellers would swap *grano* soups for strained gruels of purchased oatmeal and boiled rice on their advice. Today, many people note that these light foods do not sustain the stomach; they may fill you up, but they won't satiate you for long and give you strength to work like *granos* do.

4.4 Biting In

4.4.1 Leaving the granos *behind*

> Now one mixes indigenous and mestizo food. We have learnt to eat mestizo food. Little by little we are leaving the *granos* behind.
>
> Ana María Farinango, 64, San Pedro

During the past generation indigenous inhabitants of Cotacachi have "learnt to eat mestizo food"; by incorporating new items and cooking techniques they have also bitten into the identity of their ethnic other. At the same time, and by the same actions, they have moved away from old-fashionedness and toward modernity, away from rural backwardness and toward urban sophistication, and away from a soggy, heavy diet toward a drier, finer and lighter one, all manifested among other ways through a growing dependence on purchased, non-local foods. Returning to the schema in Table 4.2, one might indeed say that people have "eaten away" in a multi-dimensional way: through changing their food habits, they have moved from the poles identified in "A" toward the poles represented by "B", across all dimensions. Today, however, people express ambivalent feelings in relation to the occurred development.

4.4.2 Ambivalent Reactions 1: Taste

> The way of preparation is better now. My grandmother made the sambo squash without milk, without *panela*, without anything, and it wasn't tasty. I now add milk, cinnamon, *panela*. In the beans I add red onions, cilantro. One adds more flavor to the food. The way of preparation is better.
>
> Rosa Ramos, 39, Quitugo

> All the foods we used to eat were tasty, tasty, even if we did not add meat. (…) Before one made toasted maize in the tiesto, without salt. But it was tasty. Now the toasted maize is made with lard, and with salt. Fresh milk with toasted maize, a soup of milk with maize flour, without sweetening, but it was quite tasty.
>
> Luz María Tumbaco, 43, El Batan

> Noodles, we eat once a week. It's that the noodles, they are not like the others, the taste that they have is…they don't taste anything. (…) Other granos have taste, *chuchuca*, ground barley, quinoa, they are tasty to cook. But the noodle soup, it has no taste.
>
> Juliana Montalvo, 46, Turuco

As shown above, an important change identified as separating the food from before from that of today as well as mestizo and indigenous food is seasoning. Indigenous, rural and past cuisine is associated with a more limited and subtle use of seasonings: less salt, less sweetener and the use of wild herbs instead of more pungent additives such as cilantro, garlic, spices and stock-bases. Some hold that the increased use of seasonings is for the better – that their mothers' foods were bland and tasteless while they themselves have adopted more proper ways of cooking. Others say that the simpler food of the past or of the *campo* is actually tastier. They reminiscence of their grandmothers' "simple and rich" cooking, or say that for *them, their* food is better, implying that indigenous and mestizos have fundamentally different tastes. Some dismiss modern and mestizo cooking for only adding "pure *saboras*" – quantities of artificial flavor enhancer, not actually resulting in a good taste. Some speak positively about the incorporation of rice and noodles in their diets, pointing to an increase in the variety of dishes. On the other hand, many lament the lack of flavor in these foods, not comparable to any of the home grown *granos*.

4.4.3 Ambivalent Reactions 2: Nutrition and Strength

> It is as if they [the mestizos] eat more of everything that is necessary, as if they have a better nutrition. They use everything that one should use in the cooking. We are now cooking more like them, but economically, we are not able to.
>
> Laura Cachimuel, 38, Quitugo

> It appears good food – the mestizos add milk and meat. But it is not as nutritious as our granos. The *granos* give us strength, and because of this I can continue on for a good while. Their food does not give strength for field work.
>
> María Isabel Flores, 39, Quitugo

> Indigenous people eat *granos*, soups, things from where they live. The food of the mestizos is not as nourishing, like for example rice with fried potatoes. It's pure starch. They don't know it, but they are not eating well.
>
> Wilma Rosero, 41, El Batan

> The mestizo food is factory-made. Ours is natural, grown organically.
>
> Ana María Farinango, 64, San Pedro

> Here everything is fresh, in the town only bought and stored – it is not fresh. Here the food goes from the plant to the pot!
>
> Zoila Tabango, 33, Peribuela

There are those who mean that by attempting to add some of the more modern ingredients, one may at least cook something a little more varied and healthy. But a majority mean otherwise: mestizo and modern food may *appear* better, but the truth is that *grano* foods, home grown without agrochemicals and eaten fresh off the field is actually healthier and more nourishing. There seems to be a growing skepticism toward the industrially produced foods of the stores, ripe with chemicals and unknown substances. "Before the *manteca* (lard) came from a pig", Francisco Guitarra Morochos (70, El Batan) pointed out, "but today one does not know where the *manteca* comes from". His comment reflects that what is most commonly sold as "manteca" today is heavily processed shortening or margarine. On the one hand, some lament an observed movement away from *granos* and toward less nutritious and even dangerous chemically-based foods, on the other, the home grown food still eaten in these rural communities is heralded as healthy, fresh and good.

During the very last years, those once so longed-for rice dishes and spicy soups have lost much of their attractive power, and conversely, the slow-cooked and slow-digested *grano* soups are rising in appreciation. Many indeed express a wish to return toward, or at least to maintain the *grano* foods. Manuel Chavez (40, San Pedro), who is one of many weekly Quito migrants, travelling back to his wife and family high up on the slopes of Mount Cotacachi every week-end, remarked: "Earlier we wanted mestizo food. But now, working out there, we long for the food from here."

4.5 Eating Back

4.5.1 The Turn

> Before, I was ashamed of the *grano* foods. When I was recently married, I looked at the barley soup of the indigenous, and I felt bad. But this is no longer so, [now] the barley soup is *something*.

Rosa Ramos, 39, Quitugo

> Now the mestizos too eat more barley, whole wheat, *chuchuca*, *morocho*, quinoa – now they are eating as well. They are no longer like before when they did not cook [these things], it's no longer that way. Now they are eating more of the food of the indigenous. Yes, because it is more nourishing – noodles have no nutrients. Now they are eating watercress too. When they [indigenous women] are selling potatoes with watercress, oh, they [the mestizos] are very happy.

Maria Cecilia Moenala, 37, Quitugo

> Now, it's like both the mestizos and the indigenous are eating things from this time. We want to eat some of the *granos* from before.

María Dolores, 55, Ugshapungo

Today there are signs that the tide is turning; now it is the *mestizos* that are biting into *indigeneity* through food. Indigenous food is no longer equated with dirt and low dignity – instead the agricultural and culinary heritage of the county's farmers is celebrated in Cotacachi town's main plazas. During festivals and fairs, women's groups from various communities bring in generous pots of *grano* foods and offer up plates for sale to the general public. Bowls of boiled potatoes ladled with wild greens and sauce of pumpkin seed are relished by mestizo urbanites. "¡*Así* tiene que cocinar!" – "Like *this* you have to cook!", men smilingly exclaim to their wives in between mouthfuls, hinting at the authentic taste of this "real food". One group, aided by an NGO, has invented a special transportable *tullpa* with a clay tray used to prepare *tortillas de tiesto* from maize or wheat flours over open fire, and people gladly stand in long queues to purchase the steaming hot unleavened breads. A newly invented farmers' market arranges minibus tours for costumers who want to get to know where their food comes from, and urban housewives enthusiastically trot potato fields and apple orchards, attentively listening to farmers' explanations of their work. Thus, a multi-faceted *wish to return* is not only held by indigenous people, but also expressed and practiced by Cotacachi's mestizos.

How has this transformation come about? How come indigenous as well as mestizos belonging to Cotacachi's rural and urban landscapes now tend toward wanting to *eat back* – valuing and delighting in *granos* and wild greens, symbols of past, rurality and indigeneity? This turn has not come over-night; the food fairs just described are the fruits of broader societal processes. First, it is linked to the growing ideological and political strength of indigenous organizations through recent years. Secondly, it is also linked to another national and international trend: a linger to reconnect fields with plates and escape from disjointed and dangerous food systems.

4.5.2 Reindigenization

The past few years have witnessed powerful indigenous mobilizations, amounting in radical shifts in political as well as social landscapes across the Andean region (Becker 2008; Meisch 2002; Perreault 2003; Radcliffe et al., 2002; Van Cott 2002) and elsewhere in Latin America (Jackson and Warren 2005). This *reindigenization* development can be characterized as a social, political, and cultural process, through which the meanings of indigeneity are being reformulated in a more positive light. In the context of indigenous movements' success to garner support and redefine themselves as people proud and empowered by their heritage, Cotacachi *cantón* stands in a special position: several indigenous leaders on the national scene have their roots in the area, and Ecuador's first indigenous mayor, Auki Tituaña, was elected here in 1996.

His seat is currently occupied by another ethnic fellow, Alberto Anrango, who back in 1977 co-founded the county's largest and arguably most important non-governmental organization: the *Unión de Organizaciones Campesinas e Indígenas de Cotacachi* (UNORCAC). UNORCAC has worked to defend the rights of the county's rural and indigenous populace and promote and carry out sustainable development initiatives. Their current vision is to work toward achieving *alli kawsay*, or "good living" in these communities (UNORCAC 2008), resonating with the slogans of President Rafael Correa's government and the country's new constitution (Asamblea Constituyente 2008). Both UNORCAC and the municipality have quite successfully forged ties to a range of international institutions and foreign donors, and their ethnic and agricultural heritage has undoubtedly been a central currency in attracting such attention. These plentiful international relations have reinforced indigenous political power on the local scene. But this process reaches beyond the municipal administration and a rupture of old patterns of political dominance; indigeneity now begins to stand out as something to be valued and respected, breaking with centuries of denigration.

4.5.2.1 *"Soy Indígena!"*

One example from the summer solstice celebration in 2009 might illustrate this transformation. The festivities surrounding the June solstice and the days of St. John, St. Peter, and St. Lucy between June 23 and July 1 has long been known by the Spanish name *San Juan*, but has recently been re-baptized as *Inti Raymi*, Kichwa for Sun Festival. UNORCAC in particular has also worked to reorganize and expand the celebration, among other things by adding a children's day. On this day, Kichwa children from many rural communities come down to the urban center of Cotacachi to dance into the main plaza, like their parents and older siblings do on other designated days. Mimicking the dancers of the previous days, they are dressed in *anacos* [the traditional indigenous female outfit in Cotacachi], *zamarros* [leather chaps], white shirts and ponchos. I was there during the fiestas in 2009, and I too came into town for the festivities on that day. On my way, I briefly stopped at an internet café. The owners, a young mestizo couple, were on their way out as I entered. With them was their little daughter, five-year-old or so, and she was dressed up just like a little *indígena* girl with embroidered blouse and *anaco* skirts and woven ribbons, and she stood there so proud looking up at me and said "*soy indigena!*" – "I'm indigenous!" This little remark may not sound like a revolution, but I doubt anyone, mestizo or indigenous, a few years back could imagine that a mestizo girl would express such an excitement about identifying as indigenous. This is not to say that racism is gone, far from it. Much of the old structures of differences in class and economic privileges linked to ethnicity still pervade the Ecuador's and Cotacachi's society. What I want to point out are recent important breaches in this system.

Food has been one of the media through which this gradual transformation of the mestizo-urban's sociopolitical dominance has been subtly manifested and reinforced. Mercedes Chico, wife of the current mayor in Cotacachi explains:

> Before, the *mazamorra*[37], no, no. When a gentleman would come, I had to give him fried chicken with potatoes, rice, lettuce and a slice of tomato. In the communities, on the other hand, in the parties one ate *mazamorra*, and for the *seco*, hominy with potatoes and guinea pig. No rice. But one year, in the season of the fresh maize, when the chapel here in the community was inaugurated, a cardenal came. And we served him *mazamorra*, and fresh maize, potatoes and faba beans. And the nuns placed the maize kernels in his soup, and he said: 'how delicious!' and he was very pleased. And then Guayasamin came, a famous painter who was *compadre* for Rumi's baptism. And we gave him soup and hominy, and he liked it too. We started with that.

[37] *Mazamorra*, or *uchuapi* in Kichwa, is a soup based on a flour ground from toasted maize, faba beans and peas.

4.5.3 Reconnection

The rising appreciation of the foods produced in Cotacachi's fields also reverberates with a different contemporary trend observed in many countries: efforts to *relocalize* and *reconnect* food systems. Studies situated in the Global North have examined how various groups respond to threats of hegemonic homogeny from industrialization and integration, and work to shorten the growing distance between people and places involved in food production, processing, and eating (Kimura and Nishiyama 2007; Nabhan 2002; Pietrykowski 2004; Roseman 2004; Wilkins 2005; Yiakoumaki 2006). The aims are diverse but encompass ecological and economic sustainability, healthier bodies, and cultural and community revitalization. In the Global South, movements such as La Via Campesina, have led the way in re-focusing debates on food and agriculture to also encompass the role of small farmers and the importance of maintaining local production, launching concepts such as "food sovereignty" (Rosset 2008). In its new Constitution of 2008 (Asamblea Constituyente 2008), Ecuador adopted this concept, declaring in Article 13 that: "Persons and community groups have the right to safe and permanent access to healthy, sufficient and nutritional food, preferably produced locally and in keeping with their various identities and cultural traditions. / The Ecuadorian State shall promote food sovereignty."

Thoughts and sentiments related to those driving these processes, are drawing people toward *granos* and home grown foods in Cotacachi. Migrants surviving on noodles and bread in the city long back to hearty meals, and people are worried about the increasing use of agrochemicals in large-scale agriculture and prefer organically grown products with a known origin. One new arena for the exchange of farm-grown produce is a farmers' market with the slogan "Mother Earth nourishes us" (*La Pachamama nos alimenta*), where small farmers offer up freshly-picked products to excited urban costumers on Sunday mornings. This way intermediaries are omitted, and no concerned consumer needs to travel the 20 kilometers to Ibarra's Supermaxi, a foreign-owned megamarket, which is the next place organic products can be bought.

Rural households themselves also seek to decrease their dependence on the store, to increase the diversity of home-grown products and return toward greater self-sufficiency. This may also involve growing more vegetables or fruits – "new" foods that are prohibitively expensive to buy for many. One farmer explains his vision:

> What I want is to grow vegetables, in order to have everything, and not buy anything, almost. Buy the lard, the salt, and for the kids, we'd have to buy rice and sugar. But I want to have everything. I already have a little of everything planted. Now I'm going to plant quinoa. (…) I have planted winter squash, I have planted sambo squash. (…) I have planted white morocho, yellow maize, I have planted lupines, faba beans, not to have to be buying those things. (…) We make cheese ourselves, not to have to purchase it. We have milk too. And if we want to eat meat, we can also slaughter a hen or a guinea pig, or something, or a pig as well one might slaughter, we do that in between. Not to keep buying lard.
>
> Antonio Fueres, 51, Ugshapungo

As discussed above, locally produced foods are by many considered healthier: not only are they chemical free and natural, they are also fresh and strengthening. Eating right can even be healing: "We did not cure ourselves with vitamines or syrups, in those times we recuperated from our illnesses with good food." (Mercedes Chico, 57, Turuco) And this sentiment is now shared by mestizos as well, such as this lady:

> I like fried watercress with rice, and a piece of meat, with toasted maize. It's delicious. 'Who taught you to eat rice with fried watercress?', my [grown] daughters ask me. `Who taught me?', I say, 'the doctor', I tell them. 'But mother, that is a magnificent food that you are eating'. Yes, don't you see, the watercress contains iron. As it contains iron, it is an excellent food, the watercress.
>
> Gilda Vaca, 61, El Ejido

The combination with rice and meat as well as the frying are typical markers of mestizo food, but the use of watercress and toasted maize resonates with a revaluation of indigenous, *grano* foods from the *campo*.

Local health workers advocate local *grano* foods, and also in the national arena, officials are concerned about new food habits' harmful effect on health. The national program of food assistance, Alimentate Ecuador, has an ambitious agenda of not only providing direct, material food assistance to the most needy, as the practice was before, but also educating people in how to eat well. When I asked Santiago Santos, one of the program's leaders, whether he thought people's way of thinking about food was changing, he said:

> Yes, the consciousness is awoken. For example now, people only 30 or 40 years of age suffer heart attacks. Earlier, this did not happen. The children also have allergies, asthma, things that did not exist before. So, people wake up, and we see that it isn't good to eat all of those artificial products, color agents, preservatives. Instead, one has to truly nourish oneself (*alimentarse de verdad*).

Sr. Santos further explained that among their aims is to fight against what they call "Chimborazos[38] of rice": people's habit of eating a heaped plate of rice and spaghetti, believing that they are nourished. Their nutritive lessons involve "simple theory" linking foods' colors to parts and functions of the body, communicated through bright brochures and cooking demonstrations.

Carmen Cumbas, an indigenous woman from Cotacachi also cited above, seems to much agree with Sr. Santos' conclusion on the detrimental effects of current diets, but her theory to amend the situation is even simpler that his:

> But I remember that it was better. Look today – no! Because my grandmother died when she was ninety eight years old – well walked (*bien caminada*). But look today at how we are – before we are forty eight, we are old already. But look at how my grandmothers

[38] Chimborazo is Ecuador's highest mountain, at 6268m.

> were, and we don't even have half their age. This shows that the food is doing no good. Our foods are lacking. *Our* foods. Because they always give more strength, more spirit, more energy, more courage, to us, the food of *granos*.

Our foods – the *granos* once so common – are lacking, she says. But it is not only because they count more nutrients. Their power goes beyond that of proteins and vitamins: they give strength in a complete, multi-dimensional way.

4.5.4 Eating Back

In a variety of senses, then, people in Cotacachi now seek to *eat back* – through food they move closer to an indigeneity with deep roots in place and time, they eat back from the city to the *campo*, from the office to the land, from chemical-dosed foods to natural ones, from manufactured foods of unknown origin to homegrown ones with a known source, from weakness to strength.

In some ways they long and eat back in time – to when food was *real* and people ate *well*. But simultaneously, the current situation – a convergence of counter-reactions if you will – has no precedent. What is happening, rather, is the construction of a new path with respect for and inspiration in the past. Indeed, the whole process is drawing funds and inspiration from global trends and institutions, and co-evolves with currents and sparks arising from friction between globalization and localization, conservation and invention. One memorable moment for many was back in January 2009 when, after tasting each of the plates in a twelve-course meal of local foods especially prepared for the occasion, Carlo Petrini, the president of Slow Food International, from the top of a warm stomach declared in front of the crowd gathered on the grounds of Cotacachi's farmer union, that never, never even in the world's finest restaurants, had he ever tasted anything so delicious. With this statement he confirmed the complete transformation of the local cuisine's symbolic value – from previous notions of unworthiness and shame to truly the *best* food on the planet.

4.5.5 Barriers and Compromises: Convenience, Custom, Economy and Environment

Even if most people now speak warmly about *grano, campo* and home grown foods, considering them superior in taste and nutritive values, considering them a great heritage worthy of biting back into, other foods – new foods, store-bought foods – continue to be present in local kitchens. Why is this? Why has the above described revolution not lead to an abandonment of the noodle soup? In this section, I will briefly discuss some of the factors working to its favor.

Time and convenience are central key words when trying to understand why people continue cooking rice and noodles: "For an easier and quicker preparation, it's the food of today – the spaghetti and the noodles. You place them in water, heat it up, and then it is just to take them out and eat. The old way of cooking, on the other hand, is slow" (Jose Pedro Matango, 70, Quitugo). Many women engage in off farm work, and those who stay back at the farm typically have increased responsibility for agricultural work, since their husbands often migrate for weeks at a time to the city. As a result, the time they have and the priority they give to hover over simmering pots is limited. The entry of gas-stoves reinforces this trend, as gas is costly, and it is not as easy to prepare large portions and keep it for some days, as was more common when everything was cooked in the *tullpa.* Instead, quicker soups are cooked more often.

Some people also say that they are accustomed to eat the new foods, that they prefer to cook "mixed": "Now we are cooking mixed, rice with steamed maize, fresh beans…in my opinion, the two kinds of food are good. And we now are accustomed to eat food from the store too, we want to cook that too. Before, as one did not know about it, one did not need it" (María

Hermelinda Guitarra, 38, Quitugo). Such comments might come both from young and old – even if they appreciate *granos*, they are now used to eating these other foods, they explain, and it is not so easy to let them go either.

Others point to more forcing conditions, leading to the use of such foods against their will. One is a factor that pushed people towards purchasing foods in the first place: growing populations resulting in less land per family. During recent years, agricultural production has also been jeopardized by eroded soils, increasingly irregular weather and augmented pest problems that probably are linked to rising temperatures (Chapter 10). Even if the great majority of rural residents grow part of their own food, very few produce enough to take them through the year. When own stores are out, they *have to* purchase food: "What I like, are the foods of the past. I like it more when one prepares bean soups, when one prepares it with wild greens, and all of that. That I really like. But now, out of necessity, I cook rice, I eat it, but I don't like it much. Out of necessity one has to consume it, there is nothing else" (Rosa Elena Bonilla, 42, Quitugo). National and international trade and agricultural politics result in rice and pasta products being offered in Cotacachi's stores and markets at price levels well below that of *grano* foods. When a pound of *chuchuca* (a maize product) is offered at $1.20 and one of noodles goes for $0.35 many feel that they do not even have a choice. "Sometimes I buy a little out of temptation (*por antojo*)", sighed Rosalena Anrango (42, El Batan). Carmen Cumbas is frustrated by the situation:

> My grandparents, I remember that they sold cattle, they kept the money, kept the money, because there were *granos* in quantities, and where would they go to buy? They never bought. Yes, they never bought. Look today, where are we? If there is a dollar, go to buy rice. If there is another, to buy cola. Oh! Because of this we are quite poor. I don't know, but to me it seems as if we are losing our culture, the food. But yes, we are returning to it.

According to her view, the very move out of the farm, away from self-sufficiency and toward dependency on store-bought food is the root cause of poverty and of malnutrition. She attempts to create awareness among other women of the importance of maintaining their culture, their clothing, and, perhaps most centrally, their food – a core source of sustenance and strength.

4.5.6 Friction

Cotacachi's foodscape is not being recarved without friction. It is an ongoing process, set on a political and social scene in movement. Take the new farmers' market, for instance (Chapter 6). One of the things that sparked its initiation was a the demolishment of a former more open municipal market, and the construction of a new, sanitized space, only open for those who could purchase a multi-thousand dollar worth stall. Farmers were thus squeezed out, and only intermediaries left inside. When a group of women farmers in reaction opened their own outlet, spreading out fresh produce around the building of the farmer union once a week, many urbanites enthusiastically streamed in to purchase. The women also met strong political resistance, though, as the municipal administration sent both police and health inspectors to shut it all down. They had to fight against "their own" indigenous mayor, who with heavy economic interests in the municipal market critiqued them for lack of hygiene and illegal activity. The man who in many respects paved the way for indigenous recognition and power let them down, alluding to old notions of "dirty Indians". He was not re-elected. After three completed terms in 2009, he, amidst much debate, had to leave his seat to the farmer union's founder.

Strangely enough, the strongest advocates for indigenous issues are often those who come to engage the most with the external world and bring cultural change back to their communities. The *dirigentes* – the leaders – those who leave to work downtown in the farmer union, in NGOs, in municipal offices, go to meetings, travel, negotiate – move aptly between the community and the city, but also engage and ingest. They earn money, build new brick houses, furnish them with tables and chairs, sofas and TV sets, even computers and desks and bookshelves. Then, when relatives or childhood friends who have *stayed* come over, cultures crash and there is friction. When offered a meal, a father-in-law may refuse to sit at the table, so far from the low bench or mat at the *tullpa* to which he is used. “This is not my place”, he says sternly, and a bench must be found to make him stay.

This landscape is ripe with friction, contradiction, but perhaps is this what moves things forward, what incites new thought, what provokes new courage, helping to create a future that builds on the past.

4.6 Conclusion

This research has shown that in Cotacachi, food is categorized and made sense of in multiple dimensions: it varies according to time, ethnicity, geography, origin, obtainment, properness, quality, substance. In terms of the foods contained in the different categories, there is much overlap across the dimensions. As rural households have incorporated an increasing amount of new foods and cooking practices during the past generation, they have also, in a symbolic manner, moved toward the opposite poles of many dimensions; they have literally bitten into the future, mestizoness, the urban, the purchased and prestigious. Simultaneously they have through their cooking moved closer to the modern, the quick and the fine and light.

Recently, though, a countertrend is building force. People are no longer ashamed of the slow-cooked soups made over wooden fire – on the contrary, they inspire pride. Not only indigenous folks, but also their mestizo fellows, have begun to eat in the other direction. Through seeking to incorporate more of locally grown *granos* and other products on their menus, they move towards opposite poles – indigeneity, rurality and earth, away from industrial uncertainty, towards tradition, strength and substance.

A convergence of sociopolitical processes has sparked this turn. Central has been the build-up of indigenous political power, breaking with century-old patterns of social dominance. Today a proudly carried indigenous identity may be more powerful than any other; be it in Cotacachi's municipal building or on Quito's streets. Concurrently with this transformation, the symbolic meaning of indigenous foods has been converted into something valuable. But the fading allure of imported, industrially produced foods is also linked to demonstrated harmful health effects and urban alienation. People seek to strengthen their bodies, their self-sufficiency and their ties to the land and their roots – in a process that is linked to a globally observed wave of food *reconnection.*

Many barriers exist, however; the way "back" is not straight – lack of land, degraded soils and challenges brought about by climate change constrain agricultural success. Lack of time precludes slow cooking, and new kitchen set-ups have moved people away from the huge cauldrons of former days. Still, this turn of tides in terms of how foods are valued and what foods are longed for is likely to have increased the prospects for the maintenance of a range of deep-rooted foods that some time ago seemed to be on their way out. For current-day Cotacacheños, cultivating food traditions is, rather than being hung-up in the past, a way of crafting the future.

The *concepts* that structure food in Cotacachi have remained remarkably stable through this time of transformation. Despite the unequivocal response from everyone I talked to in Cotacachi that yes, food has changed, and the range of identified new ingredients as well as alterations in cooking techniques, the basic distinction into *sopa* and *seco* remains. New main or peripheral ingredients are literally and figuratively cooked into this local fundamental pattern of food and to become either soups or *secos*. In a similar vein, distinctions continue to be made between indigenous and mestizo food, rural and town food, and indeed, all the dimensions listed in Table 5.2. What has changed is above all the value attached to the foods contained in each category. Thus, in many ways food is thought of in the same manner as it was a generation ago, but it is *felt* quite differently.

4.7 Epilogue: Potatoes with Watercress

I shall end with a recipe, or actually, two (Figure 4.1). Both contain instructions on how to prepare potatoes with watercress – an emblematic indigenous *campo* food, one of which main ingredients, wild greens, can be gathered for free by even the most poverty-ridden household. Today this is a cherished and popular dish marking rural authenticity and local tradition, and a mainstay, among soups, *coladas* and tortillas, when women come from communities to Cotacachi town with festival foods. The two recipes, however, display another layer of authenticity. While the ingredients are near exactly the same (only lard is swapped for oil), the elaboration is markedly different, and so is the resulting taste. The first recipe shows "grandmother's version", while the second indicates a modern one. The latter version, full of time saving short-cuts, not only lacks the flavor from the stone ground process and the fire from the *tullpa*; taste also dissipates in the water used to boil the peeled potatoes and chill the watercress. When they now prepare this dish to sell in festivals and fairs, they do it the former way, women assure. My observation indicates that a few short-cuts sometimes still are struck, but nonetheless the dish oozes of taste and tradition, in comparison with the *salchipapas* (fried potatoes with sausages), *papipollos* (fried potatoes with fried chicken) and *empanadas* (deep fried breads filled with cheese or meat) that are common fare in downtown markets. Potatoes with watercress thus tastingly illustrate the recent complex and creative reconfigurations in Cotacachi's foodscape. I invite you to go gather some wild greens, cook up and bite in, with or without short-cuts.

¡Buen provecho!

Potatoes with Watercress (*Papa Yuyuwan/Papas con Berro*)

(After the instructions of Rosa Ramos, Quitugo)

1. Grandmother's way

One cooks with firewood, which gives a distinct flavor. One boils the watercress, not chopped into small pieces, but cut into larger ones. It is spread, and left to cool on its own. One makes toasted maize kernels in the *tiesto*, and toasts the sambo squash seed in the *tiesto.* This is ground in the grinding stone, with a little bit of cumin and a piece of chile pepper. Onions are chopped finely, and brought to a boil in a little bit of lard. The ground seeds are added, and a sauce prepared. The water is pressed out of the watercress, and the potatoes are boiled with their skin on, and peeled afterwards. In the end one places the following in a pot: first the watercress, then the potatoes, and on the top, toasted maize. Over this one pours the squash seed sauce. It is not mixed with a spoon, but the whole pot is shaken until it is all mixed, for then to be served.

2. Modern way

One cooks on a gas-stove. The watercress is cut into small pieces, and boiled. One makes a *refrito* (fried onions/peppers/spices) with oil, and the squash seed (or, in its absence, peanuts) are minced in the blender and added to the *refrito*. The potatoes are peeled and boiled with salt. The watercress is placed in cold water to cool it and then the water is pressed out. Everything is mixed with a spoon and served.

Figure 4.1: Recipes for potatoes with watercress.

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B

APPENDIX TO CHAPTER 4

RESULTS FROM 72-HOUR DIETARY RECALL EXERCISE

Current Patterns of Food

The results from a 72-hour food recall exercise demonstrate the presence of both more traditional dishes and ingredients as well as newer ones in current cooking. During this survey exercise, 89 household heads recalled a total of 642 meals that had been prepared and eaten in the household during the previous 72-hr period. Skipped meals and meals eaten away from home were also included. Tables A4.1, A4.2 and A4.3 as well as Figures A4.1 and A4.2 provide an overview of the meals' composition. In Cotacachi, it is common to eat three meals during the day: a breakfast, normally between 6 and 8 am, a lunch sometime between 12 and 2 pm, and a dinner in between 6 and 8 pm. Information on the dishes served at each of these meals were registered. In addition, some snacks may be eaten, but these were not registered in the survey. The results thus do not give a complete picture of food intake, but rather provide an overview of the diets' main components. Because people's recall ability varied, the number of meals recalled also differed between households. The mode and mean number of meals registered in each households is 7.0 and 7.2 respectively, and the standard deviation 1.6.

Breakfast

The most common breakfast meal (44.2%) consisted of bread with herbal tea, or in some instances (instant) coffee or milk. Traditional unleavened breads (*tortillas*) were present but quite uncommon (2.6%). The second most common breakfast food was savory soups - the same kinds of soup that are prepared for lunch and dinner as well. Noodle soup, potato soup, *mazamorra* (soup made from maize/faba bean/pea flour), crushed rice soup were the most common. The third most eaten food for breakfast were seco dishes. The most common seco served for breakfast were rice dishes, such as rice with eggs or rice with fried potatoes. A final breakfast food group consisted of *coladas* – sweet soups, most commonly made based on oatmeal, water and milk. Breakfast coladas are usually sweetened with either sugar or panela. Among the breakfast meals, close to one fourth (23.1%) can be considered “traditional” home made dishes, while close to three fourths (72.5%) are rather non-traditional home cooked meals.

Lunch and Dinner

Lunch and dinner dishes are very similar to each other, in fact they are often identical; quite frequently larger quantities cooked at either meal are re-heated and served again the next meal/day. In the analysis, data from both were therefore combined. A majority of the meals consisted of home cooked soups (56.9%), while a substantial minority were home cooked secos (37.2%). In addition there were a few bread meals, some skipped meals as well as some meals eaten away from home. Only in three cases did a household cook both a soup *and* a seco for the same meal. The overall most common soup is the noodle soup (18.8% of soups, 10.7% of all meals), followed by barley, potato, *mazamorra*, *chuchuca*, quinoa and oatmeal soups. The majority of secos contain rice (70% of secos, 26% of all meals), typically served with one or two side items such as fried potatoes, beans, peas, or lentils. Some traditional ones also figure rather frequently on people’s plates, most notable potatoes with toasted maize (7.2% of secos, 2.7% of all meals). All over, close to an equal part of the lunch and dinner dishes can be considered traditional (43.6%) and non-traditional (45.3%). However, if counting ingredients, more traditional ones make up a larger part, since several of the non-traditional *seco* dishes also contain *granos*, albeit prepared and served in a more “modern” form (Table A4.4).

Table A4.1: Overview of food recall data.

Measure	Number
Number of households from which meals registered	89
Average number of meals registered per household	7.2
Standard deviation, number of meals/hh	1.6
Mode, number of meals/hh	7
Breakfasts registered	231
Lunches registered	217
Dinners registered	194
Total meals registered	642

Table A4.2: The composition of breakfast meals. Based on registrations of a total of 231 morning meals from 89 households. (Continued on next pages.)

Dish type	Frequency	%
BREAD BASED MEALS		
Bread with herbal tea or coffee	89	38.2
Bread with hot milk	10	4.3
Tortillas with herbal tea or coffee	4	1.7
Frequency, bread-based breakfast	*103*	*44.2*
Additions to bread meals		
Eggs	13	5.6
Cheese	3	1.3
Banana	2	0.9
Frequency, bread- based breakfasts with some addition	*18*	*7.7*
SOUPS		
Traditional soups		
Sweet traditional soups		
Morocho	2	0.9
Red fruit and maize-based soup (*Colada morada)*	1	0.4
Frequency, traditional sweet soups	3	1.3
Savory traditional soups		
Potato soup	9	3.9
Mazamorra	9	3.9
Barley soup	5	2.1
Quinoa soup	3	1.3
Chuchuca	3	1.3
Sweet sambo squash soup with ocas	1	0.4
Pea soup	1	0.4
Trigolosi	1	0.4

Faba bean soup	1	0.4
Savory sambo squash soup	1	0.4
Frequency, traditional savory soups	*34*	*14.6*
Non-traditional soups		
Sweet non-traditional soups		
Oatmeal *colada*	11	4.7
Rice *colada*	1	0.4
Tampico *colada* (made based on store-bought fruit flavor drink-powder)	1	0.4
Frequency, non-traditional sweet soups	*13*	*5.6*
Savory non-traditional soups		
Noodle soup	12	5.2
Rice soup	7	3.0
Savory oatmeal soup	3	1.3
Frequency, non-traditional savory soups	*22*	*9.4*
Other soups		
Sweet colada, unspecified	1	0.4
Savory soup, unspecified	3	1.3
Frequency, unspecified soups	*4*	*1.7*
SECOS		
Traditional secos		
Potatoes with toasted maize	1	0.4
Potatoes with toasted maize and cheese	1	0.4
Potatoes with wild greens	1	0.4
Beans with potatoes	3	1.3
Beans with toasted maize	1	0.4
Beans with potatoes and greens	1	0.4
Peas	1	0.4
Peas with hominy	1	0.4
Peas with toasted maize	1	0.4
Porotones with sambo squash seed	1	0.4
Wild greens with toasted maize	1	0.4
Frequency, traditional secos	*13*	*5.6*
Non-traditional secos		
Rice with fried potatoes	6	2.6
Rice with fried eggs	4	1.7
Rice with spaghetti	1	0.4
Rice with tuna	1	0.4
Rice with chicken	2	0.9
Rice with chicken and potatoes	1	0.4
Rice with peas	2	0.9
Rice, unspecified	3	1.3

Fried potatoes	3	1.3
Beans with rice	2	0.9
Lentils with potatoes	1	0.4
Lentils with rice	1	0.4
Lentils with rice and fried plantains	1	0.4
Lentils with spaghetti	1	0.4
Lentils with melloco	1	0.4
Grilled chicken with rice and fried potatoes	1	0.4
Frequency, non-traditional secos	31	13.3
Other secos		
Only eggs	1	0.4
Total frequency, breakfast dishes at home	*224*	*96.1*
Breakfast meals consisting of two dishes	*6*	*2.6*
Total frequency, breakfast meals at home	*218*	*93.6*
Meals away from home		
Tripe soup in market	1	0.4
Communal work party	1	0.4
Frequency, breakfast meals away from home	*2*	*0.9*
Skipped breakfasts	*11*	*4.7*
Total registered breakfasts (including skipped meals)	231	100

Table A4.3: The composition of dinner and lunch meals. Based on registrations of a total of 411 meals from 89 households. (Continued on next pages.)

Dish type	*Frequency*	*%*
BREAD BASED MEALS		
Bread with herbal tea or coffee	4	1.0
SOUPS		
Traditional soups		
Sweet traditional soups		
Morocho soup	2	0.5
Red fruit and maize-based soup (*Colada morada)*	3	0.7
Frequency, sweet traditional soups	*5*	*1.2*
Savory soups		
Barley soup	36	8.8
Potato soup	23	5.6
Mazamorra soup	21	5.1
Chuchuca (semi dry maize product) soup	20	4.9
Quinoa soup	18	4.4

Whole wheat soup	8	1.9
Bean soup	5	1.2
Faba bean flour soup	4	1.0
Savory sambo squash soup	4	1.0
Whole faba bean soup	2	0.5
Pea soup	2	0.5
Timbushka (multigrain/vegetable) soup	2	0.5
Trigolosi (wheat product) soup	1	0.2
Frequency, savory traditional soups	*146*	*35.5*
Sub-total, frequency of traditional soups	*151*	*36.7*
Non-traditional soups		
Sweet non-traditional soups		
Rice soup	8	1.9
Oatmeal *colada*	4	1.0
Frequency, sweet non-traditional soups	*12*	*2.9*
Savory non-traditional soups		
Thin noodle-soup	44	10.7
Oatmeal soup	13	3.2
Frequency, savory non-traditional soups	*57*	*13.9*
Sub-total, frequency of non-traditional soups	*69*	*16.8*
Other/unspecified soups		
Tripe soup	3	0.7
Chicken soup	3	0.7
Plantain soup	1	0.2
Lentil soup	1	0.2
Unspecified sweet soup	1	0.2
Unspecified savory soup	5	1.2
Sub-total, frequency of other/unspecified soup dishes	*14*	*3.4*
Total frequency, lunch and dinner soups	234	56.9
Number of soup types	24	5.8
SECOS		
Traditional secos		
Potatoes with toasted maize kernels (*kamcha/tostado*)	11	2.7
Potatoes with beans	5	1.2
Potatoes with hominy	1	0.2
Potatoes with tripes	1	0.2
Potatoes with fresh, steamed maize (*chukchu/choclo*)	1	0.2
Beans with hominy	3	0.7
Beans with toasted maize kernels	1	0.2
Faba beans with toasted maize kernels	1	0.2

Watercress with toasted maize kernels	1	0.2
Peas with toasted maize kernels	1	0.2
Hominy with sauce	1	0.2
Wild greens (*nabus/nabo*)	1	0.2
Frequency, traditional secos	*28*	
Non-traditional secos		
Rice with fried potatoes	23	5.6
Rice with fried potatoes and egg	3	0.7
Rice with fried potatoes and cheese	1	0.2
Rice with fried potatoes and ground meat	1	0.2
Rice with beans	20	4.9
Rice with beans, chicken and fried potatoes	1	0.2
Rice with beans and meat	1	0.2
Rice with beans and egg	1	0.2
Rice with beans and potatoes	1	0.2
Rice with peas	13	3.2
Rice with peas and potatoes	1	0.2
Rice with peas and thick noodles	1	0.2
Rice with lentils	4	1.0
Rice with lentils and guinea pig	1	0.2
Rice with hominy	2	0.5
Rice with hominy and beans	2	0.5
Rice with hominy and potatoes	1	0.2
Rice with meat	2	0.5
Rice with tuna	2	0.5
Rice with eggs	2	0.5
Rice with chicken	2	0.5
Rice with chicken and thick noodles	1	0.2
Rice with chicken and potatoes	3	0.7
Rice with melloco and eggs	2	0.5
Rice with thick noodles	4	1.0
Rice, main dish (further ingredients unspecified)	8	1.9
Thick noodles with potatoes	1	0.2
Lentils with thick noodles	1	0.2
Fried potatoes with rice and sausages	1	0.2
Fried potatoes with peas	1	0.2
Fried potatoes with peas and rice	1	0.2
Fried potatoes with tuna	1	0.2
Potatoes with lentils	1	0.2
Faba beans with rice	2	0.5
Omelet	1	0.2
Frequency, non-traditional secos	*113*	*27.5*

Other/unspecified seco dishes		
Potato, main dish (further ingredients unspecified)	9	2.2
Beans, main dish (further ingredients unspecified)	1	0.2
Peas, main dish (further ingredients unspecified)	2	0.5
Frequency, dishes with unspecified ingredients	*12*	*2.9*
Total seco dishes registered	*153*	*38.2*
Additions to seco meals:		
Salad (chopped red onion and tomato)	10	2.4
Popcorn	2	0.5
Fried plantains	1	0.2
Squash seed sauce	2	0.5
Frequency, home cooked meals consisting of both soup and seco	*3*	*0.7*
Total frequency, home cooked meals	*388*	*94.4*
Meals away from home		
Lunch (soup and seco) at market stall/café	10	2.4
Soup at market/café	2	0.5
Party (fritada - fried pork)	1	0.2
Meal away from home, not specified	4	1.0
Frequency, meals away from home	*17*	*4.1*
Skipped meals		
No lunch	5	1.2
No dinner	1	0.2
Frequency, skipped lunch or dinner	*6*	*1.5*
Total frequency, registered lunch and dinner meals (including skipped meals)	411	100.0

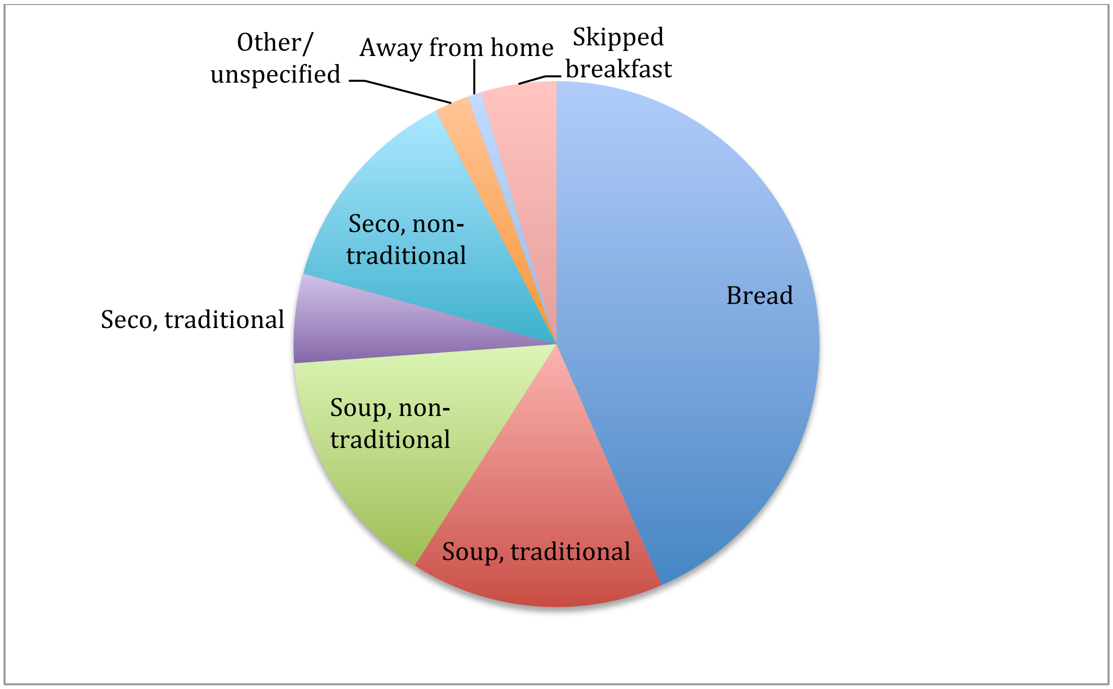

Figure A4.1: The distribution of breakfast dishes. Based on data from 233 lunch and dinner meals from 72 hour recalls in 89 households.

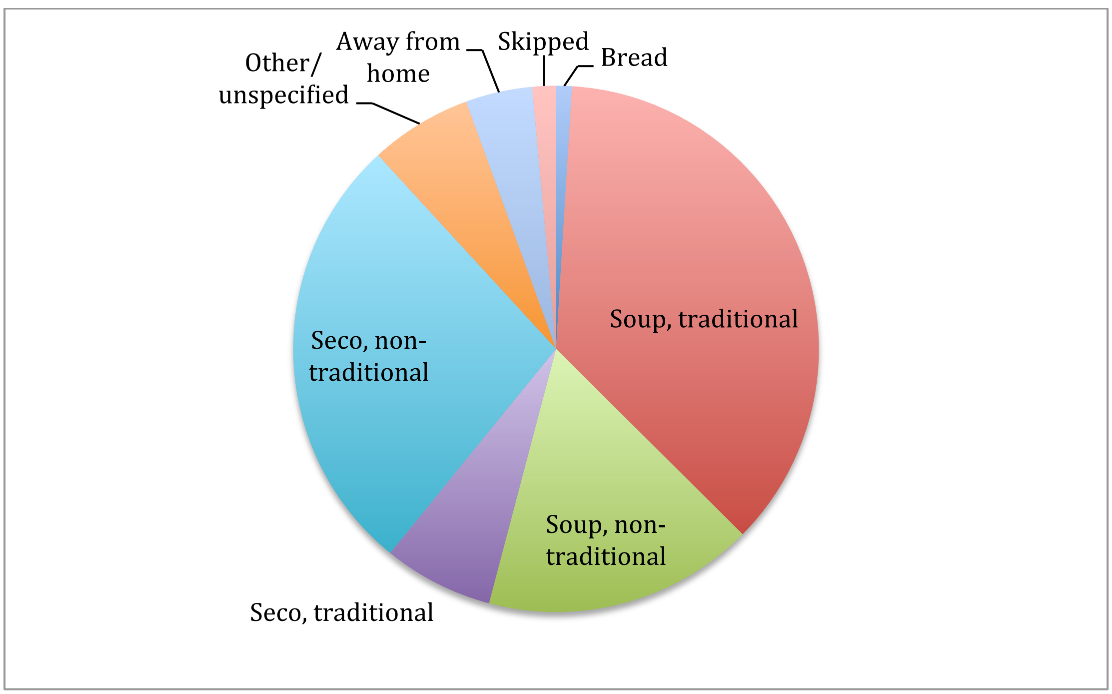

Figure A4.2: The distribution of lunch and dinner dishes. Based on data from 407 lunch and dinner meals from 72 hour recalls in 89 households. Note that some of the non-traditional secos contain, as side dishes, traditional *grano* ingredients.

Table A4.4: Frequencies of components in lunch and dinner *seco* dishes.

Ingredient	Frequency	%
Rice	107	25.8
Potatoes	73	17.8
Legumes	69	16.8
- *of which:*		
Beans	*40*	*9.7*
Peas	*22*	*5.1*
Lentils	*7*	*1.7*
Faba beans	*1*	*0.2*
Maize	31	7.8
- *of which:*		
Toasted maize kernels	*20*	*4.9*
Hominy	*10*	*2.7*
Fresh maize	*1*	*0.2*
Thick noodles	8	2.0
Melloco	2	0.5
Wild greens	2	0.7
Egg and cheese	10	2.4
- *of which:*		
Egg	*9*	*2.2*
Cheese	*1*	*0.2*
Meat and fish products	17	3.4
- *of which:*		
Chicken	*7*	1.7
Meat	*3*	0.7
Ground meat	*1*	0.2
Guinea pig	*1*	0.2
Sausage	*1*	0.2
Tripes	*1*	0.2
Tuna	*3*	*0.7*

CHAPTER 5

FLAT, DOWN AND UP:

TRENDS IN COTACACHI'S CROP DIVERSITY AT THE OUTSET OF A NEW MILLENNIUM[39]

[39] Skarbø, K. To be submitted to *Genetic Resources and Crop Evolution*.

Abstract

This case study reports on recent developments in the extent of crop diversity in Cotacachi located in the Northern Ecuadorian Andes. Like in many other regions in the world, trends of genetic erosion in Cotacachi led to simplified fields with reduced levels of crop diversity during the 20th century. The present study examines whether new developments of cultural revitalization, through which traditional and locally grown foods have risen in esteem, have had any counter-effect on this negative trend. The problem is approached through a longitudinal comparison of crop richness on surveyed farms in 2003 and 2009. The results display multiple trends; a few crops remained stable in terms of their extent among farms, some increased and others decreased their role. Those that continued to decline are in particular crops demanding in terms of the locally scarce resources of land and labor. The positive developments within some crops indicate that cultural revitalization movements provide prospects for crop diversity conservation, however, for some crops, additional initiatives may be necessary.

5.1 Introduction

This study examines recent trends in the extent of crop diversity in Cotacachi in the Ecuadorian Andes. The 20th century witnessed worldwide *genetic erosion* – a reduction in the diversity of crops grown in each field and farm (FAO 1996; Fowler and Mooney 1990; Frankel 1970; Harlan 1975). This trend was also observed in the Andes (Brush 1999; Ochoa 1975; Rhoades 1991; Zimmerer 1991; Zimmerer 1996) including Cotacachi (Skarbø 2005; Skarbø 2006; Chapter 3). In Cotacachi, the process was partly related to a depreciation and discrimination of the rural and the indigenous; by adopting imported foods and urban lifestyles and abandoning traditional, home grown foods, Kichwa farmers moved toward more prestigious and modern mestizo identities (Chapters 3 and 4). However, around the millennium shift several sociocultural trends converged to change the image of rurality and indigeneity into something more valuable and positive, leading to a rise in popularity of traditional and locally grown foods (Chapters 4 and 6). The present study asks whether this image shift has been powerful enough to halt previous trends of genetic erosion, by encouraging farmers to maintain diverse fields.

5.1.1 Genetic Erosion During the 20th Century

During the 20th century, global agriculture was profoundly transformed. In many areas, monocultures gained ground in relation to formerly more common polycultures and both on the crop and varietal levels, the diversity planted by each farmer was reduced. This process of genetic erosion has in particular been linked to the development and adoption of breeder-developed modern varieties, agrochemicals, mechanized, gasoline-powered field work and commercialization (FAO 1996; Fowler and Mooney 1990; Nazarea 1998). It is recognized as a serious problem to the future of agriculture because crop diversity constitutes the raw material both farmers and breeders have to continue adapting production to changing environmental conditions (Brush 2000; Fowler and Mooney 1990; Frankel 1970; Rhoades 1991; Rhoades and Nazarea 1998).

Concurring with global trends, farmers in Cotacachi have also reported a reduction in local on farm crop diversity during the latter decades of the 20th century (Skarbø 2005; Skarbø 2006; Chapter 3). In some cases, this is linked to the adoption of mechanized market-oriented monoculture production of certain crops' modern varieties, but for many subsistence-oriented small farmers, the reasons are different. They explain the reduction of diversity by pointing to a complex set of economic, environmental and cultural factors. These farm households, many with access to less than one hectare of land, continued to produce food mainly for home consumption throughout this period. Yet, additionally they incorporated new, purchased foods into their diets; no longer did they near wholly rely on own production as was the case for previous generations. This shift was linked to economic factors such as increasing scarcity of land as populations grew, the development of and integration into a market economy requiring cash and presenting new opportunities for off farm wage work. These trends were also motivated by culture and identity politics; rurality and indigeneity were denigrated and discriminated against in Ecuadorian society and, thus, adopting foods and livelihoods associated with urbanity and mestizoness, while abandoning traditional foods, became a way of engaging in and moving toward more prestigious identities. In conjunction, these processes led to simplified fields with reduced crop diversity during the latter half of the 20th century (Chapter 3).

5.1.2 New Trends at the Millennium Shift

Around the millennium shift, new sociocultural trends were to transform the image of indigenous and locally grown foods (Chapter 4). Indigenous movements that had been developing for decades finally burst onto national (Becker 2008) and local (Ortiz Crespo 2004) political scenes toward the end of the 20^{th} century, and as they achieved political power, cultural images of indigeneity also began to change. In several parts of Ecuador, a creative revival and revaluation of things indigenous was observed in a variety of cultural arenas (Rogers 1998; Viatori 2007; Wibbelsman 2009), including that of food (Chapter 4). At the same time, an increased value placed on local, organically produced foods in Cotacachi reflected national and international trends seeking *reconnection* or *relocalization* of the food system, in counter-reaction to industrialized food production and lack of local sovereignty in food provisioning (Halweil 2004; Kimura and Nishiyama 2007; Nabhan 2002; Pietrykowski 2004; Rosset 2008; Wilkins 2005; Chapter 6).

These transformative trends have influenced and been influenced by the work of local, national and international organizations. In Cotacachi, the local farmer union, *Unión de Organizaciones Campesinas e Indígenas de Cotacachi* (UNORCAC), has been an important actor in promoting the revaluation of traditional foods and crops. Through the arrangement of food and biodiversity fairs, awareness building through workshops, extension and cooking classes, the establishment of an agrobotanical garden as well as a nursery propagating native and non-native crops, and distribution of planting material (UNORCAC 2007a; UNORCAC 2008). Their efforts have been supported and shaped by national and international institutions, beginning with the US-based Sustainable Agriculture and Natural Resource Management (SANREM) project toward the end of the 1990s (Nazarea, et al. 2006; Nazarea, et al. 2003a;

Nazarea, et al. 2003b; Rhoades 2006), and further developing from 2002 through a coalition including the Ecuadorian national agricultural research institute and gene bank (INIAP), Bioversity International and the United States Department of Agriculture (USDA) (Ramirez and Williams 2003; Williams and Ramirez 2008). Another institutional actor has been the Italian NGO Ucodep, which has also worked to stimulate the use of native crops and agrobiodiversity conservation through collaboration with UNORCAC and independent activities (Ucodep 2010).

This study seeks to examine whether these new developments, through which local foods have significantly risen in esteem, have had any implications for the maintenance of on-farm crop diversity. Given the role played by the devaluation of indigenous, local foods in driving reduction in crop diversity, I here ask: has the recent transformation of the symbolic value attributed such foods halted genetic erosion in Cotacachi?

I approach this question through a longitudinal comparison of the crop diversity grown in 2003 with that grown in 2009. This inquiry will provide novel insights into the potential of cultural revitalization for promoting crop conservation. If a positive effect can be detected, this will indicate that programs to stimulate cultural and agricultural revival may constitute a fruitful approach to enhance the maintenance of crop diversity. Conversely, the absence of a positive effect will indicate that factors constraining diversity, such as the economic and environmental ones mentioned above, exercise a more profound influence on farmers' choices of what to plant, and that other or additional approaches should be sought. Despite the importance of understanding developments in the maintenance of crop diversity, few longitudinal studies exist to date. The present research adds to an emerging body of literature assessing change over time in cultivated biodiversity (Hammer, et al. 1996; Nabhan 2007; Nabhan, et al. 2010; Shewayrga, et al. 2008; Teklu and Hammer 2006; Tsegaye and Berg 2007), and hopes to inspire the design and execution of more such studies in the future.

The paper is organized as follows. First, I provide a description of the study area and lay out the methods. Next, I report results on shifts in the extent of different crops between 2003 and 2009. The results are discussed by crop type, before the conclusion is drawn.

5.2 Study Area and Methods

5.2.1 Study Area

Cotacachi *cantón*[40] is located in the province of Imbabura, approximately 80 km north of Ecuador's capital Quito. The *cantón* extends into various ecological zones, and this study is focused on its Andean zone, encompassing 43 rural communities and three urban centers. The rural communities count a total population of about 15,900 people, the majority of whom identify as Kichwa (UNORCAC 2007b). The urban centers are inhabited by approximately 9,000 people, most of whom consider themselves mestizos (INEC 2011). Of the households in the rural communities 84% own land and through share cropping arrangements an even higher percentage engage in agricultural production (UNORCAC 2007b). Typically, those with larger land extensions produce for the market, while those with less land focus on subsistence-oriented production (Chapter 8). Among those engaging in subsistence production, the majority complement agriculture with off farm work. The agricultural traditions of the region have roots stretching several millennia back in time (Moates and Campbell 2006), and presently a wide crop portfolio is grown in three agroecological zones stretching from the Inter-Andean valley bottom at about 2300m and up to the end of the agricultural belt at about 3300m (Chapter 2).

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[40] A *cantón* is an Ecuadorian geographical-administrative unit, roughly corresponding to the size of a United States county. The country is divided into 24 *provincias*, that altogether encompass 224 *cantones*.

5.2.2 Methods

Fieldwork for this study was carried out in Cotacachi over a total of sixteen months during 2003-2004 and 2009-2010, during which periods the author lived in the area. The main methods were participant observation and farm surveys. Participant observation in varied farm activities throughout the fieldwork gave insight into local dynamics involving agriculture and crop diversity. Participation in the work and activities of non-governmental organizations (NGOs) working with agriculture in Cotacachi provided understanding of their role in shaping farmers' crop diversity options and choices. Farm surveys yielded data on crop diversity grown during the two periods. In 2003, interviews with the heads of 45 farm households, sampled by purposive quota sampling (Teddlie and Yu 2007) taking into account the inclusion of different age groups in five communities selected to represent different geographical and agroecological zones provided data on the crops grown on these farms during the preceding one-year period. Data were collected on the on-farm diversity of field crops (crops usually grown in fields), vegetables and fruits (crops usually grown in home gardens). Initial open questions regarding which crops were grown during the past year within each of the crop types were complemented by prompting for each of the other crops grown in the area, based on an initial list of crops developed in preliminary stages of the research. Frequently, the interviews were triangulated by field and garden walks as well as demonstrations of stored seed. In 2009, it was possible to locate and interview 36 of the same farms and farmers, and the same kinds of data were resampled. All survey activities were conducted by the author, in the majority of cases together with a Kichwa-Spanish translator and assistant. In 2009 the survey was expanded to encompass 89 households, but the current analysis is based on data collected from the 36 farms that were surveyed in both periods. I analyzed the data using Microsoft Excel.

5.3 Results

In the following paragraphs I will report results on the number of farmers cultivating different crops in 2003 and 2009. In begin with data on change over time regarding field crops, and continue on to review changes within vegetable and fruit crops.

5.3.1 Changes in the Extent of Field Crops

Data on the extent of field crops are summarized in Table 5.1 and Figures 5.1–5.2[41]. Table 5.1 provides an overview of the field crops grown on the surveyed farms, the number of cultivators of each crop in 2003 and 2009, the number of farms each crop was abandoned and adopted between the two years, as well as net changes in number of cultivators. Figure 5.1 shows a graphical presentation of the number of cultivators in the two years, and Figure 5.2 illustrates the net changes.

The results show that crops exhibit varied trends; a few remain stable in terms of number of farms where they are grown, some have decreased their role and others have incremented their role. Three crops exhibit remarkable stability in extent: maize, common beans and peas. Eight crops play a reduced role in 2009 as compared to 2003, consisting of three roots and tubers (potatoes, melloco, oca), two legumes (lupines, lentils) and three grains (quinoa, wheat, barley)[42]. On the other hand, nine crops are grown on more farms in the latter year. These are two cucurbits (sambo and winter squash), two roots and tubers (sweet potato, mashua, yacon), one legume (faba beans) and two grains (amaranth, rye). This varied pattern shows that the conservation status of local field crop diversity varies between crops; there is no unidirectional trend across all crops. The data further indicate that the process of letting go of or adding crops is

[41] All tables and figures of this chapter are placed at its end.
[42] For names in Kichwa, Spanish and Latin of the crops mentioned in the text of this chapter, please refer to Tables 5.1-5.3.

dynamic in that it differs between farms; for nearly every crop, there were some farmers stopping to grow it and others beginning to grow it in the period between the two surveys (Columns "Quit" and "Began" in Table 5.1).

Overall, there is a slight positive change in field crop diversity between the two years. In total, among the 36 farms, a crop was abandoned 74 times, while one was adopted 81 times. This results in an overall 3% positive net change in the number of times any of the crops are documented (Table 5.1). All crops that were found in 2003 were also found in 2009, but in the meantime three additional crops had been added to the surveyed farms: yucon, amaranth and rye. Thus, the overall field crop richness was higher in the latter year.

5.3.2 Changes in the Extent of Vegetable Crops

The data shows a marked increase in the extent of nearly all documented vegetable crops (Table 5.2, Figures 5.3–5.4). Of the 15 vegetable crops documented in 2003, all except for three were grown on more farms in 2009. One crop, red onion, was grown on the same number of farms in the two years, and two (tomato, bell pepper) had reduced their extent. Three additional vegetable crops (red cabbage, achogcha, asparagus) had been added to the farms' overall crop portfolio. In the period between the surveys, twelve of the crops were dropped from at least one farm, while sixteen were added to at least one new farm. In total, a vegetable crop was dropped 38 times, while one was adopted 98 times. This corresponds to an overall net 82% increase in the extent of vegetable crops among the surveyed farms. The crops with the highest increase in number of cultivators were Andean chili pepper and a number of vegetables of Old World origin (onions, carrot, leaf beet and red cabbage).

5.3.3 Changes in the Extent of Fruit Crops

Fruit crops exhibit an even stronger increase in extent than vegetable crops (Table 5.3, Figures 5.5–5.6). Of the 26 fruits grown in 2003, 21 had increased in extent by 2009. Four (tree tomato, blackberry, plums, pomegranate) reduced their presence and one (strawberry) was grown on an equal number of farms in the two years. Six new fruit crops (mountain papaya, cherry, *guayabilla*, loquat, coffee, bitter orange) were added to the farms' overall fruit crop diversity, while one (pomegranate) was dropped altogether. Overall, fifteen crops were dropped from one or more farms, while 29 were added to at least one farm. A fruit crop was dropped 38 times, while one was added 154 times. Overall, there was an increase of 112% in the extent of fruit crops; they more than doubled their presence on the surveyed farms. The strongest increase in terms of numbers of cultivators was found in citrus fruits (lemon, orange, tangerine) and certain native Andean fruit crops (capuli cherry, Andean walnut, avocado, banana passion fruit).

5.4 Discussion

5.4.1 Field Crops: Flat, Down and Up

The observation that most field crops were both added to some farms and dropped from other farms in the period between the two surveys indicates that there are reasons for and against growing each of these crops. It is likely that the rising esteem attributed to local foods, crops and agriculture was an important contributing factor inciting the addition of crops to farms. On the other hand, the fact that crops were also dropped from farms indicates that certain environmental or economic reasons continue to constrain crop diversity. Overall, a field crop was added slightly more times than one was dropped, indicating that the reasons for adding such crops weigh at least as heavy as those discouraging the continued cultivation of a crop. The net change within each crop is an indicator of which direction its conservation status has developed during the first decade of the 20th century. Below I will discuss which main reasons are likely to have contributed to the observed patterns of change among crops with flat, decreasing and increasing development curves.

5.4.1.1 Flat

The absolute stability of maize – grown on all surveyed farms in both years – is linked to its central role in Cotacachi's culture and agriculture. It is considered a "mother grain", and constitutes the core crop in intercropped *chakras* (fields) typically also planted with beans, cucurbits, and in some cases faba beans, peas, lupines and quinoa (Chapter 3). It is the main ingredient in a plethora of local dishes; if one has maize in the house, there is always something to cook and serve. Its central role contributes to its perpetuation; even if harvests fail repeatedly people do not give up this crop and replant it the following season anyway. It is also an important crop for market-oriented farmers, who plant it in monocrop. Common beans are not as important culturally, but it is likely that they enjoy stability because of their close association with maize; beans are the second most important part of intercropped *chakras*. Commercial farmers often plant beans in monocrops rotated with maize cultivation. The one farm where beans had been dropped between the two surveys was a market-oriented farm whose owners had decided to focus only on maize. Peas also enjoyed net stability in terms of the number of farms where they were grown. Peas are sometimes added, in smaller quantities, to maize intercrops, but, most importantly, they are grown during the drier summer season (May-August), in between the maize harvest and its next planting. The overall substantial presence of this crop (69% of farms) and its net stability reflects that it is one of the few crops thriving in summer (the other commonly planted one is the potato).

5.4.1.2 Down

For the eight crops that exhibit a net decrease in farm extent, diversity-limiting factors have outweighed incentives stemming from the rising appreciation of traditional foods and crops. Two central limiting factors most of these crops have in common are high land and labor requirements. Most are usually grown in larger extents, meaning that they are land demanding. In addition, several of them, including wheat, barley, lupines, quinoa and lentils, require heavy labor efforts, in particular during harvest and processing. Both of these resources – land and labor – have become increasingly scarce during recent years. As a result of incomplete national land reforms (Becker 2008, Lyons 2006), many households in Cotacachi's communities have access to only small plots of land (Moates and Campbell 2006; Zapata Ríos, et al. 2006) and these continue to decline in size as the population grows; according to local inheritance patterns, land is divided between all children at generational shifts. In earlier generations, it was costumary for neighbors and kin to take turns and help each other with demanding tasks such as harvests, remunerated by a meal and a harvest share. But as community members became increasingly integrated into the market economy toward the end of 20th century, such communal labor arrangements declined. Today most men and some women engage in off farm wage work, and it is harder to find people ready to help out on others' land. Those willing to typically demand cash payment. Alternatively, crops such as wheat and barley can be harvested mechanically by hiring agricultural entrepreneurs. But the cost of both options is prohibitive for many small farmers, who instead choose to drop these crops. Quinoa and lupines in addition require labor intensive processing to remove bitter components before cooking, and farmers also refer to this characteristic as a reason to drop them from fields. Quinoa constitutes a particular case; while many farmers have dropped it, others have begun to grow it as a monocultured cash crop, stimulated by locally active NGOs (Chapter 7).

In the case of potatoes, climate change seems to be a more important factor in depressing the crop's role. This is not a very labor-demanding crop. Potatoes continue to be grown by relatively many farmers, but there is nevertheless a decrease between the two points in time. This may be linked to increasing climatic instability through the 2000s (Chapters 10-11). In the intermediate and lower zones of Cotacachi, potatoes are often planted during the dry summer, since they are susceptible to blight attacks during wetter periods. Several farmers explained that they were discouraged to plant them in 2009 because of several preceding unusually wet summers, with heavy potato harvest loss. In addition, farmers reported increasing incidence of potato tuber moths during recent years, a development that may be linked to climatic change enhancing the pest's conditions (Dangles, et al. 2008; Chapter 10). Moth infestations preclude storage of tubers for food and seed, discouraging cultivation (Chapter 10).

5.4.1.3 Up

Most of the field crops that have been planted with increased frequency during the period are native, minor crops. In addition to increasing popularity of indigenous and locally grown foods, their rise has in many cases been facilitated by the distribution of planting material from NGOs and their low requirements of land and labor. For example, the local farmer union UNORCAC, in collaboration with other institutions, has propagated and distributed planting material of various root crops. One of these, yacon, had been completely lost from Cotacachi and was reintroduced from Ecuador's national gene bank. It differs from other Andean root crops in that it is usually eaten raw; peeled and cut it is crisp and juicy like an apple. Another reintroduced crop is amaranth, an Andean grain that also was absent from Cotacachi's fields at the millennium shift.

The successful rise in importance of these crops has likely in many cases further been facilitated by their limited demands of land and labor. Most of them are minor crops that are typically grown in smaller extents. Their limited land requirements make it easier also for farmers with little land to grow them. Cucurbits are for the most part added to maize intercrops, while sweet potatoes, mashua, arracacha and yacon are planted in smaller amounts in the corner of a field or even in home gardens. These crops are much less labor demanding in terms of harvest and processing than most of the declining crops.

Amaranth, rye and faba beans constitute exceptions in that they are usually grown in larger plots and require more labor. As mentioned above, amaranth has recently been reintroduced to Cotacachi. It is so far only grown by few farmers, but it is sparking curiosity and may very well become more popular. NGOs are working to stimulate its use both in communities and urban restaurants. When we distributed amaranth seed during community workshops, participating farmers were very interested in trying out this new plant. Rye was another crop absent in 2003 but present in 2009. Rye is an Old World crop introduced after the conquest, and, albeit in a very limited extent, it has continued to be present in Cotacachi's fields throughout the last decades even if it was not grown by any of the sampled farms in 2003. The farmer growing it in 2009 explained that she had been encouraged to plant it by the mestizo landlord whose land she sharecrops, for its health-bringing characteristics. Faba beans are particularly rain resistant, and during recent years several farmers have begun experimenting with planting them during summer, instead of the late blight prone potatoes. This is likely an important reason why it is a more widely cultivated crop in 2009 than in 2003.

In sum, the overall near stability in the extent of field crops (a 3% increase in the total number of times any crop was registered) results from a balance between stability within a few crops, reduction of some and expansion of others. Those that have maintained a stable position do so because they play key roles in the local cropping system. The observation of both retracting and expanding crops indicates that the process of cultural revitalization and rising interest in locally grown foods has stimulated the recuperation of some crops, but not of all. As a general trend, crop level genetic erosion seems to continue among the crops that are more demanding in terms of land and labor, while it has been not only halted but reversed among crops that can be grown with less input of these resources. This development should be understood in relation to these two factors' growing scarcity during recent years. Separate from these trends, climatic change has favored the cultivation of faba beans and disfavored potato production.

5.4.2 Vegetables and Fruits

The near doubling in the total extent of both vegetables and fruits reflects rising popularity as well as availability. In addition to a general increased appreciation of locally grown foods, governmental institutions as well as NGOs present in Cotacachi have campaigned heavily to promote the incorporation of more fruits and greens in local diets, in particular emphasizing these foods' importance for a complete child nutrition. Several NGOs have also provided planting material, either free of cost or through credit programs. Previously, these crops did not play a prominent role in community cuisine; instead of cultivated vegetables, it was more common to add wild and weedy greens to dinner dishes, and while wild fruits were snacked by children, it was not a common practice to plant fruit trees. Farmers explain that such crops were mostly grown on haciendas and eaten by mestizo-whites. There was simply no tradition of growing them in communities, and high market prices prohibited communitarians to purchase them. Awareness of these crops' beneficial nutritional role and eased access to planting material have moved many to establish gardens around their homes during the last couple of decades, and the sharp increase between 2003 and 2009 shows that such gardens are expanding and diversifying. Like most of the expanding field crops discussed above, fruit trees and small vegetable plots do not require much land, and are thus relatively easily included despite land scarcity. Some farmers have begun to sell surplus fruit and vegetable production in local markets – in particular at a new market established by a group of women farmers in 2006 (Chapter 6). The prospect of an additional income source from this activity has likely propelled emphasis on and diversification of vegetable and fruit production.

From a local conservation perspective, the increase of vegetables and fruits is not exactly a reversal of previous erosion; these crops were not common in the communities in former generations. Rather, they represent an expansion of crop diversity in the farming system. Thus far, they are usually grown in small quantities on each farm, and their inclusion does therefore not represent a threat to other kinds of crop diversity. On the other hand, the use of wild and weedy greens to condiment soups and dinner dishes has decreased during the past generation, and farmers link this process to the growing role of cultivated vegetables.

5.5 Conclusion

This study indicates that cultural and agricultural revitalization processes developing in the 21st century's first decade have positively influenced the maintenance of crop diversity in Cotacachi. These processes, in which NGOs and social movements have played important roles, have stimulated farmers to recuperate some of the crops that had fallen in popularity during the latter half of the 20th century. However, the motions have so far not been strong enough to halt the erosion of crops that are particularly demanding in terms of land and labor. On the other hand, fruit and vegetable crops, typically planted in small portions in home gardens, have nearly doubled their presence on the surveyed farms. This latter increase represents a new expansion of diversity; fruits and vegetables did earlier not play an important role in community agriculture. Their rise reflects growing awareness of their beneficial nutritive properties, increased availability of planting material and new marketing opportunities.

The study demonstrates that the extent of crop diversity may change rather markedly over a short amount of time – both in positive and negative directions. Apart from vegetables' and fruits' sharp increase, the most important local crops have retained a stable position, while about an equal number of field crops have lost and gained ground during the period between 2003 and 2009. These varied results highlight both the prospects for and urgency of conservation efforts.

The experience from Cotacachi underlines that cultural values are important for biodiversity cultivation, and indicates that a focus on revaluation and celebration of cultural and agricultural traditions and identities may be a promising avenue for programs intended to stimulate on-farm crop diversity conservation. It also reveals that developments in crop diversity are not uniform; the maintenance or increase in the extent of one crop is not necessarily reflecting the conservation of another. The continued decline of some crops despite the increase in others indicates that there are other factors that also demand attention in a conservation perspective; in the current study scarcity in land and labor seem in particular to limit the maintenance of crops that require relatively large amounts of these inputs. In this case, new land redistributions of adjacent hacienda properties would enhance food security and foster the cultivation of more diverse fields.

The observed changes and the insights they provide demonstrate the utility of monitoring developments in on-farm crop diversity over time. In 2009, an expanded survey of crop diversity in Cotacachi included 89 farms (Chapter 8) and it is hoped that these data may provide a useful baseline for comparison in future research. Given the urgency of diversity conservation for agriculture's future, periodic surveys is proposed as an efficient tool to better understand short-term and longer-term developments in farmers' cultivation of agricultural biodiversity.

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5.7 Tables and Figures

Table 5.1: Number of cultivators of different field crops, 2003 and 2009.

Crop name				Number of cultivators					
English	**Latin**	**Kichwa**	**Spanish**	**2003**	**Quit**	**Began**	**2009**	**Net change**	**% change**
Maize	*Zea mays*	Sara	Maíz	36	0	0	36	0	0
Common bean	*Phaseolus vulgaris*	Purutu	Fréjol, poroto	33	-1	0	32	-1	-3
Potato	*Solanum tuberosum* ssp. *andigena*	Papa	Papa	31	-8	2	25	-6	-19
Pea	*Pisum sativum*	Alwirha	Alverja	25	-5	5	25	0	0
Lupine	*Lupinus mutabilis*	Tarwi	Chocho	21	-11	2	12	-9	-43
Quinoa	*Chenopodium quinoa*	Kinuwa	Quínua	20	-7	4	17	-3	-15
Faba bean	*Vicia faba*	Hapas	Habas	19	-3	10	26	7	37
Sambo squash	*Cucurbita ficifolia*	Sampu	Sambo	18	-3	12	27	9	50
Barley	*Triticum aestivum*	Triku	Trigo	12	-6	4	10	-2	-17
Wheat	*Hordeum vulgare*	Siwara	Cebada	11	-8	3	6	-5	-45
Oca	*Oxalis tuberosa*	Uka	Oca	10	-7	4	7	-3	-30
Melloco	*Ullucus tuberosus*	Milluku	Melloco	9	-6	5	8	-1	-11
Winter squash	*Cucurbita maxima*	Sapallu	Zapallo	7	-3	8	12	5	71
Lentils	*Lens culinaris*	Lanteha	Lenteja	4	-4	2	2	-2	-50
Sweet potato	*Ipomoea batatas*	Kamuti	Camote	3	-1	3	5	2	67
Mashua	*Tropaeolum tuberosum*	Mashwa	Mashua	2	-1	2	3	1	50
Arracacha	*Arracacia xanthorrhiza*	Sanyura	Zanahoria blanca	1	0	8	9	8	800
Yacon	*Polymnia sonchifolia*	Hikama	Jicama	0	0	5	5	5	
Amaranth	*Amaranthus caudatus*	Amarantu	Amaranto	0	0	1	1	1	
Rye	*Secale cereale*	Sintilina	Centelina, centeno	0	0	1	1	1	
Total, field crops				*262*	*-74*	*81*	*269*	*7*	*3*

Table 5.2: Number of cultivators of different vegetable crops, 2003 and 2009.

Crop name				**Number of cultivators**					
English	**Latin**	**Kichwa***	**Spanish**	**2003**	**Quit**	**Began**	**2009**	**Net change**	**% change**
Cabbage	*Brassica oleracea* var. *capitata*		Col verde	17	-6	8	19	2	12
Onion	*Allium cepa*		Cebolla larga	11	-4	13	20	9	82
Lettuce	*Lactuca* spp.		Lechuga	9	-6	7	10	1	11
Red beet	*Beta vulgaris*		Remolacha	8	-4	7	11	3	38
Carrot	*Daucus carota*		Zanahoria amarilla comun	7	-5	13	15	8	114
Red onion	*Allium cepa*		Paiteña	4	-3	3	4	0	0
Tomato	*Lycopersicon esculentum* var. *esculentum*		Tomate riñón	4	-4	0	0	-4	-100
Bell pepper	*Capsicum annuum*		Pimiento	3	-2	0	1	-2	-67
Leaf beet	*Beta vulgaris* var. *cicla*		Acelga	2	-1	9	10	8	400
Chile pepper	*Capsicum baccatum*	Uchu	Ají	2	0	11	13	11	550
Broccoli	*Brassica oleracea* var. *italica*		Brócoli	2	-1	3	4	2	100
Radish	*Raphanus sativus*		Rábano	1	-1	6	6	5	500
Andean tree cabbage	*Brassica oleracea* var. *capitata*		Col de árbol	1	0	1	2	1	100
Cauliflower	*Brassica oleracea* var. *botrytis*		Coliflor	1	0	4	5	4	400
Zucchini	*Cucurbita pepo* subsp. *melopepo*		Zuquini	1	-1	4	4	3	300
Red cabbage	*Brassica oleracea* var. *capitata*		Col morada	0	0	7	7	7	
Achogcha	*Cyclanthera pedata*	*Achokcha*	*Achogcha*	0	0	1	1	1	
Asparragus	*Asparagus officinalis*		Esparrago	0	0	1	1	1	
Total, vegetables				*73*	*-38*	*98*	*133*	*60*	*82*

*In the cases where no Kichwa name is given, the Spanish term is employed by Kichwa-speakers as well.

Table 5.3: Number of cultivators of different fruit crops, 2003 and 2009. (Continued on next page.)

Crop name				Number of cultivators					
English	**Latin**	**Kichwa***	**Spanish**	**2003**	**Quit**	**Began**	**2009**	**Net change**	**% change**
Tree tomato	*Cyphomandra betacea*		Tomate de árbol	18	-11	9	16	-2	-11
Blackberry	*Rubus glaucus*		Mora	13	-6	5	12	-1	-8
Lemon	*Citrus medica* var. *limon*		Limón	8	-2	14	20	12	150
Avocado	*Persea americana*		Aguacate	7	-2	11	16	9	129
Orange	*Citrus x sinensis*		Naranja	6	0	9	15	9	150
Ice cream bean	*Inga sp.*		Guaba	5	-1	5	9	4	80
Tangerine	*Citrus x tangerina*		Mandarina	5	-1	8	12	7	140
Passionfruit	*Passiflora ligularis*		Granadilla	5	-3	6	8	3	60
Banana passionfruit	*Passiflora cumbalensis/ Passiflora mollissima*	Taksu	Taxo	4	0	7	11	7	175
Peach	*Prunus persica*		Durazno	4	-1	6	9	5	125
Goldenberry, cape gooseberry	*Physalis peruviana*		Uvilla	4	-3	6	7	3	75
Strawberry	*Fragaria x ananassa*		Frutilla	3	-3	3	3	0	0
Plum	*Prunus* sp.		Claudia	3	-1	0	2	-1	-33
Capuli cherry	*Prunus capuli*	Kapuli	Capulí	2	0	12	14	12	600
Andean walnut	*Juglans neotropica*	Tukti	Nogal	2	0	10	12	10	500
Apple	*Malus domestica*		Manzana	2	0	5	7	5	250
Fig	*Ficus carica*		Higo	2	0	5	7	5	250
Babaco	*Carica pentagona/Carica x heilbornii*		Babaco	2	-1	6	7	5	250
Cherimoya	*Annona cherimolia*		Cherimoya	2	-1	4	5	3	150
Basul	*Erythrina edulis*	Kastilla purutu, kiru purutu	Porotón	1	0	5	6	5	500
Lime	*Citrus* sp.		Lima	1	0	4	5	4	400
Grape	*Vitis vinifera*		Uva	1	0	3	4	3	300

Crop name				Number of cultivators					
English	**Latin**	**Kichwa***	**Spanish**	**2003**	**Quit**	**Began**	**2009**	**Net change**	**% change**
Sugar cane	*Saccharum officinarum*		Caña de azúcar	1	0	0	1	0	
Guava	*Psidium* sp.		Guayaba	1	-1	1	1	0	0
Banana	*Musa* sp.		Plátano	1	0	1	2	1	100
Pomegranate	*Punica granatum*		Granada	1	-1	0	0	-1	-100
Mountain papaya	*Carica pubescens*	Chiliwaka	Chilehuaca, chihualcán	0	0	3	3	3	
Cherry	*Prunus* sp.		Cereza	0	0	1	1	1	
Guayabilla	*Eugenia victoriana*		Guayabilla	0	0	2	2	2	
Loquat	*Eriobotrya japonica*		Níspero, chupalón	0	0	1	1	1	
Coffee	*Coffea arabica*		Café	0	0	1	1	1	
Bitter orange	*Citrus × aurantium*		Naranja agria	0	0	1	1	1	
Total, fruits				*104*	*-38*	*154*	*220*	*116*	*112*

*In the cases where no Kichwa name is given, the Spanish term is employed by Kichwa-speakers as well.

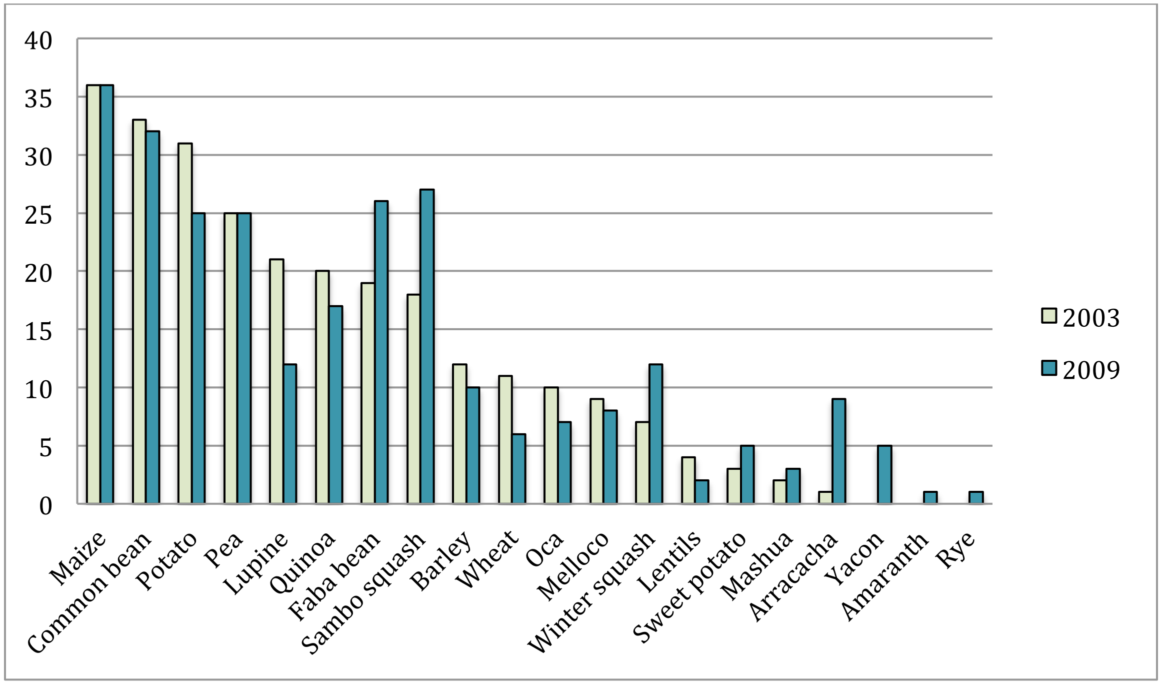

Figure 5.1: Number of cultivators, field crops, 2003 and 2009. (Total farm N=36).

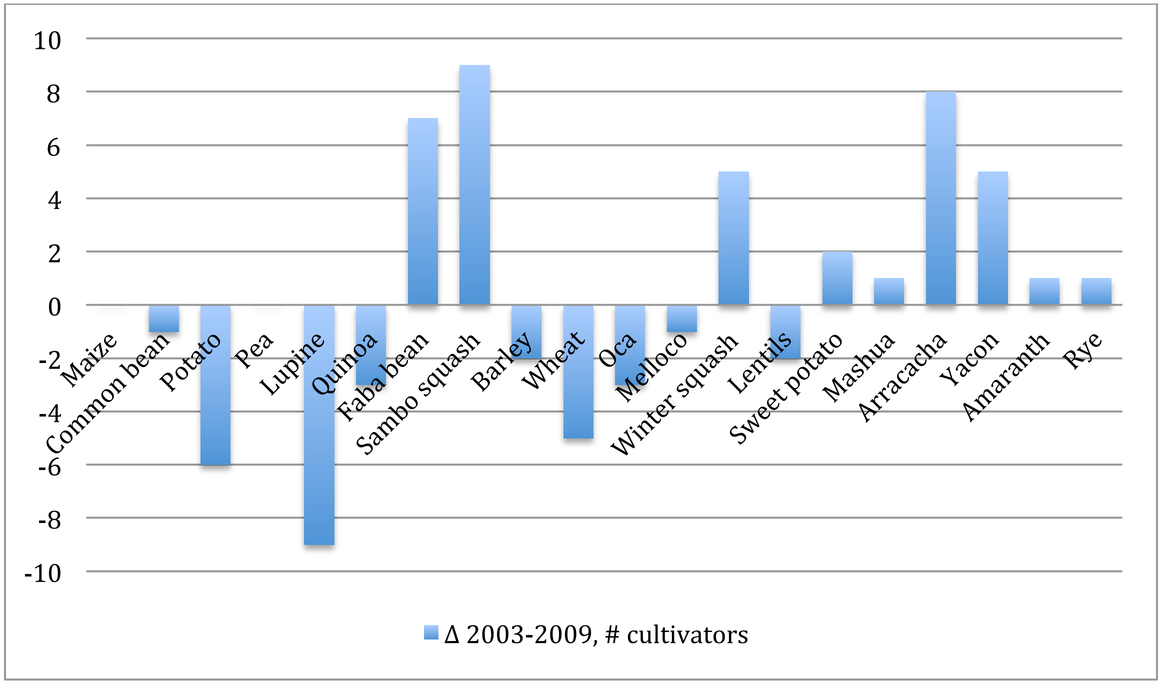

Figure 5.2: Net change in number of cultivators of different field crops between 2003 and 2009. (Total farm N=36)

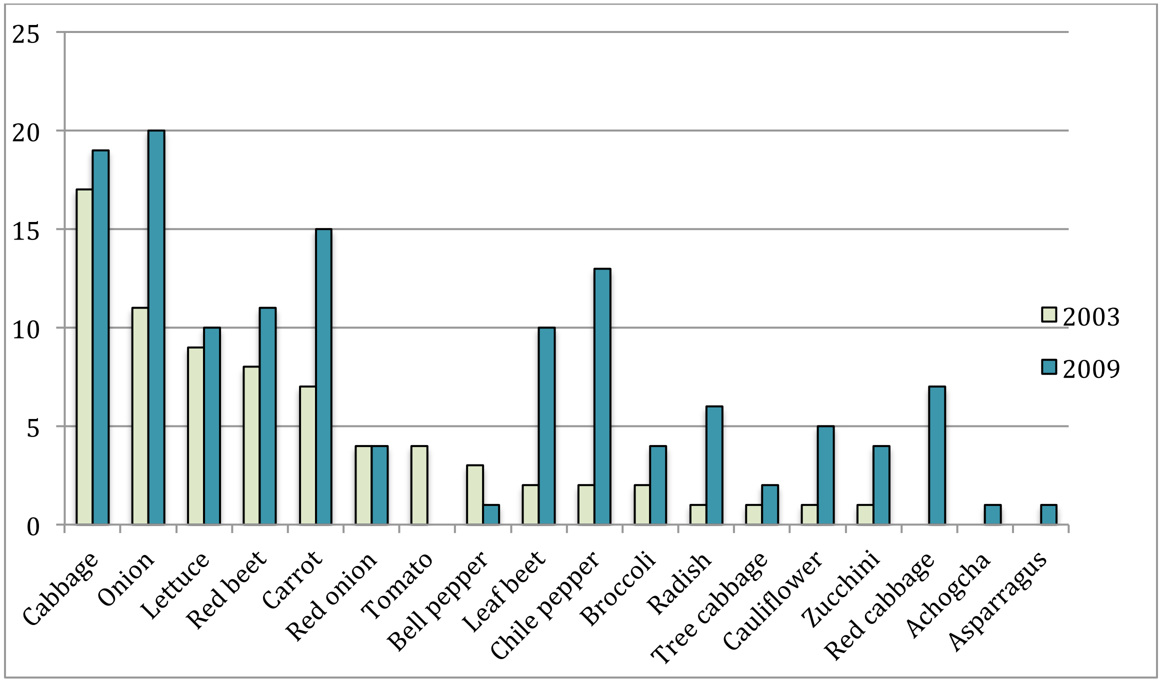

Figure 5.3: Number of cultivators, vegetable crops, 2003 and 2009. (Total farm N=36).

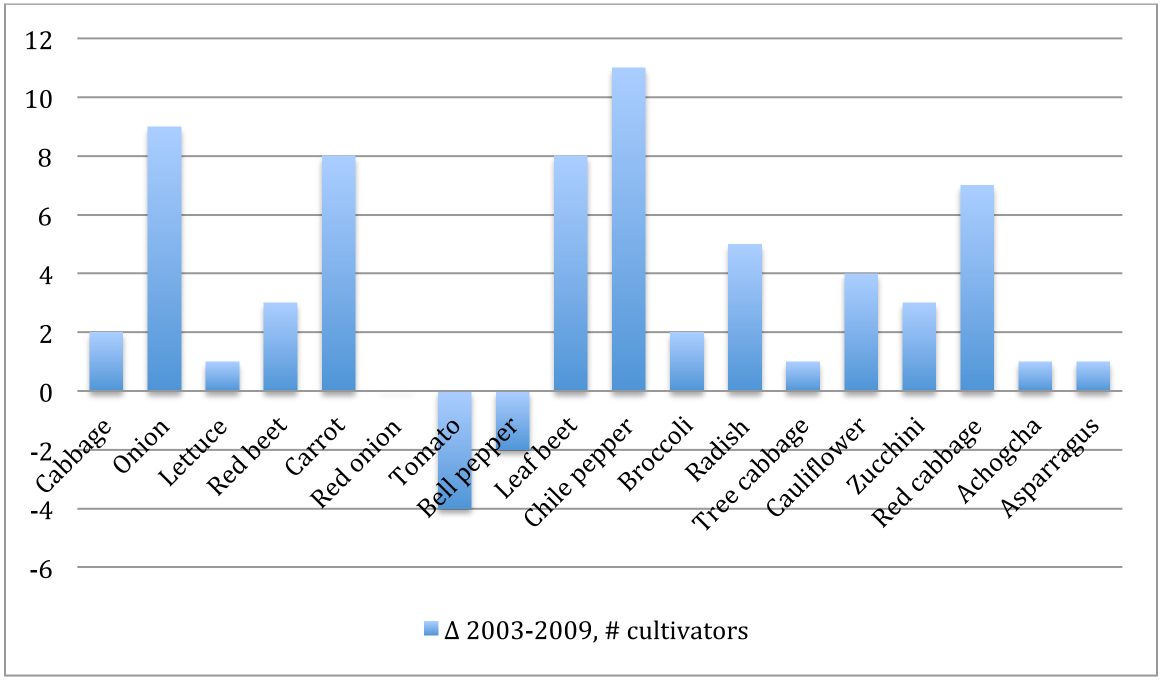

Figure 5.4: Net change in number of cultivators of different vegetable crops between 2003 and 2009. (Total farm N=36)

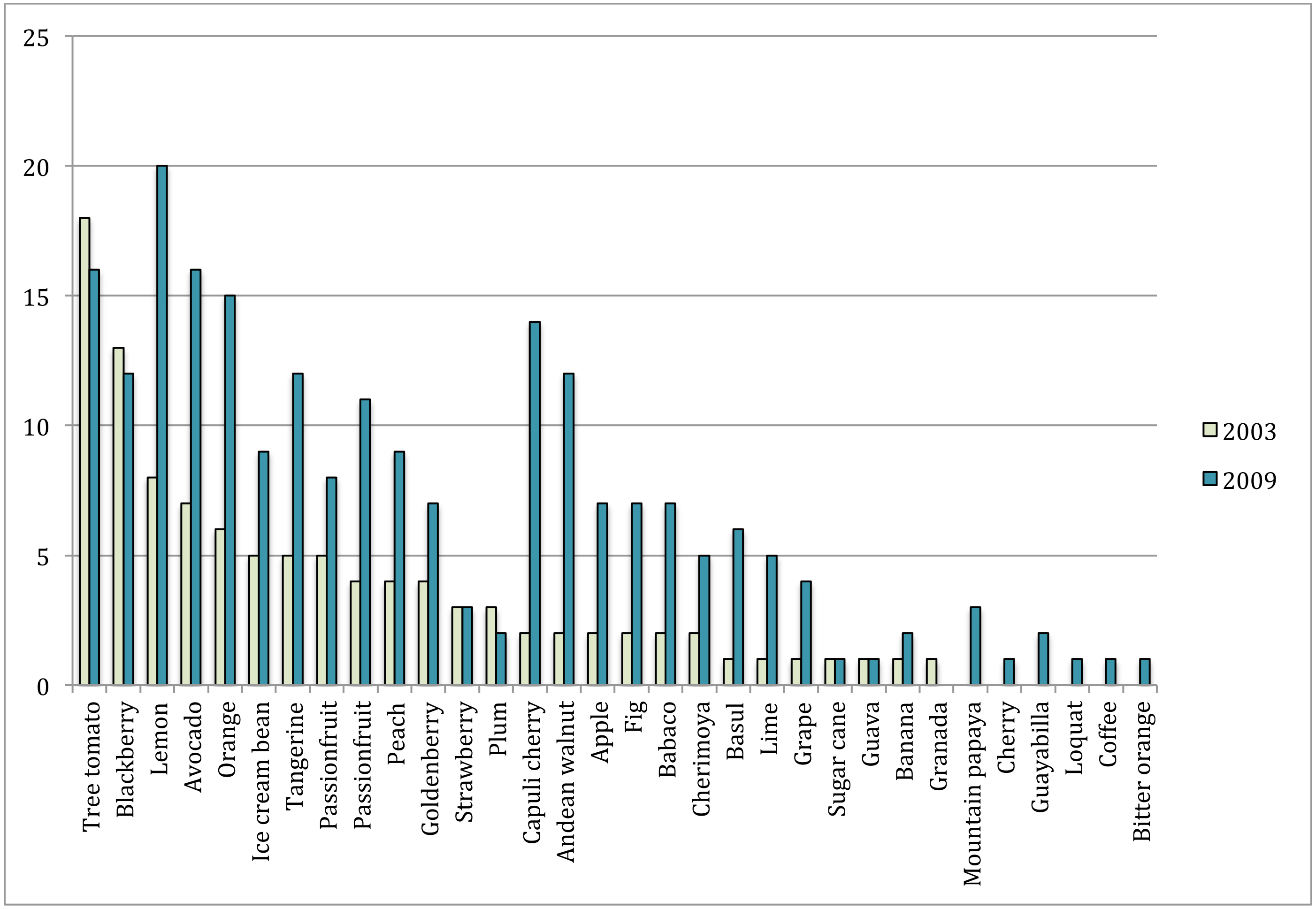

Figure 5.5: Number of cultivators, fruit crops, 2003 and 2009. (Total farm N=36).

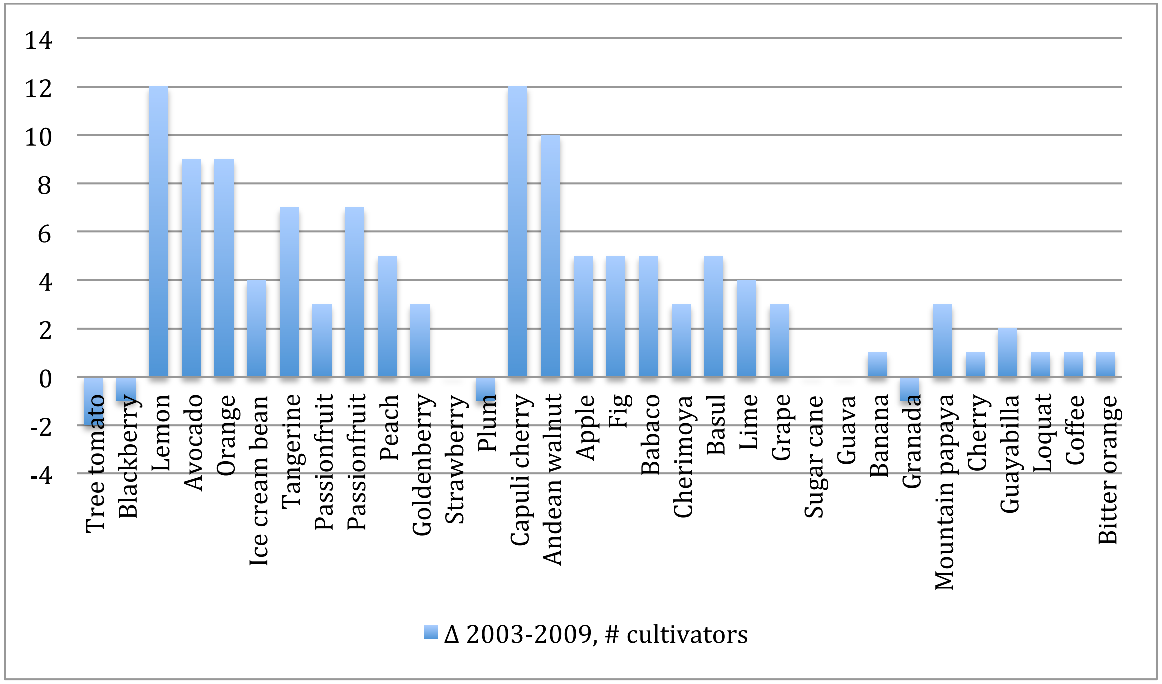

Figure 5.6: Net change in number of cultivators of different fruit crops between 2003 and 2009. (Total farm N=36).

CHAPTER 6

'MOTHER EARTH NOURISHES US':

THE DEVELOPMENT OF AN ALTERNATIVE FARMERS' MARKET[43]

[43] Skarbø, K. To be submitted to *Journal of Agriculture, Food Systems, and Community Development.*

Abstract

This paper tells the story of a new and thriving Sunday morning market in a rural town of the Ecuadorian highlands. The market's history is short, turbulent and successful, and, although played out in a Southern setting, has much in common with farmers' markets born in the Global North during the last decade. Cotacachi is a small town surrounded by a stunning patchwork of agricultural fields covering the slopes of dormant volcanoes. This region is not a mono-cultured desert dominated by supermarket provisioning; many families grow much of their own food, and it is more common to buy food through small stores and bustling markets. Still, people crowd to *la feria comunitaria* to purchase organic produce, harvested that very morning, for a fair price, directly from farmers. With this paper I would like to challenge conceptions of discrete development trajectories, and invite reflections on cross-fertilization of imagination and practice between different parts of the world.

6.1 Introduction

In recent years, a trend of *food relocalization* has developed in many countries. Direct marketing schemes such as farmers' markets as well as Community Supported Agriculture and U-picks are presented as counter-initiatives to centralized, globalized, impersonal and industrialized food systems, with long food miles, high pollution and unhealthy and contaminated food products. People flock to new local markets to reconnect with each other and their place, to access locally grown high quality products, often organically produced in small batches.

Most research on food relocalization has been carried out in high-income countries (e.g. Hinrichs 2000; La Trobe 2011; Wilkins 2005; Yiakoumaki 2006). Explicit (e.g. Feagan and Morris 2009) or implicit it seems to be assumed that such processes are restricted to high-income parts of the world, where richness and plenitude has allowed for a "quality turn" (Goodman 2004) and the development of reflexive consumers (Moore 2006; Murdoch and Miele 2004) who can afford to choose who they are through eating selectively and eating well.

On the other hand, if food is local in low-income countries, it seems to be assumed to be because the centralization of food distribution has not reached as far yet as it has in other parts of the world – in a sense they are lagging behind. Local markets thus function with completely different motivations among sellers and buyers than their counterparts in the Global North. However, here I present a case study that argues otherwise – it is a study of a fair situated in a small town of Ecuador's rural highlands sharing many attributes with the modern, reinvented farmers' markets of the North.

In what follows, I start by introducing the study area and the methods used. Next, I present a review of the Fair's history, and a description of its current state. I go on to report on factors behind its success among customers as well as grower-vendors, and the Fair's future outlook. Finally, I discuss the above, and conclude that new, direct forms of food marketing may hold promise as an avenue toward more equitable and sustainable food systems also in the Global South.

6.2 Study Area and Methods

6.2.1 Study Area

Cotacachi is a small town located in the Northern Ecuadorian Andes, about 80 km north of the capital Quito. It is the administrative center of a *cantón*[44] bearing the same name, and has a population of about 8,000 (INEC 2011). It is surrounded by 43 rural communities with a combined population of about 15,900 (UNORCAC 2007). While Cotacachi sits on the Inter-Andean valley bottom, at an altitude of 2500m, the communities spread out on the slopes of the Cotacachi volcano, up to an altitude of 3300m. The majority of rural residents identify as indigenous Kichwa, while the most common ethnic identification in the urban areas is mestizo (INEC 2011). Some rural households carry out commercially oriented agriculture, while the majority have only small plots where they cultivate mainly for home consumption. Many households have members that also engage in off farm work, either in nearby towns or in more distant cities on a migratory basis.

6.2.2 Methods

[44] A *cantón* is an Ecuadorian geographical-administrative unit, roughly corresponding to the size of a United States county. The country is divided into 24 *provincias*, which altogether encompass 224 *cantones*.

This study forms part of a larger dissertation project, for which fieldwork was carried out in Cotacachi during 12 months in 2009 and 2010. In this period, data for the current study was collected through participant observation on farms, in the Fair and in other activities of the local farmer union *Unión de Organizaciones Campesinas e Indígenas de Cotacachi* (UNORCAC). In addition to informal conversations during these activities, data is drawn from ten semi-structured interviews with fair organizers, producers and customers. The Fair's own surveys and registration protocols form a secondary data source.

6.3 History of the Fair

Several processes led up to the "Community Fair" ("*la Feria Comunitaria"*) in Cotacachi. One was the privatization of former open market space. Another was the growth in vegetable production among small-scale farmers.

Market spaces bustling with people and fresh food products sold by the pound or bunch are not restricted to nostalgic memories of a distant past in Cotacachi. During my first fieldwork here in 2003, Sunday was market day, and people came from far and near to sell and buy all kinds of products on and around a big open field between to the municipal covered market and the bus station.

However, within a couple of years, major restructuring took place. With the stated goal of supporting local agricultural production and sales, the mayor secured funding from foreign donors to rebuild the municipal market. The big open market ground was turned into a new bus station, and two market buildings were constructed; one for dry goods and one for fresh products, including meat, fruits and vegetables. The market stalls were put on sale and could be secured for a price of several thousand dollars.

Instead of supporting a broad range of local farmers, this development favored a few big producers who could afford to buy a permanent stall, in addition to paving the way for intermediaries to establish themselves as vendors. On the other hand, small farmers who had earlier sold surplus production at the Sunday market lost this venue.

Another factor sparking the initiation of the Fair was the increased production of vegetables and fruits on small farms. Projects and campaigns involving local NGOs have promoted the cultivation of vegetables originally not common in Cotacachi, such as lettuce, carrots and squash. Farmers and especially women[45], began establishing vegetable and fruit gardens close to their homes, and were excited for new harvests. But, unlike the more traditional crops (maize, beans, grains, potatoes, other roots and tubers), these products could not be stored well, and so surplus production often ended up as fodder for pigs or compost. Some women tried to sell their produce to vendors in the market, but were disillusioned by low and unstable wholesale prices and requirements of high quantities.

In the first part of 2006, 20 women farmers associated with Cotacachi's farmer union UNORCAC convened and decided to arrange a fair where they would sell fresh farm products. They asked the Municipal Assembly – an institution established to mediate between the public and the municipal administration – for permission to offer up their goods once a month at the grounds of the Union's headquarters. The rejection of their request caused frustration, and the women decided to go ahead anyway. One Sunday morning at the height of the harvest season just around Easter, they laid out woven mats on the lawn around the building, and invited passing people to buy freshly picked vegetables. Within a few hours, all they had brought was gone, and the success continued the next Sunday, too. But vendors at the nearby Municipal Market

[45] Cotacachi, as many other rural places, has during the past decades witnessed a feminization of agriculture. Many men work off-farm, while a majority of women stay behind and take care of fields and homes (Flora 2006).

despaired in fright of this new competition, and so did the mayor, owning 50% of that market's shares. As one woman explains: "as soon as [the mayor] heard that we were putting up a small fair, he made a scandal out of it". The third Sunday an angry director of the Municipal Market was sent to shut the fair down, ending in flurry with the women farmers defending their space. High administrators from the municipality and UNORCAC came together, but lasting agreement was not found. In the weeks and months and years that followed, the struggle continued. The mayor and municipal administration spearheaded a campaign against the Fair, sending health inspectors to attack lack of hygiene and police to close it. On the other hand fearless farmers withstood the storm, while continuing to provide produce for a growing group of loyal customers. The mayor tried to make them sell their products to the intermediaries at the municipal market, and then tried to rent them a space for themselves to sell there. In the end one Sunday the women lined up their produce for a negotiated low fee in a corner of the market. But they returned humiliated and angry, feeling that they had been exposed to racism and discrimination from the other vendors. This was no solution to the women, who decided to continue on their former grounds. Further, they explain, in the Municipal Market potential customers would be confused – they could not know whether what was sold were "healthy products, products that are brought by [the vendors] themselves, or if they come from somewhere else. There, mixed, one cannot distinguish, here, on the other hand, people already know the quality and all of that, and they come over here, and here we are all of us" (Carmen Farinango, grower-vendor).

The critique and tension continued until my departure from Cotacachi in 2010, but two factors eased the situation along the way. First, on the national level, a new Constitution heralding food sovereignty and among other things supporting alternative markets was approved in congress in 2008. Second, on the local level, a new mayor with more friendly attitudes toward the small farmers constituting the Fair was elected in 2009.

Figure 6.1: Market day.

6.4 Current State of the Fair

Consumers heartily welcomed the fair from the outset, creating a demand that outstripped what the farmers could offer (Figure 6.1). The group of growers has steadily grown, and by

March 2010, 80 farmers were associated with the Fair. According to a survey among 30 participants carried out by Fair organizers, most are women (90%) not employed off farm (87%), and they range in age from 13 to 75 (UNORCAC 2010b). Their land extension varies considerably (40 m^2 to 5ha), but the majority (58%) cultivate less than 1000 m^2 (UNORCAC 2010b) . They constitute a growers' association, and meet regularly once a month to discuss the development of the fair, share information about events, and set prices. They have developed a set of bylaws, among other things only permitting direct sale (no re-sales or intermediaries). There is also a strong focus on agroecology, and in collaboration with UNORCAC, there are courses and technical assistance in organic production methods. In line with the Union's focus on maintenance of agricultural diversity, each grower is encouraged to produce and offer up a range of products on their tables – in opposition to other markets that ask for a larger quantity of single products. The Fair markets itself as a place with organic products (*productos organicos*). There is no formal certification, and not everything is produced without chemicals, but most is, and the rest probably has less than what is offered in many other market venues.

The majority of growers do not have enough production to participate every week, such that the number of stalls normally varies between 30 and 50 (UNORCAC 2010b). A weekly fee of 25 cents is paid per stall, and with this communal fund they cover expenses such as cleaning equipment and have also purchased tables to sell from. Via the Union, the Fair is further associated with the US NGO Heifer International, which has contributed funds to pave the sales area and set up roofs that provide cover from sun and rain.

With the growth of the Fair, the range of products that is on sale has also increased. There are seasonal variations, but during the six-month period from October 2009 to March 2010, a total of 98 products were offered one or more times (UNORCAC 2010a). On average, each Fair encompassed 55 products, with 40 vendors offering four products each (Table 6.1). A newer addition is a food stand, offering traditional dishes, and operated on a rotational basis by women's groups from different communities.

Table 6.1: Statistics from the Fair October 09 to March 10. Source: UNORCAC 2010a.

	Average	Range	Total (whole period)
Products per fair	55	46-66	98
Vendors	40	27-51	80
Products per stand	4	1-17	

The Fair opens at around five thirty am every Sunday morning, when the first vendors have set up their tables, and ends at around ten or eleven, when the last ones pack up their empty trays. If vendors have leftovers, they typically trade these amongst themselves at the Fair's end.

6.4.1 Success among Customers

The Fair is clearly a success among customers. A variety of people come to buy, both from the urban area of Cotacachi, the surrounding communities, as well as other regional towns. They opt for the Fair instead of other food markets for different reasons. Important are quality attributes, including the freshness of the products (they are most often harvested the day before or the same morning), their taste, and their profile of healthy, natural, organic products, produced without chemicals. The quality is known, and so is the products' origin - they are grown by the vendor that stands in front of the customer. Another important factor is the price level, as prices are generally lower than in other local markets. The vendors in the Fair also emphasize that they are more generous than their counterparts in the Municipal Market a little further up the street their measuring cups are larger, and they give more as *llapa*[46] or extra heap). Buying at the Fair is thus good value – a higher quality for a lower price.

The Fair is the only place organic fresh products are sold locally. The next place to get organic produce is in *Supermaxi* – a foreign owned supermarket in the regional capital, Ibarra, some 30 km away – but here the produce section does not feature day-picked items. Even if markets with organic products are not prolific at this point, there is relatively high awareness about the dangers of chemicals in food production in Cotacachi, both among consumers and farmers. For instance, one woman, who sells among other things tomatoes at the Fair, exclaimed: “The other day I was in the [Municipal] Market, and I ate a slice of tomato. That smell of fungicide – super strong! I chewed a little bit, I was eating, but I left it. But *my* tomato, its taste is healthy (…) I grow it as if it were for me, not because I am going to sell.” (Carmen Farinango, grower-vendor)

The Fair also serves social functions for the costumers. People enjoy the experience of coming to shop, and some people coming from other towns make this a part of their Sunday family trip. The people behind the Fair have also arranged farm tours for interested costumers, where they are taken around to meet with farmers, walk in fields, interact and ask questions, and taste meals prepared from the products. As I joined one of these outings, I was somewhat surprised to realize that I seemed be more familiar with the geography of the communities than the participants from the town of Cotacachi. They were all overwhelmed by the generosity of the farmers, and thrilled to learn about the production and where the foods came from. One of

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[46] According to local custom a vendor may give the buyer a little extra after the amount and price are determined.

them emotionally told me, as I later ran into her in town, that it had been her most fascinating day of the whole year.

Table 6.2: Benefits from the Fair. Source: Interviews 2009-2010.

Customer benefits	*Grower-vendor benefits*
Fresher	Market guarantee
Tastier	Income
Healthier	Exchange of products
Natural	Training and experience:
Organic/without chemicals	Agrotechnical
Better, known quality	Market participation
Known origin	Exchange visits, other fairs
Cheaper	Empowerment
Generous amounts	Community
Experience	

6.4.2 Success among Grower-vendors

For grower-vendors, the Fair also offers benefits that keep the number of participants increasing. The most important reason may be economic – here they have space to sell with an excited and reliable mass of costumers every week. This is a significant difference from how it used to be before – women explain their disillusionment as they tried to sell produce to wholesale vendors, who only took their goods when they wanted to, and for the prices *they* decided, with the women having little to say. According to numbers from UNORCAC's survey, the average weekly income was USD 14.9 (SD 7.6), ranging from USD 2 – USD 25 (Table 6.3). To place this in perspective, the average weekly off farm income was USD 60 (SD 36.4), ranging from USD 25 - USD 180.

Further, the Fair has become a community and meeting place for the women. They exchange products among themselves. They also receive training – both more formally through courses and instruction in, for example, how to make compost and natural pesticides, and also experience in dealing with people in a sales situation. They have travelled to other parts of the country to learn about fairs and markets developing there, and received visitors from other regions.

Table 6.3: Weekly Fair and husband off farm income (USD). Data source: UNORCAC 2010b (N= 30).

Weekly income (USD)	Fair	Off farm
Average	14.9	60
SD	7.6	36.4
Median	16	50
Min.	2	25
Max.	25	180

Through the whole process, from fighting with the authorities for their right to organize the Fair, through getting acquainted with the situation of selling their products and interacting with people from many backgrounds across the produce tables, and through visits from and to farmers from other parts of the country, the Fair participants claim to have been empowered and strengthened.

6.5 The Future

As I leave Cotacachi in July 2010, the Fair leaders explain their plans are to buy a piece of land behind the current fair grounds and expand the space. The association members have already achieved the money through external funding, and are waiting for response from the mayor for institutional support from the municipality. In addition to giving room for more vendors – the current space is often filled to the rim – they aspire to also include meat products, as well as arrange a sale place for live animals. There is a positive atmosphere surrounding the

Fair, with hopes of a prosperous and fruitful future. “The Fair we would like to maintain forever. For our children, that it becomes a future. Among our dreams is this. And have land, expand more, and have a better future for our youth and children, and for everyone” (Juana Morales, President of UNORCAC’s Women Central Committee, Fair organizer and Grower-vendor).

6.6 Discussion

Cotacachi’s new farmers’ market faced a turbulent start, but the women behind it were fearless enough to fight for it and stand through the storm of authority attacks. Perhaps did this process even make the Fair stronger – giving it support and popularity both from the perspective of producers and consumers. Its leaders and vendors have fought against the attacks, placing a high focus on hygiene and freshness, and further developed its concept as something different than a market. “The market is where you have the whole question of intermediation of products, while this is a Fair of producers. Why? Because the growers come out to sell” (Juan Ulquiango, Fair Coordinator). Thus, they try to de-commercialize what takes place – the growers themselves come out and offer their harvest to the people – nobody else turns the produce into commodities just for profit.

In many ways the Fair bears similarity to farmers’ markets in the Global North – with direct sale of locally grown, high quality, fresh, organic or semi-organic products from small-scale farmers. It shows that such forms of production and marketing – a turn to celebration and promotion of the local and the natural – is not restricted to societies where farming is largely industrialized and people have reached a certain high income state where they start to care about the quality of their food. This is not a traditional market; it is a new development that exists along with other venues of fresh produce. As one of the organizers comments: “it is an alternative space of commercialization. Moreover, it is not a traditional space. Because fairs are done with a focus of changing the way of living, right?" (Juan Ulquiango, Fair Coordinator)

Omitting the intermediaries, the vendors are able to sell at a low price, and since the Fair is situated very close to the municipal market, it is just as easy to access as the other one, given one has time on Sunday mornings. Thus, this is not a place for the privileged, but open and accessible to all. In this sense, one might say that the Fair reaches further regarding issues of consumer social justice than farmers' markets of the Global North (Allen 2010).

The Fair is a place where rural people gain income and empowerment. A problem in most current food systems is that the farmer only receives a small portion of the final price of the product. In this case, farmers totally circumvent all intermediary costs, and thus are able to offer customers high-quality products at a low price. Further, the Fair, together with the farm tours, contributes to building trust and respect between producers and consumers. This is especially noteworthy and important in this case – a region with a dark history of colonial and postcolonial discrimination of indigenous people working the land and mestizo-whites holding the power (Icaza 1934; Lyons 2006). Now the farmwomen stand together, and the exchanges take place on *their* grounds, both physically (the farmer union's land) and figuratively (they set the prices).

6.7 Conclusion

Figure 6.2 shows the sign placed over the Fair grounds with its slogan "Community Fair - Mother Earth nourishes us." Below is written *valorando nuestros cultivos* – "placing value on our crops". These words, together with the picture collage of farmers working their fields in the local landscape demonstrate appreciation of what the earth provides, and pride in the role of the farmer in bringing it forth. It is a sign of new trends in Cotacachi – a few years back its existence would have been beyond imagination (Chapter 4).

The experience of this particular Fair suggests relocalized food is not only a symptom of postmodernity – there is great potential in moving toward more equitable and healthy food systems through new forms of direct marketing not only in affluent societies but in lower income ones as well.

Figure 6.2: Picture of the Fair's banner and slogan, "Mother Earth nourishes us".

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CHAPTER 7

FROM LOST CROP TO LUCRATIVE COMMODITY: THE QUINOA RENAISSANCE[47]

[47] Skarbø, K. To be submitted to *Human Organization*.

Abstract

Two decades ago quinoa was identified by the US National Research Council (1989) as a "lost crop of the Incas". Since then, it has been rescued from oblivion and attained the status of a global gourmet grain. Nutritious and tasty, it is today found in many nations' markets, and touted in a plethora of cookbooks and websites as a miracle heritage food. This development has been accompanied by a keen interest in the crop among research and development agencies, and also led to a renaissance for quinoa in its native Andes. This paper explores how quinoa's renaissance plays out on the ground in Cotacachi, Ecuador. Drawing on participant observation, interviews, and survey data, I report from several projects aimed at boosting quinoa production to feed local and export markets. Although framed as initiatives to save an eroding crop, paradoxically, the production regimes promoted have little in common with farmers' traditional quinoa cultivation, whether in terms of agricultural techniques or the actual seeds employed. In several ways, quinoa exemplifies how the "lost" sometimes becomes the "modern", and in the process, former properties fade while new ones appear. What we get is not what we had.

7.1 Introduction

This case study examines the recuperation of a "lost crop", quinoa (*Chenopodium quinoa*) in the Ecuadorian Andes. Quinoa was a central crop in Andean highlands through several pre-conquest millennia (Morris 1999; Tapia 1979), but ceded ground to Old World grains after Spanish colonization (National Research Council 1989). During the past three decades, the plant has captured considerable national and international attention, and in recent years numerous projects have been put in place to recuperate its cultivation in the Andean countryside. This study sets out to examine on-the-ground implications of this recuperation for biodiversity conservation in the case of Cotacachi, a site for several quinoa production projects. Do the efforts enhance the local maintenance of quinoa?

Below, I shall start out with a short description of the study area as well as the methods employed. Next follows a brief introduction to quinoa and its history, and a description of its traditional role in Cotacachi. I go on to describe quinoa's renaissance in the Andes in general, and then in Cotacachi in particular, through the description of two local projects. Finally, I report and discuss changes in quinoa agrobiodiversity following the implementation of the projects, and conclude that while the extent of quinoa has benefitted positively on a crop level, the new developments may threaten the conservation of quinoa landrace diversity.

7.2 Study Area and Methods

7.2.1 Study Area

The present research was carried out in Cotacachi, a *cantón*[48] in Northern Ecuador's Imbabura province, about 80 km from the capital Quito. While the *cantón* also includes a

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[48] Geographical-administrative unit roughly corresponding a US county. Ecuador is divided into 24 *provincias*, each of which is further subdivided into a number of *cantones*.

subtropical zone, the study is focused on the canton's Andean part, an area of about 219 km^2, spanning altitudes from 2,080m and up to the peak of the landmark volcano Cotacachi at 4,939m (Zapata Ríos, et al. 2006). The population is mainly divided between three urban centers – Cotacachi, Quiroga, and Imantag, with an estimated 9,000 inhabitants, and 43 rural communities, with a combined population of 15,884 (INEC 2011; UNORCAC 2007). The majority of urban dwellers are *mestizo*, while most community members identify as Kichwa (INEC 2011). Agriculture remains an important livelihood strategy among rural households, although most have members that work off farm as well. The main focus is on subsistence production, but those who have more land also cultivate for the market. Fields and communities span an altitudinal belt from about 2,300m in the Inter-Andean valley bottom and up to 3,300m. As temperature regimes change up the hill, so does the complex of crops grown. Agrobiodiversity is high, both on a farm and overall level, reflecting a long agricultural heritage. In 2009-2010, 103 cultivated species were identified, and within 20 of the most important crop species, a total of 367 varieties were documented (Chapter 2).

7.2.2 Methods

This study forms part of a larger dissertation project, involving 12 months of fieldwork in Cotacachi during 2009 and 2010. It also builds on data collected by the author in the same area in 2003-2004 (Skarbø 2005; Skarbø 2006). Participant observation in communities and urban areas allowed for insight into quinoa's changing role in different settings. Interviews with farmers and representatives of institutions and non-governmental organizations provided information about quinoa-related projects. Finally, surveys of on-farm agrobiodiversity in 2003 and 2009 yielded data on changes in the composition of local quinoa diversity during this period.

Five communities representing different geographical and agroecological zones were selected for the surveys. Of 45 farms originally surveyed in 2003, it was possible to relocate and survey 37 in 2009. Comparison of these two snapshots of local agrobiodiversity shows changes in numbers of quinoa cultivators as well as the varietal suit grown. For a fuller picture of the recent situation, the sample in 2009 was expanded to a total of 89 farms.

7.3 Background and Results

7.3.1 Quinoa's Past: Glory and Neglect

Quinoa (*Chenopodium quinoa*) is not a grass like most of our major staple grains, but belongs to the goosefoot-family. Because of this heritage it is classified a "pseudo-cereal", together with other related American domesticates (Harlan 1995). But, despite this perhaps slightly second-rate sounding term, quinoa boasts nutritive qualities superior to most cereals. Its protein contains a remarkably balanced set of essential amino acids, similar to milk's caseine (Repo-Carrasco, et al. 2003). It is also rich in polyunsaturated oil, vitamins, minerals, and antioxidants (Abugoch James 2009; Repo-Carrasco, et al. 2003).

Quinoa was domesticated about 5000 BP, probably on the high plateaus of Southern Peru and Bolivia (Bruno 2006; Pearsall 2008). At the time of the Inca Empire in the 14^{th}-15^{th} centuries it was grown along the whole Andean mountain range, from Colombia in the North to Chile in the South (National Research Council 1989). So central was its importance in the reign that the emperor ceremonially broke soil with a golden spade and planted each season's first quinoa seed (National Research Council 1989). But its public celebration was then to fade. Together with a number of other native crops, quinoa became one of those disdained by Spanish conquerors' successors. Instead, Old World imports, notably wheat and barley, grew in importance as highland grains. In the second half of the 20th century, quinoa's competitive pressure was increased as wheat gained even further stronghold as a food in the Andes, linked to the initiation of large-scale import programs (Tapia 1979). Harbored in the US Law PL480, massive amounts of wheat were cheaply or freely provided Andean governments by the United States, and white bread and pasta rose in importance in urban as well as rural diets (Brett 2010). Together with other processes, such as agricultural modernization, off farm employment and cultural change, the growing availability of imported food alternatives has been linked to decline during the past few decades in the rich agrobiodiversity cultivated in the Andes – one of the world's cradles of agriculture (Jacobsen and Sherwood 2002; Skarbø 2006, Chapter 3).

7.3.2 Quinoa Traditions in Cotacachi

Despite competition, quinoa was never lost from Cotacachi. In kitchens, it continues to be an appreciated ingredient in savory and sweetened soups. The grain forms the base of a fine soup, considered especially hearty and tasty. In the field, the plant is prized for its frost resistance. Traditionally, quinoa is most often intercropped with maize, beans, squashes, faba beans and other crops. Alternatively, it is planted with lupines or fabas only, or as a monocrop. When intercropped, farmers consider the plant to protect the whole field from night frosts. The crop's exceptional frost resistance has also been recognized by scientists, and some varieties have been measured to avoid freezing at temperatures as low as -8 °C, linked to the plant's ability to supercool (Jacobsen, et al. 2007). Recent research further shows that in quinoa monocultures, tall plants provide shade and radiative protection for lower ones, such that night temperatures often are 2-3 °C higher in their shade than on the top of the tallest plants' canopy (Winkel, et al. 2009). This ability to provide radiative shade might explain Cotacachi farmers' consideration of quinoa as a frost protector of other crop species as well. Further, quinoa is adapted to all of Cotacachi's agroecological zones and does not require highly fertile soil to produce well. Farmers distinguish between three main landraces, varying in size and coloration of plant and grain, cooking quality, and other characteristics. The crop requires high labor, especially its harvest and preparation. Panicles are hand cut, dried, and threshed. Further, each seed is enveloped in a bitter, saponine-containing coating that must be removed before cooking. This is done by packing the amount of seed needed for a pot of soup into a piece of cloth and scrubbing and washing arduously for about one hour.

According to local legends, quinoa's bitter coat is a curse from *Achiltaytiku* (Father God). Once, when he was here on Earth in personified form, the malevolent *aukas* wanted to kill him, and he had to flee. When he passed by a quinoa plant, the plant shivered and let its grain fall to the ground, thus exposing his path. *Achiltaytiku* was angered, and blew three times on the quinoa saying: "they will cut you, scrub you, then wash you, and after that you shall serve as food for the humans". The story ends with a moral lesson: we shall not spread the word about everything we come to see, for this way we might lose friends and turn bitter like quinoa. (Interview with Maria Juana Matango 2010)

The crop's legendary inscription attests to its deeply held position in local culture and agriculture. In 2003, 26 of 45 surveyed farms (58%) in Cotacachi grew quinoa (Skarbø 2006). The crop ranked 5th in popularity among 17 field crops – it was less common than maize, beans, potatoes, and peas, but as common as lupines, and more common than many others. Still, people reported its role to have declined during the past generation, a trend especially attributed to its heavy labor requirements.

7.3.3 The Quinoa Renaissance

From the 1980s, quinoa entered a new era of celebration. Researchers with background both in the Andes and beyond realized that quinoa, along with other native crops largely neglected by urban and scientific communities, carried potential for future agriculture (Mujica 1994; National Research Council 1989; Peralta 1985; Tapia, et al. 1979). Its retreat from Andean fields was characterized as worrisome; instead of further stimulating its take-over by wheat and barley, there was a need to promote its conservation and cultivation. Also from foreign perspectives, interest in the crop was sparked. In the United States National Research Council's book entitled *Lost crops of the Incas*, quinoa was listed among 30 other Andean domesticates that had largely been "lost to the outside world." (National Research Council 1989: 3). But, the authors urged, "it is not too late to rescue these crops from oblivion" (National Research Council 1989: 3). Quinoa was posed "a grain of the future" (National Research Council 1989: 150); in addition to a potentially increased importance in the Andes, it was considered a promising crop for other marginal highland areas, as well as an interesting product for consumers in developed countries. Quinoa's perceived loss was thus manifold: it was losing ground in Andean fields, and if not halted, this would mean the loss of a precious food both for those already familiar with the grain as well as potential consumers in other countries.

Since the 1980s, Andean research institutions have, with the support of foreign donors and collaborating institutions, invested considerably in the development and conservation of native crops, and among them, quinoa has played a prominent role. In Ecuador, breeding efforts began in the 1960s (McElhinny, et al. 2007), but it was not until the 1980s that a concerted research program was formed (Nieto C. 1993). Backed by foreign funds, in particular from the Canadian International Development Research Centre (IDRC, or CIID in Spanish), the National

Figure 7.1: Quinoa packaged for the Spanish market.

Institute for Agricultural and Livestock Investigation (INIAP) began systematic collection of germplasm of quinoa and other native Andean crops, breeding of improved varieties, development of harvest and post-harvest technology as well as new quinoa-based products, and promotion of the crop among producers and consumers (Nieto C. 1990). Already in 1993, Carlos Nieto, one of INIAP's researchers, declared that in this "recovery of native mountain species from their imminent genetic erosion…quinoa has been transformed from an almost forgotten crop to a commercially valuable crop in the Ecuadorian mountain range" (Nieto C. 1993: 185-188). Major achievements included the release of two near saponine-free varieties, *Tunkahuan* and *Ingapirca* (Nieto C., et al. 1992). Research, development and extension programs involving quinoa continue on today, and involve numerous foreign and local NGOs and institutions (McElhinny, et al. 2007; Peralta I., et al. 2009; Villacrés P., et al. 2011). Relatedly, a number of businesses for processing and export have appeared (Banco Central de Ecuador 2011). Quinoas' remarkable attractive power to research and development agencies seems to stem from its dual potential to improve diets and raise incomes (Jacobsen and Sherwood 2002; McKnight Foundation n.d.).

In tandem with the above development, an international market for quinoa has taken form and grown. Quinoa can be said to have it all for the modern, conscious consumer: a good bite of organic, fair trade, heritage, healthy and tasty gourmet gastronomy (Figure 7.1). According to data from FAOSTAT, 10,344 metric tons of quinoa was traded internationally in 2009, up from 177 in 1980 (Figure 7.2). Most of this global market has been fed by rising production in Bolivia and Peru (Figure 7.3). However, also from an Ecuadorian perspective, exports have risen. Ecuadorian quinoa has been sold to over 15 countries during the past two decades, the most important of them being the US, the UK, France, Spain, and Colombia (Figure 7.4).

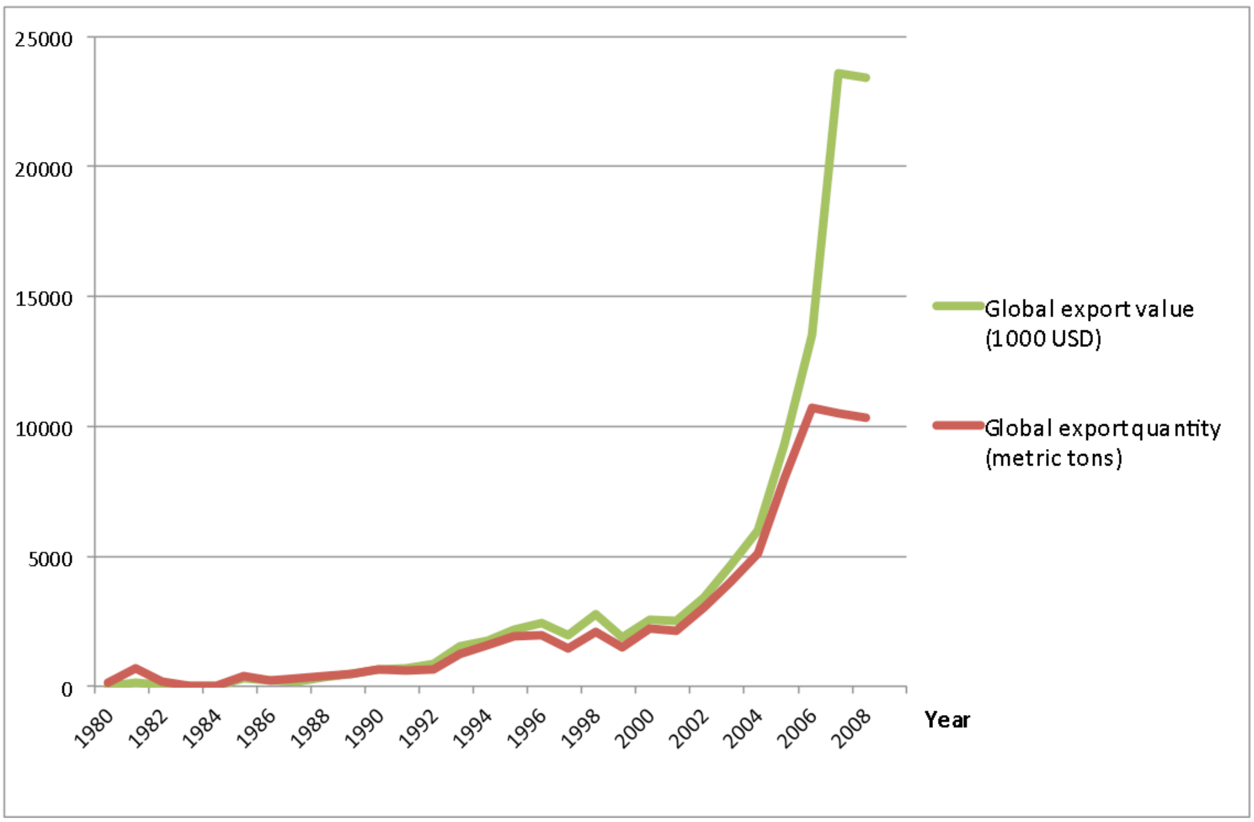


Figure 7.2: Global quinoa exports, 1980-2009. Data source: FAOSTAT, faostat.fao.org.

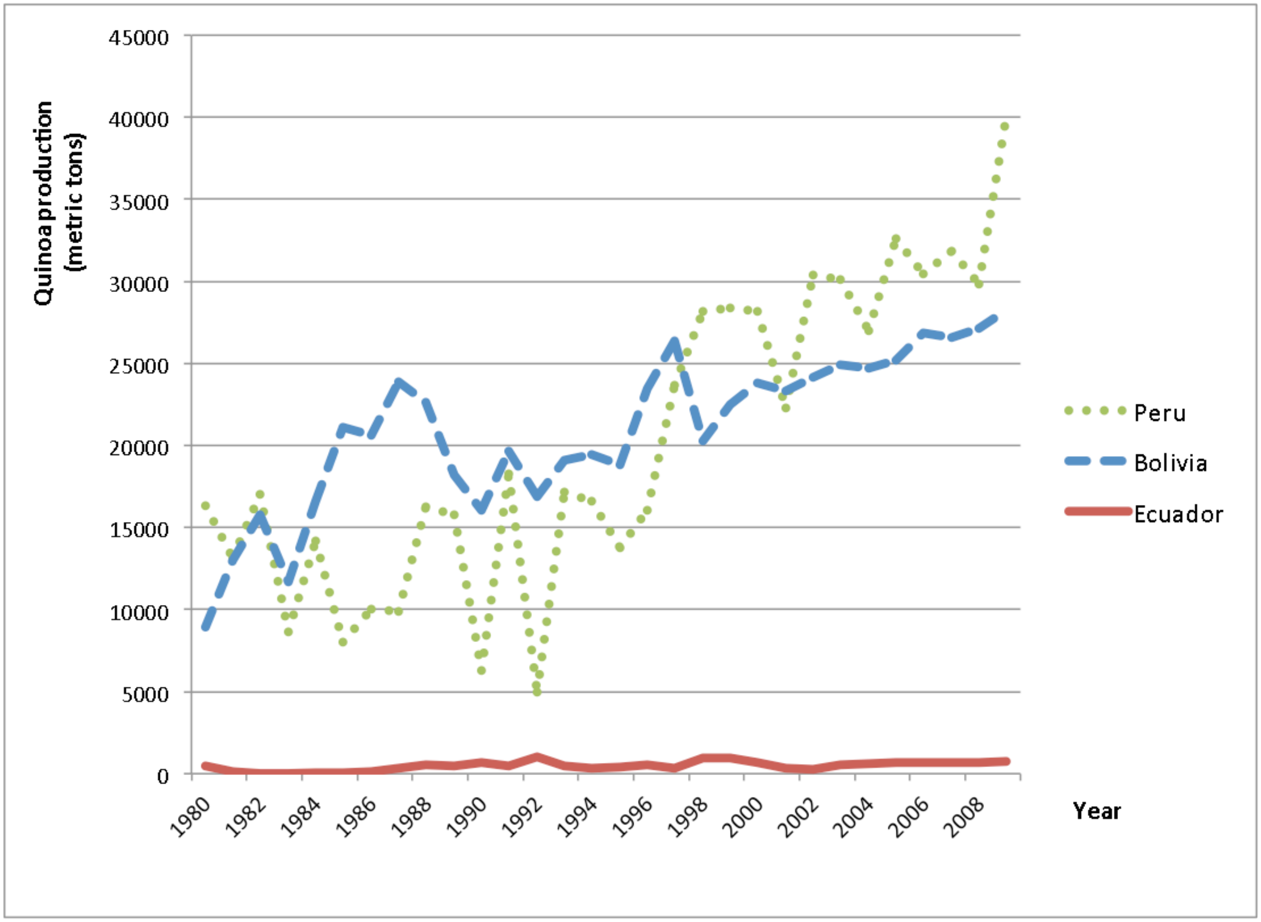


Figure 7.3: Quinoa production in three Andean countries, 1980-2009. Data source: FAOSTAT, faostat.fao.org.

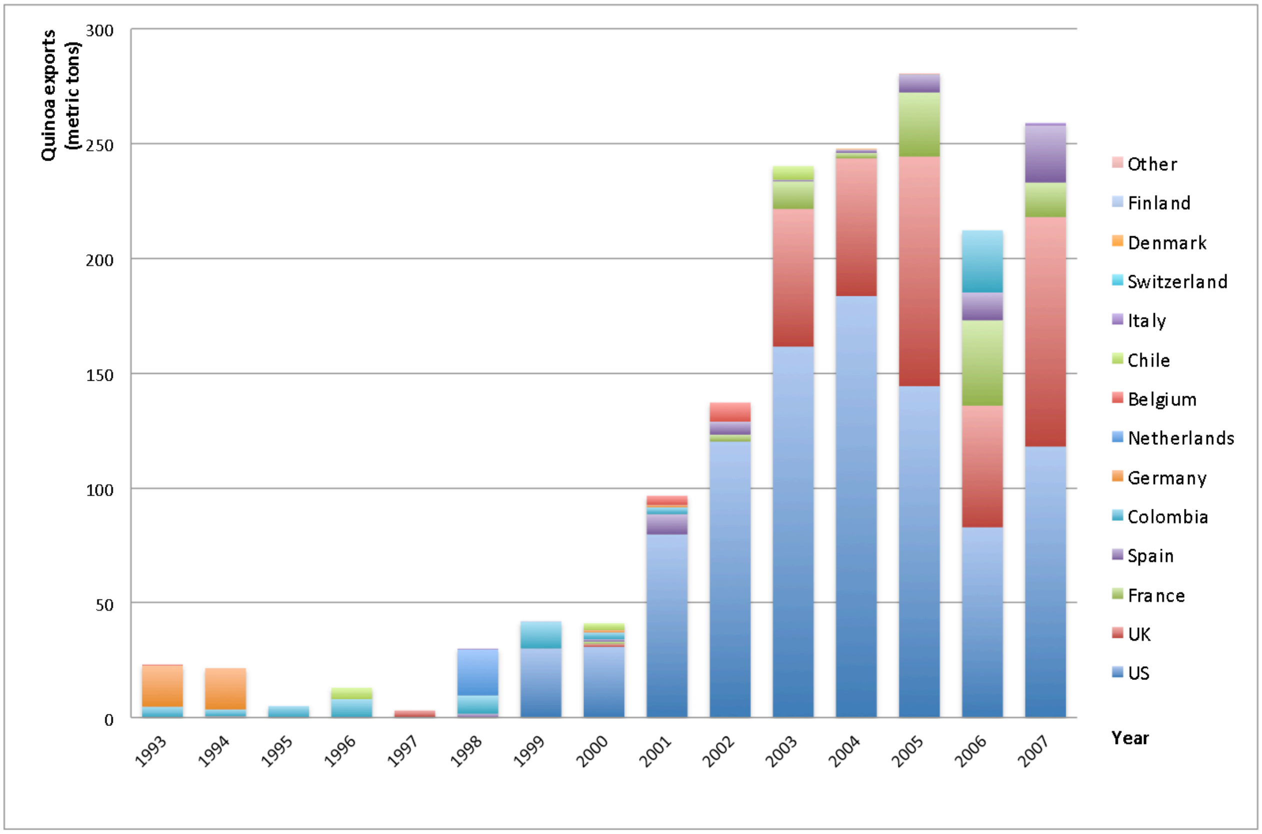


Figure 7.4: Ecuador's quinoa exports, 1993-2007. (This was the only period for which data was available at time of retrieval, in November 2011). Data source: Banco Central de Ecuador, www.bce.fin.ec.

7.3.4 Quinoa's Renaissance in Cotacachi

In 2003, quinoa was still for the most part just plain old quinoa in Cotacachi. Its renaissance had yet to reach the region, however, it was soon to come. Since then, several quinoa-focused projects have played out in local fields. Cotacachi is a worksite for a variety of organizations, and many of them have taken part in promoting the crop. For some illustration of this process, we shall here look into two larger initiatives, one led by an Italian NGO, and one by an Ecuadorian entrepreneur.

7.3.4.1 Project 1: the NGO Example

The Italian NGO Ucodep has been working in Ecuador since 1993, with the objective of "strengthening the capacities of indigenous and peasant organizations, recuperating and valuing local resources and knowledge" (Ucodep 2010: 2). Cotacachi has been one of their main sites to undertake this task. In collaboration with the local farmer union UNORCAC and other organizations, Ucodep has been involved in varied rural development projects in the area's communities. Their recent quinoa initiative, begun in 2007, has been carried out under two project umbrellas, one supported by the International Fund for Agricultural Development (IFAD) and Bioversity International, and the other by *Cooperazione Italiana* – the Italian government's aid and development agency. Ucodep has acted as a bridge between the Quito-based company *Cereales Andinos* (CA) and local farmers. The company provides seed (INIAP's saponine-free variety Tunkahuan) and technical advice to farmers, who in turn commit to sell 80% of their harvest to CA, and in addition give back an amount equivalent to the seed they received. Ucodep has invested in two threshers, which they move around to the different communities during harvest time. In 2010, farmers were paid $70/*quintal*[49], of which $5 went towards covering threshing and transport costs. Cereales Andinos process the grain into a suit of quinoa-based products for the national market, including granola, quinoa flakes and energy bars (Cereales Andinos 2011). Ucodep reports of a rapidly growing interest among farmers to participate in the project – by May 2010, 134 farmers had joined; 74 individuals and the rest organized in five community associations. In total, they were cultivating 60 ha of quinoa.

The NGO's staff explains that whereas projects typically have been oriented exclusively on export markets, they intend to change this, focusing instead first on food for the families

[49] The *quintal* is a common unit for measuring agricultural harvest in Ecuador, and corresponds to about 46 kg.

themselves, then on local markets, and third, on export. Thus, they have campaigned to foment local rural and urban consumption of quinoa and other native crops. They have worked with chefs to develop new and modern recipes, printed posters and recipe cards, arranged meetings, tasting events and even a culinary contest with the participation of local restaurants. Their efforts have not been in vain – local cafes are starting to offer modern quinoa inventions on their menus, and customers are curious to try things such as quinoa-filled *empanadas* and cakes. This rising interest in foods from an indigenous crop is also related to broader societal reconfigurations, entailing a new appreciation for indigeneity in general and indigenous foods in particular (Chapter 4).

7.3.4.2 Project 2: the Entrepreneur Example

A second quinoa production project in Cotacachi consists of community based women farmer associations producing on rented hacienda land, in arrangement with an entrepreneur. Behind this initiative stands an entrepreneur from the regional capital Ibarra, also seat of the region's branch of the Ministry of Agriculture, Livestock and Fisheries (MAGAP). In 2008, he contacted women in the communities of San Pedro and Azama, encouraging them to form associations of about 20 members and co-cultivate quinoa with him on land rented from adjacent haciendas. Seed (again INIAP's variety Tunkahuan) and agronomic advice was provided by a MAGAP employee. The entrepreneur arranged the land rent and hired someone to plow the fields with a tractor, and the women were responsible for all remaining work, including preparing furrows, planting, weeding, pesticide application if deemed necessary by the MAGAP agronomist, harvesting, drying, threshing, and packing the quinoa in sacks. Of the harvest, 25-40% went to cover land rent, and the remaining was divided equally between the entrepreneur and the women's associations. The women divided their share between them according to labor input logs. The entrepreneur then purchased any quinoa they did not want to keep, for $100/*quintal*.

I first learned of the above initiative from association members in San Pedro, during interviews together with my field assistant – a Kichwa farmer from Cotacachi's Quitugo community. The interviews were focused on other topics, and we did not ask in detail about the arrangements at that point. I then left Cotacachi for a couple of months. When I came back, my assistant told me that she had ran into the quinoa entrepreneur, who had shown great interest in setting up a similar arrangement with the already existing women's association that she was leading in her community. But when she learnt the details of the terms, she became very skeptical. The man kept returning to her home in order to settle the deal, but she just kept escaping – telling her daughter to say that she was not home – until one day she finally decided to confront him and his conditions. She let him know that to her, the scheme was going back to the time when her grandmother was young. She had a sheep, and was allowed to graze it on the hacienda's land. But in exchange for this, she had to work on the hacienda's land, she had to go cook for the *hacendados*, she had to work all day long, for no pay, just being allowed to graze her sheep. "This is the same!" she exclaimed in his face. She proposed that he come work with them with the hoe, or, if he wanted half of the harvest, that he came forth with an equal number of workers, throughout the seven-month growing season. But that was no option for the entrepreneur – *they* were the ones that were many, and could provide labor, he insisted. He tried in many ways to convince her, talked about the crop's high nutritional value for her children, about the income she would get, but she was not to be rocked. The man explained he had contacts in Germany, and a large order that was to be filled. But no deal was struck in Quitugo.

The woman stood firmly on her ground, and did not wish to go back in time. She later found out that he had made arrangements with a neighboring community.

Even if my assistant was put off by the entrepreneur's terms, she fully supported my suggestion of giving seeds of Tunkahuan (the modern variety) to workshop participants in her community. It was thus not the quinoa-part she was against, but rather the disproportionate part of the harvest the man wanted to carry off. His successful negotiations in other communities demonstrate people's high interest in the "new" quinoa and the income generating opportunity presented, even despite these slightly exploitative terms.

7.3.4.3 Old Grain – New Ways

The two above examples illustrate the ample set of actors riding the quinoa wave in Cotacachi and beyond: farmers, governmental and non-governmental organizations from local to global levels, processing companies, restaurants and entrepreneurs. A range of intentions is involved – from pure profit making to earnest attempts to improve others' livelihoods and conserve the cultivation of an eroding crop.

The two initiatives are quite different in the aims and motivation of their architects, as well as the distribution of benefits – but not so unlike in practice when it comes down to agricultural production. In both cases, quinoa is grown in monoculture, employing the formally bred Tunkahuan variety. The main focus is on market production, and only a small part of the harvest is kept for home consumption. Some level of mechanization is involved, including tractors for field preparation and mechanical threshers. And the cultivation is supervised by external institutions' technical staff. This stands in rather sharp contrast to the traditional way of growing quinoa in Cotacachi described above – where landrace varieties of quinoa are intercropped with other plants, employing low levels of mechanization, guided by traditional knowledge, primarily for subsistence purposes (Table 7.1). Apart from the fact that the same species is involved, the latter has little to do with the former – even the actual genetic material in the seed is different.

Table 7.1: Comparison of traditional and modern quinoa cultivation in Cotacachi.

Feature	Traditional quinoa cultivation	Modern quinoa cultivation
Dominant cropping system	Intercropping	Monoculture
Varieties	Landraces	Formally bred variety
Mechanization	Low	Medium
Technical supervision	Traditional/farmers' knowledge	Scientific/agronomist's knowledge
Orientation of production	Subsistence	Market

7.3.4.4 *Mishki Kinuwa*: Embracement of Quinoa's Modern Guise

What makes the new quinoa so attractive among project participants? Table 7.2 presents a comparison of the characteristics of different quinoa varieties from local perspectives, based on workshop exercises. Tunkahuan is called *mishki kinuwa* or "sweet quinoa" in the local Kichwa vocabulary, for its lack of bitter saponine. This feature in particular thrills women, as it dramatically reduces the amount of labor needed to prepare a pot of soup. Its "pure" white color is also appreciated by many. *Mishki kinuwa* further has good market accept, and sells for a high price, thus presenting a chance to earn extra income. All of these factors seem to propel farmers' interest in participating in the quinoa renaissance.

Table 7.2: Characteristics of quinoa varieties in Cotacachi.

Name (Kichwa)	Chawcha	Puka chawcha	Hatun	Mishki
Name (Spanish)	Chaucha	Chaucha rojo	Grande	Dulce
Name (English)	Fertile	Red fertile	Large	Sweet
Name (formal)	-	-	-	Tunkahuan
Origin	Native	Native	Native	New
Plant description	Short plant Slender stem Dark green leaves with red powder	Short plant Slender stem Pale green leaves with white powder	Tall plant Thick stem Dark green leaves with white powder	Tall plant Thick stem Green leaves with pink powder
Grain color	White	Reddish	Yellow	White
Medicinal properties	No	No	Yes	No
Rinsing requirements	Relatively quick	Long time	Long time	Very brief
Cooking quality	Soft	Hard; longer time needed	Soft	Soft
Market accept	Low	Low	Low	High

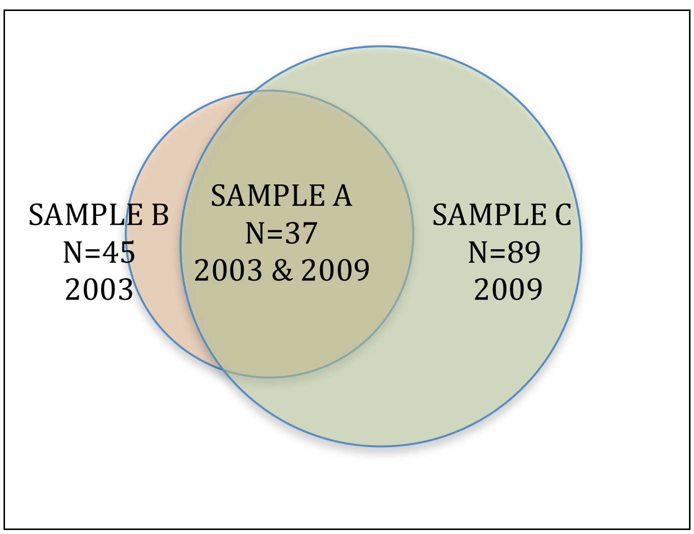


Figure 7.5: Venn diagram of the partly overlapping farm samples from 2003 and 2009.

7.3.5 Conserving Quinoa? Impacts on Cotacachi's Agrobiodiversity

Do the new quinoa production projects contribute to conserving quinoa in the case of Cotacachi? In what follows, I will examine this question in the light of data on agrobiodiversity from sampled farm households. As explained above under *Methods*, the data comes from two rounds of surveys in Cotacachi, one in 2003 and one in 2009, documenting the crops and varieties planted by each farm household during the previous agricultural year. The total sample sizes were 45 in 2003 ("Sample B") and 89 in 2009 ("Sample C"). The two samples partly overlap – 37 farms were surveyed in both years ("Sample A") (Figure 7.5). Below, I will report changes in agrobiodiversity on the crop and variety levels, as well as data on seed sources, before discussing the projects' conservation implications.

7.3.5.1 Changes at the Crop Level

Table 7.3 and Figure 7.6 show that there was a decline in the portion of farmers growing quinoa from 2003 to 2009, both when considering the smaller and the larger samples in each year. In 2003, close to 60% of surveyed farmers grew quinoa, while the figure was reduced to near 40% in 2009. Farmers themselves explained that their abandonment of the crop was related to its high labor requirements. The decline in the number of quinoa producers resonates with a decline in the number of farmers growing several other field crops during the same period, a complex process that is linked to reduction in available labor, increasing importance of off farm work and purchased foods, climatic calamities, and the lack of regeneration of local planting material.

Table 7.3: Proportions of farmers growing quinoa in 2003 and 2009.

Grows quinoa?	Yes		No		Total	
Sample	*N*	%	*N*	%	*N*	%
Sample A - 2003	*21*	57	*16*	43	*37*	100
Sample B - 2003	*26*	58	*19*	42	*45*	100
Sample A - 2009	*15*	41	*22*	59	*37*	100
Sample C - 2009	*33*	37	*56*	63	*89*	100

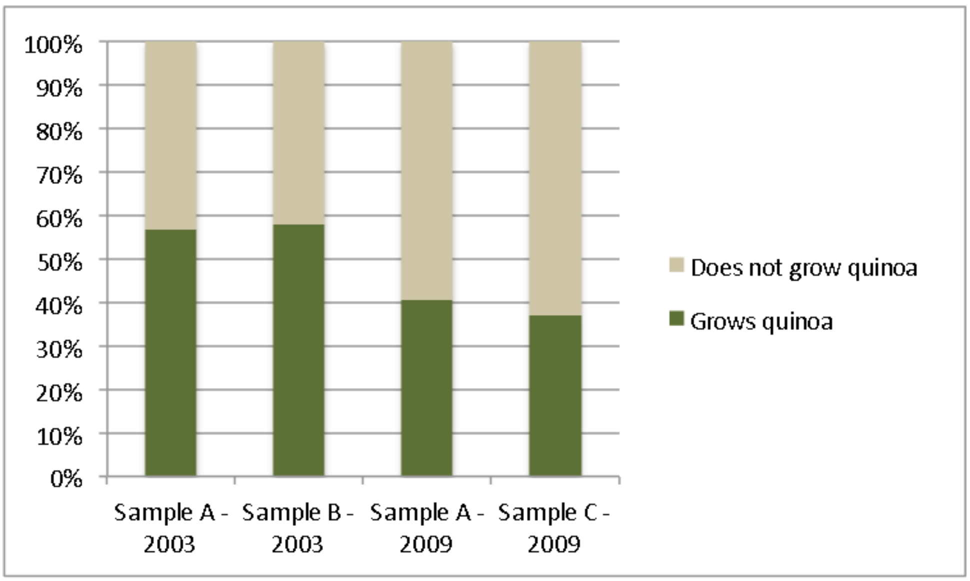


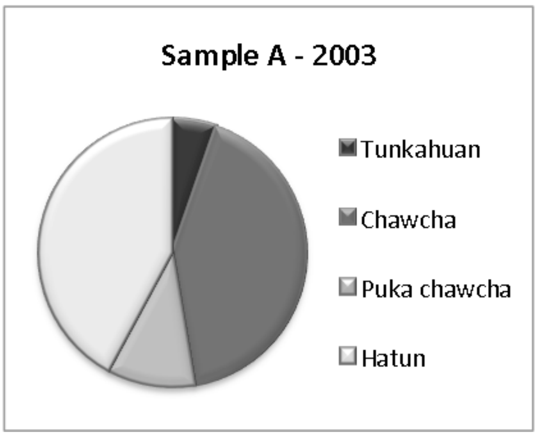
Figure 7.6: Proportion of farmers growing quinoa in 2003 and 2009. See Table 7.3 for frequencies.

7.3.5.2 Changes at the Varietal Level

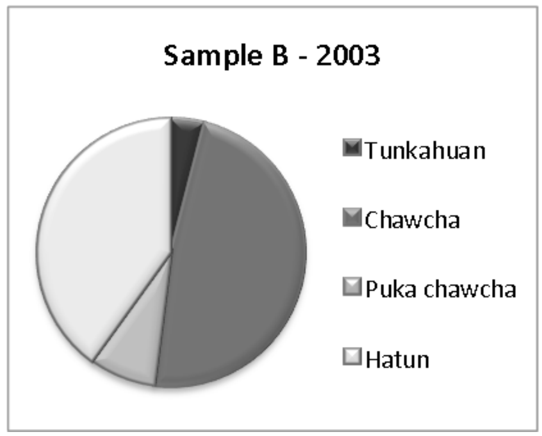
Changes in the distribution of varieties are reported in Table 7.4 and Figure 7.7a-d. Most quinoa-growing farmers planted only one variety, but some planted two or even three different varieties. Thus, the total number of *seed lots* (seed of one variety, selected and planted on a specific farm during a season [Louette 2000]) slightly exceeds the number of surveyed farms. In 2003, the seed lots planted were almost exclusively local landraces; only one sampled farm

Table 7.4: Relative distribution of quinoa varieties in recorded seed lots, 2003 and 2009.

Sample/Variety	No. of seed lots	Tunkahuan (%)	Chawcha (%)	Puka chawcha (%)	Hatun (%)	Unspecified landrace (%)
Sample A – 2003	*23*	4.3	35	8.7	35	17
Sample B – 2003	*30*	3.3	40	6.7	33	17
Sample A – 2009	*19*	42	26	5.3	26	0
Sample C – 2009	*42*	43	26	4.8	26	0



a.



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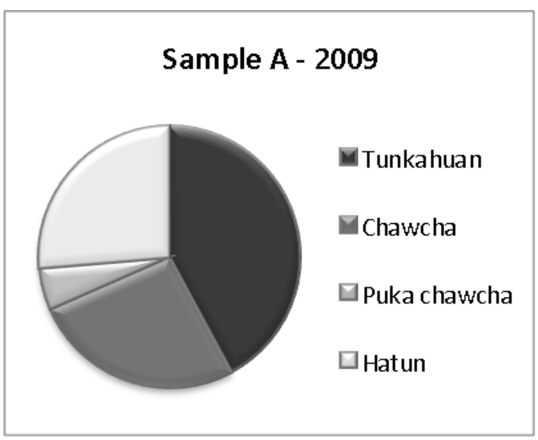
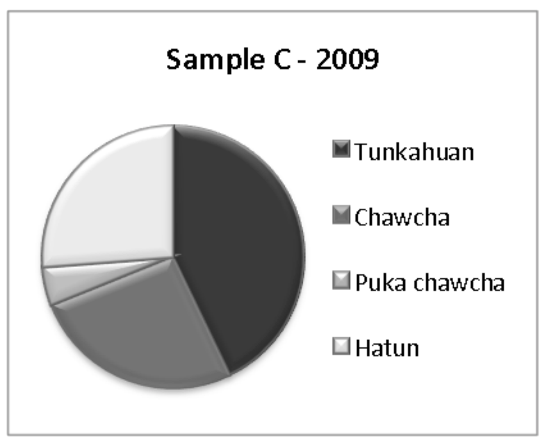


c.



d.

Figure 7.7a-d: The proportion of different varieties making up sampled farmers' seed lots in 2003 and 2009. See Table 7.4 for exact percentages.

household had planted INIAPs Tunkahuan variety, acquired on a trip to another region. The situation was turned on its head in 2009, when over 40% of the seed lots were made up by this new variety. Both among the subset of farmers sampled in both years (Sample A), as well as in the larger sample (Sample C), Tunkahuan had become the most popular variety.

Data on the age of each seed lot from the extended 2009 sample confirm the recent introduction of the latter variety in the local farming system. Table 7.5 shows summary data on farmers' reports of how many years they had planted and saved seed of their currently grown quinoa seed lots. While the mean age of landrace seed lots ranged from 8.5 to 17.6 years, with a maximum of 60, the average number of years Tunkahuan seed lots had been planted was 2, with a maximum of 7.

Table 7.5: Number of years seed of the current seed lot have been planted on farm. Summary data based on 42 seed lots from 33 farms, 2009.

Variety	Tunkahuan	Chawcha	Puka chawcha	Hatun	Total
Mean	2	17.6	8.5	14.7	*9.6*
Median	1	5	8.5	10	*2*
Min.	1	1	2	1	*1*
Max.	7	60	15	40	*60*

7.3.5.3 Seed Sources

Finally, data on seed sources underline the central importance of projects and NGOs in organizing the entry of Tunkahuan seed to Cotacachi's farms. Table 7.6 and Figure 7.8 present an overview of where farmers originally obtained the quinoa seed they planted in 2009. While family (including parents, grandparents, and fictive kin) was the chief source of landrace seed

(71%), NGOs or other projects were the most important sources of Tunkahuan seed (50%). In addition to the two projects described above, farmers had received seed directly from the farmer union UNORCAC, from a project in a community school, and from organized visits to project sites in other areas. Others had obtained Tunkahuan seed through exchanges or gifts from neighbors or family members, most of whom had received seed from institutions. Thus, seed introduced through projects rather rapidly move on to non-participating farmers interested in testing the variety. So far, local markets have played no role in the spread of Tunkahuan, while they play a minor role as a source of landrace material.

7.3.5.4 Conservation Implications

What are, then, the conservation impacts of quinoa's renaissance in Cotacachi? Do the projects and initiatives that have grown out of an original concern about the loss of this crop contribute to conserving it? The answer depends on how we pitch our gaze.

On an overall crop level, it is likely that the initiatives have had a positive effect – both in terms of number of cultivators and in area devoted to the crop. The observed decline in number of quinoa cultivators between 2003 and 2009 might have been steeper if the campaigns and projects were not in place. Although I do not have data concerning changes in the area under quinoa cultivation, it is very likely that the recent developments have led to an expansion in this regard. This is because, first, Tunkahuan is grown in monoculture, and thus on a larger area than quinoa grown the traditional way, intercropped with other species. Second, many grow it as a cash crop, and thus in larger extensions than they would if it were solely for subsistence needs.

On the varietal level, the answer is mixed. At least in this initial stage, there is a positive effect on local varietal diversity by the new addition – farmers have one more variety to choose

Table 7.6: Reported sources of quinoa seed, 2009.

Varieties	Tunkahuan		All landraces		Total	
Seed source	*N*	%	*N*	%	*N*	%
Family	*3*	17	*17*	71	*20*	48
Neighbor	*4*	22	*1*	4	*5*	12
Local market	*0*	0	*3*	13	*3*	7
NGO/Project	*9*	50	*0*	0	*9*	21
No data	*2*	11	*3*	13	*5*	12
Total	*18*	100	*24*	100	*42*	100

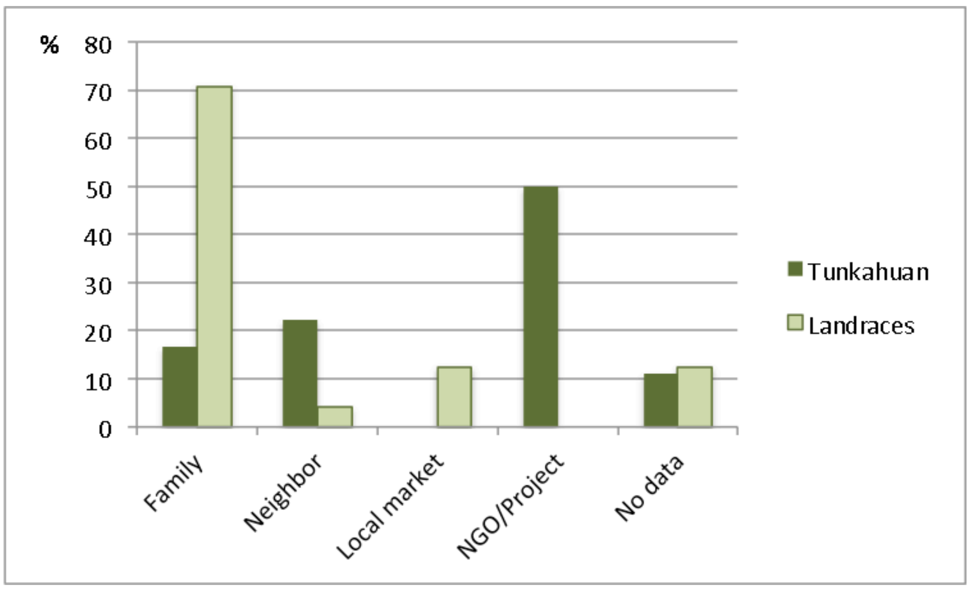


Figure 7.8: Reported sources of quinoa seed, 2009, graphic presentation.

among. However, since the new Tunkahuan variety now makes up over 40% of seed lots, its entry has probably reduced the extension of local landraces. If the new variety in future years pushes other landraces out of cultivation, the net conservation impact on varietal diversity will be negative.

Finally, on the genetic level, the answer reverberates with the preceding one. The introduced variety is bred from landrace material from another Ecuadorian province – Carchi (Nieto C., et al. 1992), and thus brings new alleles to the quinoa diversity of Cotacachi. However, if the domination of the new variety leads to severe reductions in the extension of landraces, their populations may reach levels where genetic bottlenecks lead to loss of alleles. And of course, if they are completely abandoned, their genetic composition will disappear from the repertoire of local farmers as well as distant breeders. Because these landraces potentially carry the genetic base for the crop's adaptation to changing environments, their loss would undermine quinoa's future cultivation.

Amidst the excitement about the new seed and quinoa's transformation into a cash crop, a few farmer voices question the trend. "Everyone grows quinoa now", one woman thoughtfully remarked, "but our quinoa was different" (55 year old woman, Ugshapungo). With this sentence, she neatly sums up the crop's current situation in Cotacachi; on one hand, it is gaining ground, but on the other, this gain seems to be accompanied by an imminent, silent withdraw of local landraces. Even if this withdraw was brewing from before, the entry of the new variety and production system has likely fueled the process. The landraces are still there though, and they might regain their stand. One of them, *hatun kinuwa*, or "large quinoa", has local value not only as food, but also as medicine – for curing human fever and pigs' trichinosis. Time will show whether this character will contribute to its continued cultivation among some, or whether this piece of knowledge slips away as the variety loses its grip of Cotacachi's fields.

7.4 Conclusion: Recuperation and Transformation

The perceived loss of quinoa has led to concerted recuperation efforts, involving a broad crew of actors. In Ecuador and Cotacachi, many are now jumping on the quinoa bandwagon, from researchers and institutions to farmers and restauranteurs. Researchers are drawn to the crop's fine adaptation to the region's harsh conditions as well as its nutritive and functional properties, eager to redress past neglect. Quinoa presents itself as a perfect alternative for rural development projects; it is a healthy product with a high price, and thus promises to improve farm families' nutrition as well as increase their earnings. Farmers are curious to participate, drawn by the new variety's ease of preparation and market fame. Chefs and café owners cook up new recipes and place the heritage crop on their menus.

Although sparkling with positive spirits and success, the process of recuperation presents some paradoxes worth noting. While its role had declined, quinoa was never lost from Cotacachi. But rather than stimulating the recuperation of local cultivation traditions, the projects to save and boost the crop have "returned" a formally bred variety that was never there in the first place. Further, the production regimes promoted depart from former ways – the focus is now on monoculture, supervised by agronomists, and mainly destined for the market. And the final product, which used to be a hearty soup, is being turned into new culinary creations such as cakes and cereal bars. Rather than recuperation, it is more fitting to talk about a *transformation* of what was once the Inca's sacred grain. Quinoa has indeed been rescued from a looming loss, but what is gained is not what was – it has been converted into something new and different. There is of course nothing wrong with this *per se* – times are achanging, life is evolving, and quinoa is transformed together with other facets of the constantly reconfiguring global human-ecological web. However, if this process ends up accelerating the loss of local landraces, as it seems to be in Cotacachi, it might be time to stop and reconsider goals and means of action.

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CHAPTER 8

THE COOKED IS THE KEPT:

FACTORS SHAPING THE MAINTENANCE OF AGROBIODIVERSITY[50]

[50] Skarbø, K. To be submitted to *Environment and Development Economics*.

Abstract

This study examines the influence of different farm and household factors on agrobiodiversity decision making in Cotacachi, Ecuador. The research expands former approaches to this topic in two ways. First, it incorporates cultural variables into an econometric analytic framework encompassing the impact of demographic, farm physical and market factors on agrobiodiversity. Second, it includes a suite of different measures of agrobiodiversity at the crop as well as intracrop level. Data are drawn from interviews with the heads of 89 farm households, triangulated with field, garden and seed store inventories. Poisson regressions are used to analyze the relation between the various farm and household factors and the different agrobiodiversity measures. The results show that culture and subsistence play crucial roles in fostering diversity maintenance; those who identify strongly with local cultural traditions and those whose production is mainly subsistence-oriented grow the most diverse fields. In addition, farm factors play some role in shaping diversity, while demographic factors play only a minor role. These findings indicate that initiatives to foster cultural revitalization and agriculture oriented at home consumption are likely to yield positive results for on farm diversity maintenance.

8.1 Introduction

This study contributes to scientific insight regarding farmers' agrobiodiversity decision-making with a case study from the Ecuadorian Andes. Two bodies of literature related to this issue are identified; one employing econometric frameworks and concentrating on the role of demographic, economic and agroecological variables in shaping agrobiodiversity decisions, and another based in ethnoecology and focusing on the role of cultural factors in farmers' diversity management. The current study aims at reconciling insights from both perspectives.

Much research on agrobiodiversity distribution in farming communities has been carried out within a theoretical framework of rational decision-making, where the choices by farm households of what to grow are expected to maximize utility, given the economic and agrophysical resources available. Thus, a series of studies have examined differences among households in terms of levels of crop diversity, and analyzed these in relation to demographic, economic, farm physical and market related factors (Benin, et al. 2004; Brush, et al. 1992; Brush and Meng 1998; Rana, et al. 2007; van Dusen and Taylor 2005). These studies show that diversity choices can partly be explained as adaptation to variation in the above conditions – allowing farmers to secure production by exploiting available resources. This body of research has thus helped confirm that growing diverse crops and varieties, and in particular landrace varieties developed in the region, is rational and logical for many small farmers. It enables farmers to adapt production to their available labor and land resources, decreases risk, gives more stable yields, improves pest management, and, in the case of subsistence farmers, directly provides the base for a varied diet (Bellon 1996; Brush 2004; Rhoades and Nazarea 1998).

On the other hand, ethnoecological research has shown that farmers' decisions with regards to what to grow are not purely the product of rational thinking, but also linked to values, memories and principles inscribed in culture (Nazarea 1998; Nazarea 2005; Nazarea 2006; Rhoades and Nazarea 1998). The maintenance of crops and landraces over a long period in an area has been associated with their incorporation in traditions and practices, especially regarding food, e.g. in studies on sweet potatoes in the Philippines (Nazarea 1998), wheat in Ethiopia (Tsegaye and Berg 2007) and potatoes in the Andes (Brush 1992).

Even authors of papers that employ economic theory acknowledge the importance of cultural values, and express concern that sociocultural change might undermine agrobiodiversity in the future (Birol, et al. 2006; Perales, et al. 2003). Nevertheless, related variables are largely absent from their analyses. A few recent contributions, however, have included ethnicity as a variable, and indeed shown that diversity choices vary by ethnic group, even if socioeconomic and agroecological conditions remain similar (Brush and Perales 2007; Perreault-Archambault and Coomes 2008; Stromberg, et al. 2010).

The current study goes a step further, by analyzing the relationship between agrobiodiversity and a set of cultural variables within one ethnic group, Cotacachi's Kichwa, in an econometric framework. Based on the above research, I hypothesize that agrobiodiversity choices will vary, among other factors, depending on how firmly the household members are rooted in local cultures and traditions. I expect that farmers who express a stronger identification with Kichwa culture maintain more crop biodiversity, and in particular more diversity of traditional crops and landraces. The study will test whether degree of cultural rootedness can be linked to measures of agrobiodiversity, and speak to the strength of this association in relation to other factors.

With the exceptions of Van Dusen and Taylor (2005) and Benin et al. (2004), who examined the distribution of varietal diversity across a limited subset of cultivated crops, most previous analyses of agrobiodiversity distribution among households have either focused on varietal diversity of a single crop (Brush 1992; Brush and Meng 1998; Brush and Perales 2007; Perales, et al. 2003; Rana, et al. 2007) or interspecific diversity measured as the number of crops grown, without intraspecific detail (Major, et al. 2005; Perreault 2005; Perreault-Archambault and Coomes 2008; Reyes-García, et al. 2008; Stromberg, et al. 2010). The current study takes a more comprehensive approach, by examining species level diversity among all cultivated food crops of the area, as well as varietal diversity within all field crops. The assessment will detect any differences in distribution patterns between different measures of agrobiodiversity, in order to advance our understanding of similarities and discrepancies between these.

Below, I begin by presenting the econometric model guiding the analysis, the study area and methodology. After a brief description of the agrobiodiversity in the area, I review dependent and explanatory variables employed in the analysis. The following results section is divided into reports of bivariate and multivariate analyses. Last, the results are discussed and the conclusion drawn.

8.2 Methods and Analysis

8.2.1 Econometric Model

Following previous studies of agrobiodiversity, I hypothesize that agrobiodiversity will be linked to cultural factors, in addition to household demographic and economic factors, farm agro-ecological factors, and market related factors. The following econometric expression represents this hypothesis:

$$D = \alpha + \beta C + \gamma H + \delta A + \zeta M + \varepsilon$$

In this equation, *D* is a measure of agrobiodiversity, *C* stands for a vector for cultural factors, *H* represents a vector for household demographic factors, *A* stands for a vector of agronomic and agroecological factors that may condition agrobiodiversity, and finally *M* denotes a vector which captures market related factors of the farm.

8.2.2 Study Area, Data collection and Analysis

The study was carried out over a 12-month period in 2009 - 2010 in the Andean zone of Cotacachi Cantón in the Northern Ecuadorian Andes. The area covers 219 km^2 and an altitudinal span of 2080-4939m, and harbors high levels of wild and cultivated biodiversity (Rhoades 2006). Agriculture is carried out from the plain fields of the Inter-Andean valley bottom at around 2300m and up the slopes of the dormant volcano Cotacachi to an altitude of about 3300m. Before land reforms in the 1960s and 1970s, most agricultural land belonged to haciendas, owned by mestizo-whites and labored by indigenous Kichwas (Moates and Campbell 2006). Although sizeable tracts of hacienda land remain today, 67.5 % of cropland is constituted by fields less than 5 hectares, most of which are owned and farmed by Kichwa households settled in one of the 43 communities in the area's rural zone (UNORCAC 2007; Zapata Ríos, et al. 2006).

Data for the current study was collected on 89 farms sampled across five communities representing differences in geographical and altitudinal distribution in the area, as well as variations in average farm size and ratio of subsistence vs. commercial production. In these relatively small communities (mean=57 households, SD=26), purposive quota sampling taking into account age of household heads was used to ensure representative inclusion of all age groups. The survey included 20 households in each community except for one, where no more than a total of nine households were living at the time of the study, and the sample only reached this number. Data from semi-structured interviews with heads of these 89 farm households form the base for the econometric analysis reported here. All interviews were conducted by the author, in the majority of cases assisted by a Kichwa-Spanish translator. Data analysis including ANOVA and regressions was performed using STATA IC 11.2 for Mac.

8.2.3 Brief Description of Cotacachi's Agrobiodiversity

As one of the cradles of agriculture, the Andean region has fostered the domestication and development of a range of crops, including beans, potatoes, other roots and tubers, pseudo-cereals in the Amaranthaceae family, and a number of fruits (Cook 1925; National Research Council 1989). Following the Spanish conquest, a number of Old World crops have further been added to Andean farmers' plant repertoire (Crosby 1972; Hernández Bermejo and León 1994).

Table 8.1: Number of species documented in the research.

Crop type	Number of species
Field crops	25
Fruits	32
Vegetables	15
Herbs*	30
Forage	1
Total species count	*103*

*Another 6 herbs which scientific classification could not be determined were registered.

In the current research project, a total of 103 cultivated species were documented (Table 8.1; See Chapter 2 for detailed information). Only crops grown for food and medicine were included[51] – the survey thus excluded certain species grown for fiber, fencing and ornamental purposes. The crops are divided into four groups: field crops, vegetables, fruits, and herbs. Field crops encompass crops that are usually grown in larger extents in fields, whereas the other three groups are typically grown in home gardens. In practice, the categories are somewhat diffuse; some crops that here are categorized as field crops may be included in home gardens (such as yacon, arracacha, sweet potato, runner bean), and sometimes vegetables are included in fields (e.g. some cabbage plants may be planted in a maize/bean intercrop). However, for purposes of this analysis, these categories provide a useful approximation. Twenty of the field crop species were also documented at the varietal level and among these, a total of 367 varieties were found. Cotacachi's agricultural land is roughly divided into three agroecological zones based on altitude, and the complex of crops changes as one moves up or down in the landscape. The area's wealth of crop diversity has given rise to rich and varied food traditions (Camacho 2006; Nazarea, et al. 2006; Ramirez and Williams 2003; Chapter 4).

8.2.4 Explanation of Variables

8.2.4.1 Dependent Variables: Measures of Agrobiodiversity

Agrobiodiversity was assessed on crop and varietal levels. At each farm, all crops cultivated during the previous year were documented through semi-structured interviews. For each type of crop (field crops, fruits, vegetables, herbs), I posed an initial open-ended question regarding which crops had been grown during the past year. Subsequently, I followed this up by prompting for any forgotten crops based on a previously compiled list of crops grown in the area.

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[51] One forage species, alfalfa (*Medicago sativa*), was also registered. It is used for feeding guinea pigs and rabbits and is typically grown on a small scale in home gardens together with vegetables. For the purposes of the current analysis it is therefore included with vegetables.

Next, varietal diversity was assessed for 20 of the most common field crop species by asking farmers to list the varieties they had planted of each field crop. In many cases, the information gathered through interviews was triangulated through garden, field and seed storage inventories. Although there is not necessarily a direct relationship between variety diversity and diversity of alleles, former analyses indicate a high level of correspondence between varieties identified by farmers and genotypes identified through molecular analysis (Quiros, et al. 1990; Sadiki, et al. 2007), warranting the adoption of variety counts based on farmers' identification as a measure for a household's agrobiodiversity at the intraspecies level.

Table 8.2 gives an overview of the agrobiodiversity measures applied in this study. The measures represent 1) intraspecific diversity summed across field crops, 2) intraspecific diversity within the three most common field crops and 3) interspecific diversity.

The principal diversity measure, capturing elements of both field crop and varietal diversity, is total variety richness (Smale 2006) calculated as the sum of variety counts of all field crops grown by the household. To examine differences in the distribution of landraces and modern varieties (MVs), measures are also calculated for total landrace richness (number of landraces grown, summed across all field crops), and total modern variety richness (number of modern varieties grown, summed across all field crops).

To explore differences between crops in terms of how the different explanatory variables are linked to diversity, measures are also given for varietal richness (count of varieties) of each of the most common field crops: maize (*Zea mays*), common beans (*Phaseolus vulgaris*) and potatoes (*Solanum* spp.).

Finally, a set of crop level richness measures is included in the analysis. Measures are calculated for total field crop species richness (count of field crop species), fruit and vegetable richness (count of fruit and vegetable crops), and herb richness (count of herbs).

Table 8.2: Dependent variables: richness measures of agrobiodiversity.

Variable	Obs	Mean	Std. dev.	Min	Max
Intraspecific div., summed across 20 field crop spp.					
Total varieties	89	26.74	19.81	1	105
Total landraces	89	23.43	19.02	0	99
Total modern varieties	89	3.31	2.22	0	12
Intraspecific div., most common crops individually					
Total maize varieties	89	3.19	3.79	0	23
Total bean varieties	89	14.19	12.26	0	59
Total potato varieties	89	1.52	1.83	0	9
Interspecific diversity					
Total field crop species	89	7.22	3.51	1	17
Total fruit and vegetable crops	89	7.48	7.63	0	38
Total herbs	89	3.04	4.08	0	28

8.2.4.2 Explanatory Variables

Following the model in 8.1, explanatory variables are classified into four groups consisting of cultural factors (*C*), household demographic and economic factors (*H*), farm agronomic and agroecological factors (*A*), and market factors (*M*). Their definitions, hypothesized effects and summary statistics are presented in Table 8.3, and in the following pages I will explain them in more detail.

Table 8.3: Definition and summary statistics of explanatory variables.

Variable	Hypothesized effect	Obs	Mean	Std. dev.	Min	Max
Cultural variables						
Proportion of traditional foods in diet (continuous)	(+)	88	0.56	0.17	0.21	1
Proportion of traditional foods in diet, (categorical)	(+)	88	2.01	0.82	1	3
Frequency of traditional dress (categorical)	(+)	87	2.72	0.58	1	3
Language(s), intergenerational communication (categorical)	(+)	89	2.15	0.83	1	3
Household demographic and economic variables						
Age of HH head (years)	(+)	89	44.70	15.39	19	88
Schooling of HH head (years)	(+, −)	89	2.94	3.40	0	13
Number of adults	(+, −)	89	2.81	1.27	1	7
Number of children	(+, −)	89	2.58	2.11	0	9
No HH head works off farm (dummy)	(+, −)	89	0.28		0	1
One HH head works off farm (dummy)	(+, −)	89	0.58		0	1
Two HH heads work off farm (dummy)	(+, −)	89	0.13		0	1
Farm variables						
Size of cultivated land (hectares)	(+)	89	1.05	1.72	0.033	10
Square of cultivated land size	(−)	89	4.03	13.82	0.001	100
Livestock assets (monetary value, 1000 USD)	(+)	89	1.14	2.54	0	18.98
Square of livestock assets	(−)	89	7.68	41.08	0	360.16
Land has irrigation access (dummy)	(+, −)	89	0.44		0	1
Low zone (dummy)	(+, −)	89	0.67		0	1
Intermediate zone (dummy)	(+, −)	89	0.22		0	1
High zone (dummy)	(+, −)	89	0.10		0	1
Market relations						
No part of crop production (CP) sold (dummy)	(−)	89	0.49		0	1
Very small part of CP sold (1-10%) (dummy)	(−)	89	0.13		0	1
Small or medium part of CP sold (11 - 70%) (dummy)	(−)	89	0.15		0	1
Large part or all of CP sold (≥71%) (dummy)	(−)	89	0.22		0	1

8.2.4.2.1 Cultural Factors

Cultural factors (C), or degree of rootedness in the local Kichwa culture, are assessed by three cultural markers: food, dress, and language. As discussed above, previous econometric studies of agrobiodiversity distribution have so far only included ethnicity or ethnolinguistic group per se as a variable (Brush and Perales 2007; Perreault-Archambault and Coomes 2008; Stromberg, et al. 2010), and the current study attempts to draw the analysis to a more detailed level, by assessing degree of cultural attachment within one ethnic group. Ethnicity is a fluid concept in the Andes, and people may move between identifying as mestizo or indigenous (Orlove 1998; Weismantel 2001). Dress, language and food represent three domains or axes through which people in public and private spheres express their identity. Although it is impossible to accurately quantify and measure cultural rootedness or identity, these variables may still serve as indicators for how much people identify with Kichwa culture.

Proportion of traditional foods in diet was calculated based on data from three dietary recall exercises (Lee and Nieman 2007). Seventy two-hour recall exercises of all meals eaten in the household were carried out at two different points in time (2009, 2010). In addition, a 1-month recall of the use frequency of a list of 60 locally available food items was undertaken. With the help of key informants and focus groups all foods were classified into categories of traditional, modern and neutral (neither particularly traditional nor modern) foods. Traditional foods encompass products from grains, legumes, roots, tubers and cucurbits with a long history of cultivation in the area. Modern foods include non-local items typically accessed in stores and markets, including rice and noodle products. Meat, egg and milk products were not included in any of the two groups, nor were fruits and vegetables; these are foods that for the most part have been present locally for a long time, but only consumed to a limited degree by Kichwa farm households. The proportion of traditional foods was calculated, and the final score represents the mean of the three recalls. For the purposes of ANOVA and correlation analyses, this continuous variable is also converted into a categorical variable with three equally sized categories. I expect those who identify strongly with Kichwa culture to include a high portion of traditional foods in their diet. The link between food and agriculture is likely, but not certain – traditional foods may also be obtained through barter, gifts or the market. The strength of the relation between amount of traditional food and diversity will indicate whether those who compose their diet to a larger degree of traditional foods tend to grow them themselves, or rather access them from other sources.

Dress was assessed as a categorical variable representing the frequency of which the female household head wore the traditional *anaco*[52] costume (1=never, 2=sometimes, 3=nearly every day). *Language* was assessed as a categorical variable representing the language(s) used in communication between household heads and their children (1=only Spanish, 2=both Spanish and Kichwa, 3=only Kichwa). As stated above, I expect cultural variables to be positively related to agrobiodiversity, and especially to diversity of landraces and crops with a long tradition of use and cultivation in the study area.

8.2.4.2.2 Household Demographic and Economic Factors

Household demographic and economic factors that were assessed included age of household head, schooling of household head, number of adults living in household, number of children (<16 years old) living in household, and off farm work. I expect diversity to be positively related to *age* of household head, since older people are likely to be keepers of traditions, and have had more time to gather agricultural experience as well as planting material. *Schooling* (measured in years) might negatively affect diversity, since it implies devotion of time and energy to activities other than agriculture. I do not have reasons to expect household

[52] The *anaco* costume of Cotacachi consists of dark and white wrap-around skirts, white, embroidered blouses, woven ribbons, in addition to other complements. It is related to, but is different than the traditional dress of other regions of Andean Ecuador. Whereas men typically only wear their traditional clothing (consisting of white trousers and shirt, and a dark, woolen poncho) on special occasions, women retain this tradition to a larger extent.

demographic composition to have a large influence on diversity, however, *number of adults* might have a slight positive influence through providing more labor, whereas *number of children* might have an opposite effect through decreasing parents' time available for agricultural work. *Off farm work* was captured by two dummy variables: one indicating whether one household head (either male or female) worked off farm, and the other indicating whether both spouses worked off farm at the time of the research. Engagement in off farm work might influence agrobiodiversity in several ways. It might have a negative effect through taking away time from agricultural work and increasing access to purchased foods. On the other hand, it might positively enhance access to new planting material, as well as providing funds to cover agricultural expenses such as hired labor and tool costs.

8.2.4.2.3 Farm Factors

Farm factors include size of cultivated area, livestock assets, irrigation access and agroecological zone. *Size of cultivated area* was measured in hectares. I expect diversity to be highest on the farms that are medium sized. Very small farms might be restricted in diversity due to space limitations, whereas big farms are more likely to focus on production for the market, which typically implies monocultures of a low number of crops and varieties. A quadratic term for land size is included to test this hypothesis. *Livestock assets* were calculated based on counts of different livestock multiplied by local market prices. I expect livestock assets to bear a positive relation with agrobiodiversity, as animals provide manure and draught power, thus enhancing production conditions. However, very high livestock assets might be a) an investment strategy for households earning much from commercial crop production or b) a sign of large portions of the agricultural land set aside for livestock rearing as a commercial strategy - both alternatives that are likely to be linked to lower crop diversity levels. To test whether these predictions might be the case, a quadratic term is included also here. *Irrigation* access was measured as a dummy variable (0=no irrigation access, 1=irrigation access for some or all of land). Irrigation is expected to lower the need for maintaining a mixture of crops and varieties adapted to different water conditions, and thus reduce diversity needs. Cotacachi is roughly divided into three *agroecological zones* based on altitude; the low, intermediate, and high zones (Moates and Campbell 2006). Location in each agroecological zone is indicated by dummy variables. As crop adaptation varies with altitude and associated temperature regimes, the crop complexes and diversity measures in each zone are expected to show some variation.

8.2.4.2.4 Market Relations

Market relations were assessed by proportion of farm production destined for the market during the past year. Four dummy variables indicate whether or not the portion of the crop production sold was 1) none or 2) very small (1-10%) 3) small or medium (11-70%), and 4) a large part or all (>70%).[53] I expect agrobiodiversity to bear a negative relation to commercial production, since the market typically demands high quantities of uniform products, thus incentivizing monoculture production based on few crops and varieties. Conversely, I expect a large portion destined for household consumption to be linked with higher levels of diversity, in order to meet diverse dietary needs.

[53] Original categories for small and medium proportions were combined due to low frequencies in each.

8.3 Results

8.3.1 Bivariate Analyses

Prior to the multivariate regression analyses, two sets of bivariate analyses were performed; a correlation analysis of the different agrobiodiversity measures and analyses of the relationship between total varietal diversity and each cultural variable.

8.3.1.1 Correlation Analysis of Measures of Agrobiodiversity

The correlation matrix in Table 8.4 shows that nearly all the measures of agrobiodiversity employed in the study are positively correlated, and in most cases, the correlation is highly significant. Thus, households that grow a greater diversity of one kind likely also grow more diversity by the other measures. The correlation coefficients, however, display enough variation in size to merit further investigation of differences in how they are linked to explanatory variables. It might be noted that total variety richness is best correlated to the other measures (mean r=0.73), whilst average least correlation is exhibited by richness of potatoes (mean r=0.29), fruits and vegetables (mean r=0.41), and modern varieties (mean r=0.44).

Table 8.4: Correlation matrix of different measures of agrobiodiversity (dependent variables).

Richness measure	*Total var.*	*Total land-races*	*Total MVs*	*Maize var.*	*Bean var.*	*Potato var.*	*Field crop spp.*	*Fruits & veg.*	*Herbs*
Total var.	1.00								
Total landraces	0.99***	1.00							
Total MVs	0.40***	0.30***	1.00						
Maize var.	0.75***	0.73***	0.46***	1.00					
Bean var.	0.88***	0.90***	0.14	0.54***	1.00				
Potato var.	0.26**	0.20*	0.58***	0.18*	-0.10	1.00			
Field crop spp.	0.78***	0.75***	0.52***	0.61***	0.46***	0.52***	1.00		
Fruits & veg.	0.40***	0.38***	0.34***	0.38***	0.32***	0.06	0.42***	1.00	
Herbs	0.64***	0.62***	0.33***	0.50***	0.44***	0.34***	0.61***	0.55***	1.00

*Significant below the 0.10 level, **significant below the 0.05 level, *** significant below the 0.01 level.

8.3.1.2 Analyses of Agrobiodiversity and Cultural Variables

A second round of analyses was performed examining the relationship between cultural variables and levels of agrobiodiversity. A total of 27 ANOVAs were run, one for each of the three cultural variables across the nine agrobiodiversity richness measures. The ANOVA results reported in Tables 8.5a-c (end of chapter) show that increased use of traditional dress, heavier use of Kichwa in relation to Spanish in intra-family communication, and higher proportion of traditional foods in diet are all linked with higher levels of diversity across nearly every agrobiodiversity measure. In all of the 27 analyses, the measure representing strongest cultural rootedness is associated with a higher mean diversity than the lowest measure. In 21 cases, there is a stepwise increase in mean agrobiodiversity along the cultural measures. The differences between groups are significant at the $p \leq 0.01$ level in 17 and at the $p \leq 0.05$ level in 20 of these analyses. The only measures exhibiting somewhat weaker relationships with the cultural variables are modern varieties and potato varieties. Overall, these results strongly suggest that those who to a higher degree identify with the local Kichwa culture, as evaluated by the three cultural markers employed in the current study, are more likely to grow more diverse fields and gardens. The following multivariate analyses will assess whether this relationship is maintained also when including a set of other variables.

8.3.2 Multivariate Analyses

Poisson regressions with robust standard errors were employed in the multivariate analyses because of the count nature of the dependent variables (Cameron and Trivedi 1998). Tables 8.7a-c (end of chapter) give an overview of regression results. In order to examine differences between measures of agrobiodiversity, the regression model was estimated using three sets of dependent variables, as explained above in section 8.2.4.1. I first report in detail on the regression estimation using total variety richness as dependent variable, and subsequently comment on the results of the other estimations in relation to the former.

Including all three cultural variables in the regression analyses introduced severe collinearity problems, due to the high correlation between these measures.[54] One way to solve this issue is to omit all but one of the correlated variables. Since the continuous variable for traditional food consumption provides the most detailed level of measurement, I decided to use it as a proxy for cultural rootedness in the multivariate regression analyses.

[54] A Kendall's rank correlation analysis of the three variables (using the categorical variable for food consumption) yield positive bivariate correlation coefficients ranging in size from 0.46-0.66, significant at the $p<0.0001$ level.

8.3.2.1 Total Varieties Regressions

8.3.2.1.1 Cultural Variable

The first regression (Table 8.6a, "Total varieties" columns) demonstrates a strong, positive and highly significant association between the consumption of traditional foods and total varietal diversity (coefficient=1.147, p=0.004). This result supports the hypothesis that rootedness in the local Kichwa culture is linked with higher levels of agrobiodiversity on the overall varietal level, even when controlling for a large set of other variables.

8.3.2.1.2 Household Demographic and Economic Variables

All other factors held equal, age has no effect on total varietal diversity (coefficient=-0.001, p=0.833). This result is different from the expectation to find a positive relationship between age and agrobiodiversity. Indeed, when analyzed separately in an ordinary least square regression, there is a positive relation – diversity increases with age (coefficient=0.327, p=0.016, R^2=0.06). An explanation of why the effect of age disappears in our model estimation might be that people of higher age mainly keep more diversity because of their rootedness in the local culture. Indeed, when the model is estimated without the cultural variable, a positive effect of age remains, albeit with low significance (coefficient=0.004, p=0.275). Closer examination of the data reveals a turning point at an age of 60; the positive relation is stronger up to 60 years, above which diversity levels are lower.[55]

Schooling is not significantly related to varietal diversity (coefficient=0.005, p=0.732), indicating that there should be no conflict between seeking formal education and maintaining

[55] Introduction of a term for age squared in the full regression model did not improve the significance of age and only improved the explanatory power of the model to a minuscule degree (Δ pseudo-R^2=0.0003), and was therefore omitted.

agrobiodiversity – at least in the case of the moderate levels of education common in Cotacachi (sample mean=2.9 years, standard deviation=3.4, range=0-13).

Number of adults has no significant effect on varietal diversity (coefficient=-0.026, *p*=0.517), but number of children in the household has a slight, negative effect (coefficient=-0.037, *p*=0.090).

Off farm work, other things being equal, bears a net positive, but insignificant relationship to total varietal diversity. The relationship is slightly stronger if only one spouse works off farm (coefficient=0.206, *p*=0.117) than if two do (coefficient=0.147, *p*=0.468).

8.3.2.1.3 Farm Variables

Size of cultivated land bears a significant, positive association with total varietal diversity (coefficient=0.284, *p*=0.013), but only up to a certain point. The negative sign of the squared term indicates that when the land is larger than a certain size, the relation is reversed (coefficient=-0.019, *p*=0.088). Closer examination of the land data in relation to varietal diversity shows that there is a turning point at around 0.7 hectares – farm households cultivating more land tend to plant less diverse fields. Thus, greatest diversity is found on the mid-sized farms, even when controlling for other farm and household characteristics.

A similar trend is found for livestock assets. There is a positive trend up to a certain point, above which there is a slight negative link between assets and varietal biodiversity (coefficient, linear term=0.175, *p*=0.020, coefficient square term=-0.008, *p*=0.021). Examination of the data indicates that on average, varietal diversity increases with the value of livestock on the farm until about $1500, while farms with more livestock assets have lower diversity.

As expected, the coefficient sign indicates that irrigation access bears a slight negative relation to varietal diversity, but it is not significant (coefficient=-0.161, p=0.239). The lack of significance suggests that irrigation access does not play a major role in shaping overall varietal diversity.

Finally, the variables for agricultural zone show that the highest levels of varietal diversity are found in the intermediate zone, while they are slightly lower in the low zone (coefficient=-0.192, p=0.113), and lowest in the high zone (coefficient=-1.23, p<0.001).

8.3.2.1.4 Degree of Commercialization

As predicted, a high degree of commercialization is linked with lower overall varietal diversity. While the negative association is strong and highly significant for the group of farms producing mainly or only for the market (coefficient=-1.981, p<0.001), it is weaker and insignificant for the small-medium level of commercial production (coefficient=-0.218, p=0.183). Those who sell only a very small part of their production (1-10%) are actually associated with slightly higher diversity than those who sell no part, but the relation is insignificant (coefficient=0.035, p=0.792). Thus, on a limited level commercialization does not seem to bear a marked negative effect on overall varietal agrobiodiversity.

8.3.2.2 Regressions for Landraces and Modern Varieties

Model estimations using number of landraces and number of modern varieties as dependent variables show distinct patterns (Table 8.6a, “Total landraces” and “Total MVs” columns). The estimation of the model for landrace diversity shows a very similar pattern to that of total variety richness, but with a slightly better fit (pseudo-R^2=0.60). All coefficient signs are the same; the main difference is a stronger negative association with a high degree of commercial production (coefficient=-3.050, p<0.001). First, this reflects that the majority of varieties in the local agriculture are landraces. Second, it indicates that landraces are not common in market production.

Conversely, the model explains much less of the variation in the number of modern varieties grown (pseudo-R^2=0.14), and few variables show significant effects. Although coefficient signs are similar to the two previous estimations, there is a striking difference in that all levels of commercial production have positive coefficients, albeit with overall low significance. Variables that remain significant are land size and livestock assets – showing similar patterns as in the case of total number of varieties. These results point toward a more even distribution of modern varieties across farms with different variable attributes than what is the case for landraces. Even though modern varieties are more common than landraces on farms with higher degrees of market production, they are also common on other farms.

8.3.2.3 Regressions for Intracrop Diversity of Individual Crops

Individual regressions for varietal diversity of the three most common crops in the area, maize, beans, and potatoes, show some differentiation (Table 8.6b). The model explains the distribution of bean diversity quite well (pseudo-R^2=0.58), and to some degree also patterns of maize and potato diversity (pseudo-R^2=0.30 for both). Coefficient signs are similar to the initial model of total variety number.

In comparison to the initial model, the food variable becomes more important in the case of maize diversity (coefficient=1.476, p=0.037), remains similar for bean diversity (coefficient=1.250, *p*=0.020) and displays less importance for potato varietal richness (coefficient=0.129, *p*=0.830).

Land size influences the diversity of all three crops, but more so for maize (coefficient, linear term=0.592, *p*=0.049). Further, there are, as can be expected, differences between agro-ecological zones with regards to the intraspecific diversity of the three crops. In particular, farmers in the high zone plant less maize diversity (coefficient=-1.729, $p<0.001$), much less bean diversity (coefficient=-18.844, $p<0.001$) and more potato diversity (coefficient=1.034, *p*=0.002) than those in lower zones.

In terms of degree of commercial production, coefficients are generally negative. The only exception is for very small portion of harvest sold, which is positively associated with maize and potato diversity. Statistical significance is rather low, with the exception of the strong negative link between bean diversity and high portion of harvest marketed (coefficient=-3.156, $p<0.001$). This reflects that even though subsistence-production is generally linked with average higher varietal diversity, a fair number of subsistence-oriented farmers have limited numbers of maize and potato varieties, while most keep a diversity of beans.

8.3.2.4 Regressions for Field Crop Diversity

The regression estimations on the crop level are related to, but slightly different from the variety level ones (results reported in Table 8.6c). Despite the high correlation between total number of field crop varieties and total number of field crop species (*r*=0.78), the model explains less of the variation in field crop species diversity. Signs are similar to the initial total variety model estimation, but the pseudo R^2-value is lower, and coefficients are generally smaller and less significant. However, if we estimate the model using the square of field crop species number as the dependent variable, coefficient sizes approximate those of the varietal level estimation, and variables show higher statistical significance. The lack of power of the first estimation might be linked to the lower variation in crop number, as compared to variety number (Table 8.2). While the average number of varieties kept per farm is 26.7 ± 19.8 (range: 1-105), the mean crop species number is 7.2 ±3.5 (range: 1-17). The estimation with the square value of species number amplifies the rather small differences between farms in terms of the number of crops grown. This shows that when amplified, the differences bear close linkages to the explanatory variables in the model – in a similar fashion to total varietal diversity.

8.3.2.5 Regression for Fruit and Vegetable Diversity

In the model estimation for number of fruit and vegetable crops, coefficient signs and sizes do not depart dramatically from estimations of diversity at the variety level, yet there are some differences worth noting. Contrary to most of the other model estimations, number of children bears a slight positive relation to fruit and vegetable diversity (coefficient=0.048, p=0.232), as does education (coefficient=0.065, p=0.026). Among the farm characteristics, land size is not significant (coefficient, linear term=-0.021, p=0.923, coefficient, square term=-0.155, p=0.556). We further note that the negative association between high zone farming and fruit and vegetable diversity is particularly strong (coefficient=-1.394, p=0.005). Finally, fruit and vegetable diversity is positively associated with low to moderate levels of commercial production (coefficient=0.759, p=0.002).

8.3.2.6 Regression for Herb Diversity

When it comes to number of herbs, proportion of traditional foods in diet becomes an even more important variable (coefficient=1.828, p=0.035), indicating that cultural identity plays a central role for herb diversity. Among the household variables, we note a strong, positive link between off farm work and herb diversity (coefficient=0.947, p=0.008 and coefficient=0.784, p=0.093). In terms of the farm variables, land size is not significant (coefficient, linear term=0.158, p=0.615). And, also like the case for fruits and vegetables, less herb diversity is found in the high zone (coefficient=-1.487, p=0.020). Other things equal, very small to medium levels of commercial production is positively associated with herb diversity.

8.4 Discussion

The set of regressions reported above shows that the positive associations between measures of cultural rootedness and total varietal richness obtained in the initial analyses (3.1.2) are maintained when controlling for a number of household, farm, and market related characteristics. Those who prepare and eat more traditional foods, a measure correlated with other cultural variables, are more likely to grow more varieties in total, more landraces, more varieties of maize and beans, as well as more field crop, fruit/vegetable and herb diversity. The only measures of agrobiodiversity where the link to cultural variables is less clear are richness of modern varieties and potato varieties. The latter is partly related to the former, as 57% (12 of 21) of the potato varieties grown by farmers in the sample are modern varieties. The weaker association between richness of modern varieties and cultural markers might be understood as a product of their recent introduction to the study area (during the last five decades).

The separate analyses of intracrop diversity showed that those who have a diet composed of more traditional dishes in particular have more maize diversity, and this might be explained by the high importance of this crop in the local culture and cuisine. Maize plays a central symbolic role in the Andean cosmovision of the region. There is a plethora of traditional maize dishes in Cotacachi, many of which are based on different varieties of the crop, whereas differentiation into varieties suited for special dishes is much less elaborated in the case of potatoes and beans[56].

Somewhat surprising is the relatively strong relation between more traditional values of cultural variables and the diversity of fruits and vegetables. Except for a few species (including Andean walnut [*Juglans neotropica*], capuli cherry [*Prunus capuli*], passion fruit [*Passiflora cumbalensis*], chili pepper [*Capsicum baccatum*]), cultivated fruits and vegetable crops have traditionally not played a prominent role among Kichwa small-scale farmers in Cotacachi. Instead, they would use wild and semi-cultivated (protected weeds) greens and fruits as condiments and snacks. Cultivated fruits and vegetables, many of which are Old World introductions, have to a larger degree been grown on haciendas, and consumed by the mestizo-white populace. However, this situation is currently changing. Local markets offer a wide variety of fruits and greens, and the crops are becoming more common also on smaller farms – a process partly fueled by educational campaigns promoting the value of these products for health and nutrition, and NGOs providing planting material. The results of this analysis indicate that those who identify more with Kichwa culture have embraced the trend of increasing fruit and vegetable diversity to a stronger degree than those who do less. This might be interpreted as linked to a general higher appreciation of and curiosity about agricultural biodiversity among this group of farmers.

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[56] For instance, during the present research project, recipes for thirty different maize dishes were collected.

The especially strong link between the proportion of traditional foods in diet and herb diversity might also be interpreted as rooted in household heads' dedication to nutritional and health matters. Herbs are used for seasoning, herbal teas, and medicinal purposes, and many are linked to positive health benefits in the local pharmacopeia (Gallaher and Fueres 2006).

The close relation found between consumption of traditional foods and agrobiodiversity indicates that households in the study preferring a diet rich in traditional foods to a large degree maintain the base for such a diet in their own agricultural production, instead of relying on market or other sources for this type of food. Hence, a relatively direct link between food and agriculture is maintained. It follows that the maintenance of pride and appreciation of cultural and agricultural heritage, and preferences for a diet rich in traditional foods, are important factors enhancing the conservation and cultivation of agrobiodiversity in the area.

The present results regarding variables for household and farm characteristics for the most part accord with previous research on varietal diversity and crop level diversity in small-scale agriculture across the world, although there are points of divergence. In the following paragraphs I will summarize findings regarding each independent variable from the current work, and briefly discuss these in relation to other studies.

One exception to the accordance with previous research is constituted by the present findings on the relation between age and agrobiodiversity. The lack of a significant association between these variables in the total varietal level regression was maintained throughout the estimations using alternative agrobiodiversity measures as the dependent variable. This is contrary to the positive link found in most other studies examining this relationship (van Dusen and Taylor 2005; Perreault 2005; Perreault-Archambault and Coomes 2008; Reyes-García, et al. 2008). The explanation why this effect is not maintained in this analysis, while it remains in other studies, most likely has to do with older people's deeper rootedness in the local culture – a factor that has not been included in the previous studies. Indeed, when analyzing the direct relationship between age and diversity, without including cultural variables, the present data also yields a positive relation. This trend is stronger up to an age of 60, above which it is less clear. This result is similar to that found in Mexico by Van Dusen and Taylor (2005) and may have to do with the decreasing capacity to labor fields of those reaching high age.

Our initial finding of a positive but insignificant relationship between schooling and agrobiodiversity was also maintained through most regression estimations. This is consistent with previous research that has found either non-significant or positive associations between education and varietal (Benin et al. 2004; van Dusen and Taylor 2005; Rana et al. 2007) or crop level diversity (Perreault-Archambault and Coomes 2008; Reyes-García et al. 2008). This strongly suggests that education is indeed compatible with the maintenance of agrobiodiversity among small-scale farmers.

The insignificant association between number of adults and diversity found in the first regression was repeated through the estimations for all alternative diversity measures. These results are in accordance with Van Dusen and Taylor's (2005) analysis of varietal diversity in Mexico, but depart from that of Perreault-Archambault and Coomes (2008) who found a small, positive association between number of adults and crop level diversity in the Peruvian Amazon. Our finding of a slight negative link between number of children and total varietal diversity was maintained through many of the other diversity measure estimations, except for fruits/vegetables and herbs, where small, positive associations were found. The modest negative link might be attributed to time constraints for the parents of many minors, whereas the positive relations can be explained in the light of children's preferences and health and nutrition concerns. Growing fruits and vegetables in home gardens offers a direct supply of healthy and tasty foods and snacks, avoiding the often prohibitive costs of procuring such items in the marketplace. Number of children has rarely been included in other analyses, making it hard to compare with previous results. Overall, the results of past and current research indicate that in relation to other factors, demographic variables do not have large effects on measures of agrobiodiversity.

Off farm work was generally associated positively with agrobiodiversity measures, but significance levels were low. In most cases, the positive relationship was higher when only one spouse worked off farm. Off farm work for one spouse (typically the male) is a common solution when the farm is not large enough to provide sufficient food and/or market income to cover household demand[57]. This secures some income, and at the same time allows the other to stay at home, taking care of agricultural tasks for subsistence needs. The slight positive association may be an indirect consequence of this subsistence orientation. The coefficients are particularly large for fruit/vegetable and herb diversity, likely reflecting the enhanced access of those working off farm to planting material of these crops, many of which have not traditionally been common in Cotacachi's communities. Variables for off farm work have surprisingly not been included in many previous analyses of agrobiodiversity distribution. One study with a result different than ours is Brush et al. (1992), who found a negative relationship between off farm work and potato landrace diversity in Southern Peru.

The positive association between land size and total varietal diversity up to a certain point, above which the reverse was the case, was with varying degree of strength repeated in the subsequent regression estimations. This supports the hypothesis that more land facilitates the planting of more diverse crops and varieties – up to a point where farmers are likely to switch

[57] A t-test shows that households where one or two spouses work off farm cultivate significantly less land in comparison with those with where both stay on the farm (means 0.74 (SD 2.35) ha vs. 1.82 (SD 1.31) ha, p=0.01).

over to monoculture-based market production.[58] Land size appears to be more important for inter- and intraspecific diversity of field crops, and less important for fruits, vegetables, and herbs. This is likely because in contrast to field crops, fruits and vegetables are more often grown around homes or along field edges, thus not requiring much land. Among the field crops, the positive link between land size and maize diversity is particularly strong. This is likely related to the high rate of out-crossing common in this crop, making it especially difficult to manage several varieties within a small area. Most previous research only supports the first part of the present findings regarding land, reporting that diversity increases with size of cultivated land (Benin, et al. 2004; Perreault 2005; Perreault-Archambault and Coomes 2008; Rana, et al. 2007; van Dusen and Taylor 2005). Reasons for this discrepancy – a parabolic vs. a linear relation – may be, apart from the evident possibility of a real difference, either that larger farms were not included in the previous analyses, or that the alternative of parabolic relation was not examined.

With regards to livestock assets, a similar situation as that of land was maintained through most estimations; a positive relationship up to a point above which larger assets were linked to lower diversity levels. The positive relation can be linked to the contributions of farm animals to agricultural production in the form of manure and drought power. Livestock is a form of investment and saving in Cotacachi, and a larger value thus also indicates relatively well-off households that are not resource-limited in their agricultural production. Yet farms with very large assets tend to be commercially and monoculture oriented and/or situated in the high zone, restricting the types of crops and varieties grown.[59] These results are partly supported by some

[58] Examination of the data supports this interpretation; as much as 50% (16 of 32) of those with land above 0.7 hectares market a large part of their crop production, while only 7% (4 of 57) of those with less land do so.

[59] Seventy-three % (8 of 11) of the farms in the sample with livestock assets over $1500 sell a medium to large part of their agricultural harvest. Fifty-five % (6 of 11) are farms located in the high zone.

previous evidence of positive links between cattle ownership and crop diversity (Perreault 2005) as well as cereal varietal diversity (Benin, et al. 2004) and between livestock number and rice landrace diversity (Rana, et al. 2007). Like in the case of land, previous studies do not report to have examined possible non-linear relations, such as those found in the present work.

Most regression estimations showed in a negative link between irrigation and total varietal diversity, although only in the case of a couple of measures was it significant. This result supports the general hypothesis that the presence of agricultural inputs such as irrigation reduces diversity needs (Bellon 1996; Bellon 2001).[60] It further corresponds with previous research having found that farmers with irrigation access tend to cultivate more modern varieties (Rana, et al. 2007) or more land in modern varieties (Brush and Meng 1998) in relation to landraces.

In terms of agroecological conditions, the initial result of higher diversity in the intermediate zone than in the low and high zones was reproduced through the majority of estimations for other diversity measures. This pattern is linked to differences in agro-ecological conditions and crop adaptations. Farmers in the intermediate zone are able to cultivate many of the crops adapted to the warmer conditions of the lower zone (maize, beans), as well as the colder ones of the high zone (potatoes, other roots and tubers). On the other hand, farmers only cultivating in the high zone cannot grow beans due to low temperatures, and only recently did global warming allow them to begin the cultivation of maize (Chapter 11). Both beans and maize are crops with especially high varietal diversity in the area, and their exclusion from the crop portfolio is therefore linked with lower numbers of varieties. The only variety measure exhibiting most diversity in the high zone is potato richness, reflecting the cold-adaptation of this crop. These results are consistent with previous research that has likewise found differences in

[60] If climatic conditions continue to change in the Andes and Cotacachi as predicted (see Chapters 10–11), this relation may change in the future – and irrigation may actually allow farmers to maintain more diversity not adapted to lengthened periods of dry conditions.

diversity levels along altitudinal gradients (Brush and Perales 2007; Perales, et al. 2003; van Dusen and Taylor 2005; Zimmerer 1996).

A high degree of market-oriented crop production was associated with strong, negative effects on agrobiodiversity across all measures except richness of modern varieties. This result supports the expectation that a high degree of subsistence-oriented production is related to higher levels of diversity, whereas a high degree of market-orientation is linked to lower levels, due to the difference between the diverse food demands of a household's subsistence and the market's demand for uniform, large quantities of the same product. The negative effect of high levels of market production was particularly strong for bean diversity, in comparison to maize and potatoes. This differentiation is likely linked to the way these crops are managed – when grown for home consumption, bean varieties are typically planted in mixed populations, whereas maize and potatoes to a larger degree are separated by variety. As a result, relatively high bean diversity is the "default" for subsistence farmers, whilst a higher diversity in maize and potatoes is not as obvious.

The effect of market integration on agrobiodiversity has been a topic of interest for several previous researchers. Brush et al. (1992), Nazarea (1998) and Rana et al. (2007) found that sites with average higher market-orientation of crop production exhibited lower levels of potato, sweet potato and rice landrace diversity, respectively. Van Dusen and Taylor (2005) found that farmers in villages that were closer to major market towns, had higher average use of hired labor, and more US migration, tended to grow less diverse *milpa* fields. Brush et al. (1992) also found that within both sites, farms closer to markets tended to grow more land in modern varieties, a variable that was related to lower landrace diversity. Brush and Meng (1998) concluded that farms where a higher proportion of the wheat harvest was marketed planted less of their land in landraces, and Abbott (2005) found that the proportion of bean harvest devoted to the market was higher among farmers growing only modern varieties of the crop. Finally, Major et al.'s (2005) results from the Brazilian Amazon indicate that those who devoted more land to market production on average had slightly fewer crop species than those who focused more on subsistence production[61]. Although these studies vary widely in geography, farming systems, and the measures adopted for market integration as well as crop diversity, they all lend support to the hypothesis that as the share of farm production that is marketed increases, agrobiodiversity and/or landrace diversity in particular, is likely to decrease. And, conversely, that higher subsistence orientation is linked with higher biodiversity, and especially landrace diversity. Still, the shape and strength of these relationships remain unclear.

[61] However, the sample of Major's team was small (N=16), and the difference was not found to be statistically significant.

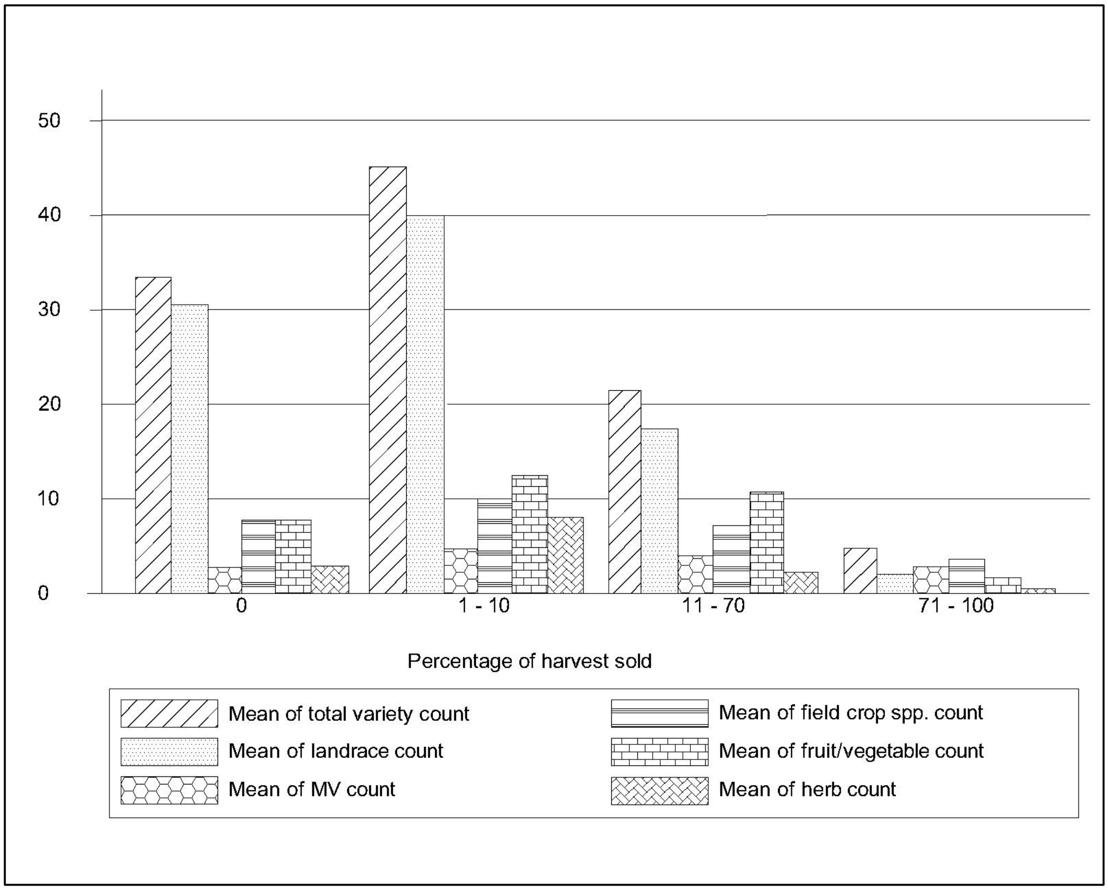

Figure 8.1: Bar chart showing mean values of agrobiodiversity measures by proportion of harvest sold.

Results from Cotacachi are consistent with this body of research, but further indicate a non-linear relation between market production and agrobiodiversity which shape varies depending on diversity measure. In several cases, those selling a very small or a small to medium part of their harvest on average grew the most diversity, other things being equal. A bar graph showing mean values of principal diversity richness measures by degree of commercial production is consistent with the regression results (Figure 8.1). Across measures, a large degree of commercial production is linked with strong negative effects on diversity – but in comparison to those selling nothing, those with a very small or small to medium market-orientation display similar or more diversity for several measures. Those that sell only a small part of their production are likely to be households able to cover much of their subsistence needs through their farm, in addition to sometimes having a small surplus to market. These farm households may be less resource-limited than those completely destining their production for subsistence use, a situation that may explain their propensity to cultivate somewhat more diverse crops. Marketing *per se* does not automatically reduce agrobiodiversity – but when major portions of the farm are destined market production, farmers in Cotacachi do not maintain diverse crops for subsistence use along with their commercial plantings.

8.5 Conclusion

The current study shows that a wide set of factors guide agrobiodiversity decisions in Cotacachi. Cultural variables that have previously not been included in comparable cross-sectional studies, demonstrate to carry special importance, both when analyzed separately and in the context of a variety of other farm and household characteristics. The degree to which households prepare and eat traditional foods in particular holds importance for most diversity measures, indicating that the maintenance and cultivation of local food traditions will be important for the fate of the rich crop diversity of the area. Relatedly, degree of subsistence-orientation emerges as another important factor; households that destine most or all of their harvest to non-market uses on average maintain a significantly higher number of crops and varieties in comparison to those who largely market what they grow.

Farm characteristics also play their role in conditioning the diversity of crops in the area. Other things being equal, higher diversity levels are generally linked to moderate land and livestock assets – an indication of relatively well-off subsistence-oriented households whose production decisions are not compromised by lack of agricultural resources. Different altitudinal zones provide better growing environments for some than for other plants, and this is reflected in the regression results. Demographic factors carry only minor weight and employment off farm is displays a weak positive link to most diversity measures.

The sign of the relationships between the different household and farm factors and agrobiodiversity remain similar for most of the inter- and intraspecific diversity measures employed in the study. Relatedly, most diversity measures are positively correlated to each other. This indicates that people who grow a high diversity based on one measure are likely to also maintain other types of diversity. Still, the size and significance of the coefficients in both correlation and regression analyses vary enough to merit some caution against broad conclusions based on single diversity measures. Including several different measures at both crops species and varietal levels allows for a fuller understanding of how each independent variable is linked to different dimensions of biodiversity.

Finally, the study found that several household and farm characteristics, including land size, livestock assets, and degree of production market-orientation, were related to measures of agrobiodiversity in non-linear ways. Future analyses might benefit from examining the possibility of such relationships.

In conclusion, across agrobiodiversity measures and among potentially influential factors, culture and subsistence stand out as central to the continued cultivation of agrobiodiverse fields and gardens in Cotacachi. Farm households that maintain local food traditions and destine a large part of their harvest for home use are those most likely to grow an extensive portfolio of crops and varieties; what is cooked is what is kept. From this insight one might extend that the future conservation and cultivation of agrobiodiversity in the area will be enhanced if the structural conditions for viable subsistence-oriented small-scale farming will be improved, and if people continue to identify with and appreciate their cultural and agricultural heritage.

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8.7 Tables and Figures

Tables 8.5a-c: Results of ANOVA analyses of the relationship between cultural variables and agrobiodiversity.

Table 8.5a: Results of ANOVA analyses of the relationship between cultural variables and richness measures for total varieties, total landraces, and total modern varieties.

		Total varieties				Total landraces				Total MVs			
				Between group				Between group				Between group	
	N	Mean	SD	F	p	Mean	SD	F	p	Mean	SD	F	p
Traditional dress													
Never	6	8.3	9.0	9.58	0.000	5.8	9.6	9.21	0.000	2.5	1.6	2.01	0.140
Sometimes	12	11.9	11.4			9.6	11.5			2.3	0.8		
Always	69	31.5	19.4			28.0	18.6			3.6	2.4		
Total	87	27.2	19.8			23.9	19.0			3.3	2.2		
Language													
Spanish only	25	8.6	10.1	26.13	0.000	5.8	10.2	27.22	0.000	2.8	1.1	1.03	0.362
Both Spanish and Kichwa	26	27.8	12.2			24.5	11.3			3.3	2.5		
Kichwa only	38	38.0	20.3			34.3	19.3			3.7	2.5		
Total	89	26.7	19.8			23.4	19.0			3.3	2.2		
Traditional food													
Low	29	13.5	13.4	14.72	0.000	11.0	13.5	14.24	0.000	2.5	1.2	2.91	0.060
Medium	29	29.7	16.3			26.0	15.7			3.8	2.5		
High	30	37.4	21.0			33.7	19.9			3.7	2.6		
Total	88	27.0	19.8			23.7	19.0			3.3	2.2		

Table 8.5b**:** Results of ANOVA analyses of the relationship between cultural variables and variety richness measures for maize, beans, and potatoes.

		Maize varieties				Bean varieties				Potato varieties			
				Between group				Between group				Between group	
	N	Mean	SD	F	p	Mean	SD	F	p	Mean	SD	F	p
Traditional dress													
Never	6	1.0	0.0	3.18	0.047	4.2	7.8	6.16	0.003	0.8	0.8	2.58	0.082
Sometimes	12	1.4	1.2			6.8	8.5			0.6	0.7		
Always	69	3.8	4.1			16.6	12.2			1.8	2.0		
Total	87	3.2	3.8			14.4	12.2			1.5	1.9		
Language													
Spanish only	25	1.1	0.4	8.09	0.001	3.8	8.2	19.14	0.000	0.8	1.0	2.87	0.062
Both Spanish and Kichwa	26	2.9	4.8			15.1	9.7			1.9	2.3		
Kichwa only	38	4.7	3.6			20.2	11.8			1.7	1.8		
Total	89	3.2	3.8			14.1	12.3			1.5	1.8		
Traditional food													
Low	29	1.4	0.9	6.2	0.003	7.6	9.8	8.23	0.001	0.7	0.6	4.55	0.013
Medium	29	3.6	4.9			15.5	10.8			2.0	1.9		
High	30	4.6	3.7			19.4	13.1			1.9	2.3		
Total	88	3.2	3.8			14.2	12.2			1.5	1.8		

Table 8.5c**:** Results of ANOVA analyses of the relationship between cultural variables and richness measures for field crop species, fruits and vegetable crops, and medicinal plants/herbs.

		Field crop species				Fruit and vegetable crops				Herbs			
				Between group				Between group				Between group	
	N	Mean	SD	F	p	Mean	SD	F	p	Mean	SD	F	p
Traditional dress													
Never	6	4.3	2.1	7.38	0.001	0.8	0.8	4.46	0.015	0.0	0.0	3.89	0.024
Sometimes	12	4.8	2.9			3.9	3.8			1.3	2.1		
Always	69	8.0	3.4			8.2	7.3			3.7	4.3		
Total	87	7.3	3.5			7.2	7.0			3.1	4.1		
Language													
Spanish only	25	4.3	2.3	17.68	0.000	2.6	2.9	9.21	0.000	0.8	1.3	6.32	0.003
Both Spanish and Kichwa	26	7.7	2.8			10.0	7.7			3.4	3.3		
Kichwa only	38	8.8	3.5			8.0	6.9			4.3	5.1		
Total	89	7.2	3.5			7.1	6.9			3.0	4.1		
Traditional food													
Low	29	5.1	2.7	11.59	0.000	3.8	4.3	8.43	0.001	1.0	1.8	8.91	0.000
Medium	29	7.7	3.2			6.8	7.6			3.0	3.4		
High	30	8.9	3.5			10.7	6.8			5.2	5.2		
Total	88	7.3	3.5			7.2	7.0			3.1	4.1		

Tables 8.6a-c: Poisson regression results.

Table 8.6a: Poisson regression results for total variety richness measures. (Continued on next page.)

Explanatory variable/Statistic	Total varieties			Total landraces			Total MVs		
	Coef.	z	P>z	Coef.	z	P>z	Coef.	z	P>z
Cultural variable									
Proportion of traditional foods in diet (cont.)	1.1472	2.9	0.0040	1.1936	2.64	0.0080	0.5265	1.24	0.2160
Household demographic and economic variables									
Age of HH head	-0.0009	-0.21	0.8330	0.0000	0.00	0.9980	-0.0073	-1.15	0.2490
Schooling of HH head	0.0051	0.34	0.7320	0.0092	0.56	0.5770	-0.0306	-1.11	0.2660
Number of adults	-0.0257	-0.65	0.5170	-0.0347	-0.83	0.4080	0.0288	0.64	0.5250
Number of children	-0.0369	-1.7	0.0900	-0.0412	-1.65	0.0980	-0.0031	-0.09	0.9290
No HH head works off farm^									
One HH head works off farm	0.2059	1.57	0.1170	0.2172	1.51	0.1320	0.1858	1	0.3160
Two HH heads work off farm	0.1471	0.73	0.4680	0.2103	0.78	0.4370	-0.1445	-0.47	0.6380
Farm variables									
Size of cultivated land	0.2840	2.49	0.0130	0.2523	1.92	0.0550	0.4583	4.2	0.0000
Square of cultivated land size	-0.0191	-1.7	0.0880	-0.0047	-0.37	0.7100	-0.0568	-4.05	0.0000
Livestock assets	0.1751	2.32	0.0200	0.1734	1.98	0.0480	0.2058	3.06	0.0020
Square of livestock assets	-0.0084	-2.3	0.0210	-0.0082	-1.94	0.0530	-0.0097	-2.93	0.0030
Land has irrigation access	-0.1606	-1.18	0.2390	-0.1511	-1	0.3160	-0.2782	-1.56	0.1190
Low zone	-0.1919	-1.58	0.1130	-0.2243	-1.76	0.0780	0.1397	0.78	0.4370
Intermediate zone^									
High zone	-1.2323	-5.98	0.0000	-1.5007	-5.74	0.0000	-0.3772	-1.27	0.2050
Market relations									
No part of crop production sold^									
Very small part of crop production sold	0.0354	0.26	0.7920	-0.0072	-0.05	0.9600	0.4272	2.54	0.0110
Small or medium part of crop production sold	-0.2175	-1.33	0.1830	-0.2761	-1.48	0.1390	0.2953	1.06	0.2890
Large part or all of crop production sold	-1.9814	-6.49	0.0000	-3.0499	-6.33	0.0000	0.1287	0.34	0.7330
Constant	2.8403	9.38	0.0000	2.7329	8.26	0.0000	0.5995	1.25	0.2120

Explanatory variable/Statistic	Total varieties			Total landraces			Total MVs		
	Coef.	z	P>z	Coef.	z	P>z	Coef.	z	P>z
Observations	88			88			88		
Wald chi-square	342.24			223.34			193.18		
Probability > chi-square	0.0000			0.0000			0.0000		
Pseudo R-squared	0.5658			0.5960			0.1415		

^Omitted because of collinearity.
Note: All regressions are run using robust standard errors.

Table 8.6b**:** Poisson regression results for maize, common bean, and potato richness measures. (Continued on next page.)

Explanatory variable/Statistic	Maize varieties			Common bean varieties			Potato varieties		
	Coef.	z	P>z	Coef.	z	P>z	Coef.	z	P>z
Cultural variable									
Proportion of traditional foods in diet (cont.)	1.4761	2.08	0.0370	1.2495	2.32	0.0200	0.1293	0.21	0.8300
Household demographic and economic variables									
Age of HH head	0.0082	0.77	0.4420	-0.0027	-0.54	0.5890	0.0052	0.63	0.5310
Schooling of HH head	0.0254	0.63	0.5310	0.0043	0.27	0.7890	0.0206	0.62	0.5360
Number of adults	-0.0537	-0.7	0.4840	-0.0466	-0.91	0.3620	0.0743	1.37	0.1700
Number of children	-0.0779	-1.72	0.0850	-0.0444	-1.56	0.1180	0.0241	0.48	0.6280
No HH head works off farm^									
One HH head works off farm	0.4667	1.4	0.1610	0.1650	1.05	0.2920	0.2479	1.17	0.2410
Two HH heads work off farm	0.0155	0.05	0.9640	0.2646	1.31	0.1910	-0.2703	-0.5	0.6160
Farm variables									
Size of cultivated land	0.5928	1.96	0.0490	0.3090	1.39	0.1650	0.4166	3.4	0.0010
Square of cultivated land size	-0.0664	-1.43	0.1540	-0.0233	-0.77	0.4400	-0.0475	-3.83	0.0000
Livestock assets	-0.0775	-0.66	0.5120	0.1076	0.89	0.3730	0.1911	2.1	0.0360
Square of livestock assets	0.0045	0.74	0.4590	-0.0064	-0.47	0.6360	-0.0076	-1.71	0.0880
Land has irrigation access	-0.7301	-2.01	0.0450	0.0323	0.2	0.8450	0.2197	0.87	0.3870
Low zone	0.0183	0.07	0.9430	-0.0962	-0.62	0.5360	-0.3892	-1.41	0.1580
Intermediate zone^									
High zone	-1.7289	-4.29	0.0000	-18.8442	-32.24	0.0000	1.0335	3.17	0.0020
Market relations									
No part of crop production sold^									
Very small part of crop production sold	0.1571	0.64	0.5200	-0.1917	-1.18	0.2400	0.8310	3.59	0.0000
Small or medium part of crop production sold	-0.4715	-1.17	0.2440	-0.2100	-0.97	0.3320	-0.2028	-0.74	0.4610
Large part or all of crop production sold	-0.4621	-0.95	0.3440	-3.1564	-11.27	0.0000	-0.7995	-1.45	0.1470
Constant	0.0027	0	0.9970	2.3890	6.61	0.0000	-0.9071	-1.43	0.1530
Observations	88			88			88		
Wald chi-square	282.46			3236.41			1085.75		

Explanatory variable/Statistic	Maize varieties			Common bean varieties			Potato varieties		
	Coef.	z	P>z	Coef.	z	P>z	Coef.	z	P>z
Probability > chi-square	0.0000			0.0000			0.0000		
Pseudo R-squared	0.3010			0.5829			0.3011		

^Omitted because of collinearity.

Note: All regressions are run using robust standard errors.

Table 8.6c: Poisson regression results for crop level richness measures.

Explanatory variable/Statistic	Field crop species			Fruits and vegetables			Medicinal plants			Field crop species, square		
	Coef.	z	P>z	Coef.	z	P>z	Coef.	z	P>z	Coef.	z	P>z
Cultural variable												
Proportion of traditional foods in diet (cont.)	0.5536	2.61	0.0090	1.6148	2.47	0.0130	1.8275	2.11	0.0350	1.0994	2.59	0.0100
Household demographic and economic variables												
Age of HH head	-0.0008	-0.24	0.8110	-0.0049	-0.72	0.4700	0.0053	0.49	0.6260	-0.0016	-0.23	0.8160
Schooling of HH head	0.0071	0.61	0.5430	0.0652	2.23	0.0260	0.0117	0.34	0.7350	0.0196	0.79	0.4280
Number of adults	0.0203	0.83	0.4080	0.0048	0.09	0.9270	0.0128	0.20	0.8400	0.0327	0.68	0.4940
Number of children	-0.0104	-0.54	0.5910	0.0400	1.19	0.2320	0.0849	1.86	0.0630	-0.0239	-0.62	0.5350
No HH head works off farm^												
One HH head works off farm	0.0534	0.59	0.5520	0.3463	1.51	0.1310	0.9472	2.67	0.0080	0.0917	0.46	0.6470
Two HH heads work off farm	0.0673	0.31	0.7530	0.1480	0.43	0.6690	0.7837	1.68	0.0930	-0.0173	-0.05	0.9600
Farm variables												
Size of cultivated land	0.1892	2.54	0.0110	-0.0212	-0.1	0.9230	0.1575	0.50	0.6150	0.3349	2.13	0.0330
Square of cultivated land size	-0.0140	-1.99	0.0460	-0.0155	-0.59	0.5560	-0.0804	-1.33	0.1830	-0.0284	-1.99	0.0470
Livestock assets	0.1094	1.86	0.0640	0.1752	1.24	0.2150	0.4669	2.35	0.0190	0.2517	2.17	0.0300
Square of livestock assets	-0.0043	-1.53	0.1270	-0.0086	-1.37	0.1710	-0.0212	-2.48	0.0130	-0.0101	-1.81	0.0710
Land has irrigation access	-0.1953	-2.34	0.0200	-0.7785	-3.06	0.0020	-0.1457	-0.47	0.6380	-0.4684	-2.92	0.0030
Low zone	-0.1861	-1.87	0.0620	0.0533	0.26	0.7940	-0.6501	-2.51	0.0120	-0.4253	-2.29	0.0220
Intermediate zone^												
High zone	-0.6090	-3.55	0.0000	-1.3940	-2.78	0.0050	-1.4864	-2.33	0.0200	-1.3355	-3.76	0.0000
Market relations												
No part of crop production sold^												
Very small part of crop production sold	0.1105	1.06	0.2900	0.2711	1.33	0.1850	0.7892	3.35	0.0010	0.2666	1.29	0.1970
Small or medium part of crop production sold	-0.0567	-0.67	0.5020	0.7593	3.08	0.0020	0.5332	1.67	0.0940	-0.0675	-0.37	0.7120

Explanatory variable/Statistic	Field crop species			Fruits and vegetables			Medicinal plants			Field crop species, square		
	Coef.	z	P>z	Coef.	z	P>z	Coef.	z	P>z	Coef.	z	P>z
Large part or all of crop production sold	-0.7561	-3.21	0.0010	-0.3794	-0.78	0.4330	-0.2339	-0.41	0.6840	-1.2101	-2.97	0.0030
Constant	1.7328	6.27	0.0000	0.7609	1.43	0.1520	-1.3244	-1.84	0.0660	3.6195	6.30	0.0000
Observations	88			87			88			88		
Wald chi-square	250.03			184.43			167.18			288.23		
Probability > chi-square	0.0000			0.0000			0.0000			0.0000		
Pseudo R-squared	0.1883			0.3746			0.3972			0.5488		

^Omitted because of collinearity
Note: All regressions are run using robust standard errors.

CHAPTER 9

'THE ONE WHO HAS CHANGED IS THE PERSON': OBSERVATIONS AND EXPLANATIONS OF CLIMATE CHANGE IN THE ECUADORIAN ANDES[62]

[62] K. Skarbø, K. VanderMolen, R. Ramos and R.E. Rhoades. 2012. 'The one who has changed is the person': observations and explanations of climate change in the Ecuadorian Andes. *In* Climate change and threatened communities: vulnerability, capacity and action. D. Brokensha, A.P. Castro, and D. Taylor, eds. Pp.119-128. Rugby, UK: Practical Action Publishing. Reprinted here with permission from the publisher.

Abstract

This chapter reviews explanations of recent climatic change and its effects on agriculture from the perspective of the indigenous worldview or 'cosmovision' of Kichwa farmers in Cotacachi, Ecuador. During recent years warmer temperatures and irregular rainfall have resulted in confusion regarding the agricultural calendar and higher instances of crop loss in this Andean community. Those villagers still rooted in the local 'cosmovision' link these changes to people's loss of respect for a living environment and weakened awareness of their intricate co-existence with the elements of nature. The chapter demonstrates that climate change is not only a technical and political issue, but also one of moral and religious dimensions.

9.1 Introduction

Kichwa farmers in the highlands of Cotacachi, Ecuador explain that certain changes in the weather have disrupted the agricultural calendar in a way that is without referent in local memory. In this chapter we will review how the effects of climate change are perceived in the landscape and explained from the perspective of the local 'cosmovision', which exists today as a syncretism of Andean and Catholic beliefs (Sarmiento et al., 2008). This worldview is reflective of that of the greater Andean tradition. It conceives of nature as alive and endowed with sentience and agency such that human–environment interactions are dialectical (Estermann 1998; Apffel-Marglin and PRATEC 1998). This is not the only lens through which climate change is perceived in the area. Government institutions, development organizations, telecommunication, and the formal education of youth also influence understandings of environment and climate. Here, however, we will focus on explanations from those who remain firmly rooted in the local cosmovision, primarily Cotacachi's elders. Like Turner and Clifton (2009), we believe that indigenous perspectives on human–environment relationships can offer insights for a world wanting to lessen its impact on the earth and construct a sustainable future. It is in this spirit that in the following pages we attempt to provide a channel for voices from Cotacachi on the issue of climate change.

9.2 Study Area and Methods

Cotacachi's 43 Andean communities cross the eastern slopes of the dormant Cotacachi volcano (4,939 m) located approximately 80 kilometers north of Ecuador's capital, Quito, in the province of Imbabura (PUCE 2005). The communities' combined population is estimated to be 15,878 (UNORCAC 2006). Although over 70 per cent of the working population is employed primarily in the neighboring cities of Otavalo, Ibarra and Quito, agriculture continues to be important as slightly more than 84 per cent of the population owns and cultivates land, aiding livelihoods by supplementing inadequate income and seasonal unemployment (UNORCAC 2007). While farmers with larger landholdings typically produce crops for sale in local and regional markets, the majority have only small plots (less than 1 hectare) where they grow food for household consumption. Fields span from 2,300 to 3,300 m in elevation and exhibit high agricultural biodiversity (Skarbø 2006). Maize and beans are among the most commonly grown crops at lower altitudes, whereas higher up, tubers, grains and fava beans predominate. During the past decade maize has also been introduced into higher altitudes as warmer temperatures have allowed for its successful cultivation. Given that only 43 per cent of the population has access to irrigation water, most farmers depend on rainfall for the growth and maturation of their crops (UNORCAC 2007).

Beyond and because of its millennia-old basis for subsistence in the area, agriculture also plays an important symbolic and material role in the constitution of culture and indigenous identity for the predominantly Kichwa population in Cotacachi (Rhoades 2007). Although the locally grown diet is composed of a variety of foods, maize is the crop of primary cultural significance. It is considered the ‘mother’ of all crops and provides sustenance and social cohesion through a wealth of dishes consumed on everyday, festive and ritual occasions.

The information presented in this chapter was collected through participant observation, workshops and semi-structured interviews conducted by the authors in a 12-month period spanning 2009 and 2010. During this time, two of the authors lived with an indigenous family in the community of Turucu in Cotacachi’s lowlands where they participated in agricultural and ritual activities throughout the year. Five workshops involving 200 participants were held, focusing on changes in weather and agriculture and explanations for their occurrence. Additionally, over 100 semi-structured interviews were conducted on a variety of climate- and agriculture-related topics with both men and women farmers between 20 and 90 years of age across 11 communities.

9.3 Climate and Agriculture in Cotacachi: Past and Present

Farmers in Cotacachi explain that the year used to be divided into a rainy winter (September–April) and a sunny, windy summer (May–August), consistent with documentation of seasonality in neighboring highland areas (Rovere and Knapp 1988). Winter rains were punctuated by two *veranillos* (little summers): *el veranillo de las almas* (the little summer of Souls) in November, and *el veranillo del Niño* (the little summer of the Christ Child) in December. The agricultural calendar was fixed around this pattern. In lower altitudes, farmers typically intercropped maize with beans, faba beans, squashes, quinoa and lupines (*chochos*) in the early rains of September–December, and planted wheat and barley in the later rains of February and March. In March and April they would harvest some fresh maize but would leave most to dry on stalk for harvest in May and June. They would then plant fields with potatoes and peas, crops that thrive in the dry of summer, and harvest them in August along with the wheat and barley. Farmers then repeated the cycle when new rains began in September.

During the last years, however, Cotacacheños have noted increasingly irregular weather that deviates from the pattern described above. They report less rain overall and longer dry periods, lack of rain during what used to be wet winters and intense rain during what used to be dry summers. They further note decreasing levels in waterways and springs, as well as higher daytime temperatures. These changes pose challenges to local agriculture. The winter dry spells hinder the development of maize and beans. Rainy summers rot maize left to dry on stalk and leave potato and pea crops prey to blights.

One farmer explains: ‘My parents planted in accordance with the weather, winter or summer, as they knew in which season it would rain, they planted peacefully. Now they cannot do this anymore, because in the winter sometimes it rains and other times it is hot. One cannot plant anymore’ (Workshop participant, 30 Nov 2009). Decreased water levels in local waterways further constrain agriculture by hindering irrigation and water use for livestock. Farmers also report greater loss of crops due to new pests and increased attacks of those already known, occurrences which may be associated with warmer temperatures and climatic change (Dangles, et al. 2008)

When harvests are scarce, as they have been during the last decade, food security is threatened and the local diet changes as people tend to replace hearty local foods like soups and stews made from wholegrain quinoa, barley, wheat, cucurbits, maize and beans, with the purchase of less nutritious white rice and pasta. Lost harvests and more pests also inhibit the saving of seeds for the next year, threatening the maintenance of local biodiversity and the basis for future harvests. Summarized in the words of Cotacachi’s mayor: ‘There is a great climatic confusion […]. There is disorganization, a confusion regarding the climate, regarding the time to sow, to harvest, and the effect is poverty, increased poverty. There is no production, there is no food, and because of this, there is malnutrition’ (Alberto Anrango, 11 Nov 2009).

The lack of available local climate data makes it difficult to corroborate farmers’ perceptions of change (Rhoades, et al. 2006). However, farmers’ observations are generally congruent with regional trends. Ontaneda (2007) reports high variability in rainfall in Ecuador’s northern highlands during the past five decades, and decreased precipitation in more recent years

(2000–2006). Throughout much of South America, including Northern Ecuador, an increase in consecutive dry days as well as intense rainfall was registered during the last four decades of the 20th century (Haylock, et al. 2006). In Latin America as a whole, the incidence and intensity of severe climate events such as El Niño/La Niña have also increased in recent decades (Magrin, et al. 2007). These trends may partially explain farmers' observations of increased weather irregularity and reversed seasonality. The decreasing volume of the area's waterways is linked in part to the disappearance of Cotacachi's glacier during the last part of the 20th century (Rhoades, et al. 2006). Andean tropical glaciers play an important role in regulating seasonal water availability and their retreat has been predicted to threaten water supplies (Bradley, et al. 2006; Vuille, et al. 2008). Farmers' observations of a warming environment are supported by climate data from the entire Andean region (Vuille, et al. 2008; Vincent, et al. 2005); in Ecuador's highlands mean temperatures on average increased by 0.9ºC in the period 1960–2006 (Ontaneda 2007).

9.4 Explanations of Change

Many of Cotacachi's elders explain climate change and its effects as resulting from the loss of traditional beliefs and practices connected to the local cosmovision. This is an ongoing trend that they attribute to the formal education of youth and their lack of interest in agriculture, the 'modernization' and mechanization of agriculture, and sometimes to the increase of evangelicalism as well. As education exposes young people to alternative worldviews, activities and professional opportunities, they lose interest in agriculture and belief in the worldview to which it has traditionally been tied. The contrast in perspectives within families is so generationally marked that when parents and elders share their beliefs, children often laugh and tell them that they 'are crazy to believe such lies'. The modernization and mechanization of agriculture, in turn, are said to distance people from direct interaction with the earth and negatively affect human and environmental health. Finally, evangelicalism is considered to challenge the local worldview as its advocates reportedly discourage expressions of respect for the natural world which they misinterpret as adoration. As one woman explains: 'They [evangelists] come and say "you adore the earth and you are adoring the rocks, adoring the water, adoring the mountains", but we do not adore them, all that we do is respect them because we feel that they have life'. (40-year-old woman, Quitugo)

9.5 The Local Cosmovision

Traditional beliefs and practices in Cotacachi are founded upon respect for the natural world and its constituent elements. Mother Earth (*Pacha mama*), Mother Water (*Yaku mama),* Mother Rain (*Tamya mama*), Mother Cloud (*Fuyu mama*), Mother Wind (*Wayra mama*), Father Hurricane (*Akapana tayta*), Father Sun (*Inti tayta*), Mother Grain (*Grano mama*) and Mother Fruit (*Fruto mama*) are all alive. They are *personajes*: living elements that have personalities, roles and relationships to one another and to the local population as well. The two dormant volcanoes that dominate the area's natural landscape, *Mama Cotacachi* (Mother Cotacachi, also named *Urku rasu* (Snow-capped mountain) or *Urku mama* (Mother mountain), and *Tayta Imbabura* (Father Imbabura), are also bestowed with life – they are God's (*Achi tayta*) stewards of the region, and bound by marital ties.

In order for there to be successful harvests and a secure food source, people throughout past generations have depended on the will and care of these *personajes*. Yet people are not passive subjects – their actions also affect the behavior of the *personajes*; the communication is two-way. In awareness of their dependence on the natural world, people in Cotacachi have traditionally demonstrated respect for the elements of their landscape, through both daily activities and on ritual occasions. They have asked for permission before entering sacred springs and mountains, and they have carried out prayers, offerings (*ofrendas*) and masses (*misas*) for nature's elements – to keep them awake, to keep them happy, to remind them how important and revered they are among people, to call them to come or to ask them to withdraw. *Misas* and *ofrendas* were primarily carried out on sacred mounds (*tolas*). For example, people would throw grain and bean flours from atop *tolas* on days of fog in offering to Mother Cloud 'for her to be orderly, for what is happening now not to happen, for it to rain as it has to rain, and for the clouds to come down and sip from the springs, only to sip, and not to drink them dry' (Workshop participant, 20 Nov 2009). For Mother Earth, twelve counts of potatoes, maize, beans, fava beans and other foods would be blessed on a *tola* and buried in the center of unproductive fields amidst prayer and throws of blessed water. For Mother Wind, twelve pieces of each crop would be blessed in the town of Ibarra, then buried in the Garden of *Mama Cotacachi*: a sacred place filled with wild flowers close to her summit.

Reverence was not only shown in rituals, it was also expressed through everyday life, asking Mother Earth´s permission to enter fields and planting with what elders describe as 'faith and heart', in conversation with *Mama Cotacachi*: 'I am going to leave you in charge of these grains so that next year you return them to me multiplied'. An elderly man from Quitugo, frustrated by the carelessness of the young of today, explains:

> It is not only a question of working, weeding or watching the moon. If a person weeds without having faith in God, he will not have a good harvest. […] My mother always said that one has to believe in Mother Earth, one has to believe in God, in the Hurricane, in the breeze of the wind. 'One has to respect them so that they will also respect our crops', she said. When a crop was lost, she said, 'Who of you have faulted in your respect of Mother Earth? You have to regret and apologize'.

9.6 Effects of the Loss of Beliefs, Respect and Practices

When respect and communication are lost, it is thought that the natural world becomes upset and that agricultural production will invariably decline. Many elders and some young people explain the current climatic situation as punishment or a test of God, or Mother Earth. For example, some farmers describe the increase in pests and plant diseases as occurring because, as people have forgotten God, he drops handfuls of pests to the earth such that he might be newly remembered. Others explain that in the past they successfully eliminated the presence of pests by paying for mass, but, they say, having forgotten God and the life in nature, this no longer happens.

> Nature has life. Why do you think that when you bury a seed it grows? Because Mother Earth knows that she must make it grow. […] I think that realizing this, we should start respecting our Mother Earth, our Lord. But since we do none of this, I think that it affects us, and because of this we also receive all these punishments. Well, they say that one should not say punishment, but they are making us remember that Mother Earth has life.
>
> (49-year-old man, San Pedro)

Elders note that during dry spells children are no longer gathered to call for Mother Rain, and so, they say, she remains absent. They also explain the lack of rain as caused by the removal of native vegetation which they believe 'call the rains' by drawing clouds to the area's waterways where they fill with water before releasing rain. During the last decades much native vegetation has been lost, ceding space to roads, construction and eucalyptus plantations. Without this vegetation it is thought that the clouds are unable to form and fill with water, and that instead winds blow them away.

In explanation of diminishing waterways some say that Mother Water sleeps when people do not make offerings to her, and that as she sleeps her volume diminishes. Since the implementation of water distribution systems during the last decades, community members no longer frequent the springs and waterways where they once made offerings to ensure the continued plenitude and availability of water. Tubing now delivers water to individual homes for which elders note that people have become physically and culturally removed from the resource. Some stress that this removal must be re-bridged as they note Cotacachi's youth as sharing a false sense of security about future water availability. They consider that ritual offerings to Mother Water should be restored among youth so that waterways remain plentiful. It is also believed that springs can dry from lack of demonstrated reverence by their users, flee in fright of loud noises and become covered by landslides only to re-emerge from the earth elsewhere – as far away as neighboring mountains. In such cases the springs may return but only through ritual: ceremoniously calling the water and cleansing it with the help of a *yachak* (shaman) so as to cure it of its fright. Without this knowledge, belief in Mother Water as life bearing, and the awareness that water originates from the earth, elders express concern that the vulnerability of water as a resource will not be understood.

Elders also tell about dreams in which they have experienced revelations about the current climatic situation and about the importance of continuing the beliefs and practices that they know. In one workshop, an elder shared a dream of his, explaining the recent increased intensity of sunlight:

> I had a dream about Father Sun, where he said that he only opened his eye a little bit. This is why the sun is shining normally. But Father Sun said, 'When I get angry and open my eye wider, I will burn plants, houses, people, I will burn everything'. Father Sun says that in the coming years he will open his eye wide. Then, he will finish with all of us. Nobody will be saved.
>
> (80-year-old man, San Pedro)

9.7 Discussion and Conclusion

Indigenous knowledge in Cotacachi – when considered as *a way of knowing the world* (Berkes 2009) – exhibits resilience in the face of recent climatic change. The local knowledge system, grounded in the indigenous cosmovision, has been shaped by generations of local experience infused with new ideas through regional and global flows of people, information, goods, and non-native plants and animals throughout the past millennia. Even though some of its current content, like knowledge of weather prediction and the timing of agricultural tasks, seems to lose its utility in the face of climate change, on a more fundamental level, the cosmovision retains its explanatory power. The tales, teachings and cautionary dreams of elders offer precise frames of reference for the interpretation of climatic conditions for which local memory has no referent.

Yet, current cultural change is so strong that many young people reject the beliefs and practices rooted in the cosmovision, which according to elders provokes environmental change. Without the continued daily and ritual demonstration of reverence for Mother Earth, Mother Rain, Mother Wind, Mother Water, and Father Sun, they become disengaged and lose interest in performing the activities that sustain human life. Instead, they fall asleep, drift away, or become angry at both people and each other, the result of which is a less habitable environment. As one man states: 'It is not that the climate has changed. The one who has changed is the person, he has lost beliefs and all respect'. (89-year-old man, Quitugo).

Although understanding of climate change by Cotacachi's elders is culturally and locally contained, it might still offer reflection on some of the broader issues of climate change and human – environment interaction. From their perspective, the way people perceive the natural world, its workings and their relationship to it is of ultimate importance in shaping actions that in turn influence a shared environment. They point to our dependence on the natural world and the dialectic that characterizes our interactions with it, cautioning that to view nature as inherently static or as constant in regard to the provision of human needs is to underestimate the importance of our actions towards it. Further, they caution against viewing the environment in purely mechanistic terms. One woman explains: 'the environmentalists say that one should not cut down trees because they filter the air, they give purity to the air, nothing more. But they only reach so far, they don't arrive at the depth of it, that there must be contact and communication [with nature]' (40-year-old woman, Quitugo). According to this view, action based on physical understanding of the environment alone is insufficient and likely to be unsustainable. When we consider the impressive body of scientific information that exists on current climatic and environmental change against the lack of mitigating efforts around the globe, it becomes apparent that this knowledge alone seems to be an insufficient trigger of ameliorative action (Heyd and Brooks 2009).

The roads toward more integrated and sustainable human–environment interactions may be many. The landscape perceptions and principles of interaction with the natural world contained in the knowledge system of Cotacachi's elders bear similarity to those of indigenous peoples in places such as the Pacific North West (Cruikshank 2001), Tibet (Byg and Salick 2009) and surely others as well. They are also related to views of nature and norms of behavior formulated in more modern Western traditions, such as Deep Ecology (Næss 1973; 1989). The case presented here offers an example of a holistic view of the world; a view that has old roots and still guides the lives of a few. It is our hope that the *Cotacacheños* cited above may remind us of our dependency on nature and that reconsideration of our relationship to it will be necessary to abate current and future environmental change.

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CHAPTER 10

IMPACTS OF CLIMATE CHANGE ON AGRICULTURE IN COTACACHI[63]

[63] Skarbø, K. To be submitted to *Climatic Change*.

Abstract

This study examines impacts of recent climate change on agriculture and farmers' emerging coping strategies in the Ecuadorian Andes. Climate change is expected to alter global agricultural conditions, and it is clear that in order to maintain sufficient levels of food production, adaptation measures will be necessary. Policy action to aid future agricultural adaptation would benefit from knowledge of already occurring impacts on agricultural systems and the ways in which farmers observe and deal with them. This paper speaks to these issues through a case study in Cotacachi, Ecuador, employing workshops, semi-structured interviews and participant observation over a period of 12 months. The results show that several facets of recent climate change have altered agricultural conditions; farmers observe seasonal weather irregularity, increased water scarcity, more intense sunshine, torrential rainfall and higher temperatures, corresponding to scientific analyses of Andean climate data. These processes affect crop and livestock production in a variety of ways, often resulting in reduced harvests. Farmers approach the new conditions by strategies including searching for new water sources, reducing livestock assets,increasing the use of agrochemicals, moving planting and harvest dates and swapping crops between zones and seasons. It is suggested that the resilience and adaptive capacity of the local farming system would benefit from policy action to provide climate forecasting, improve irrigation structures, develop sustainable pest management and support the conservation of local agrobiodiversity.

10.1 Introduction

Trends of rapid global climatic change during recent decades – including rising temperatures, altered precipitation and evapotranspiration regimes, and increased incidence of extreme weather – are expected to continue developing during the 21st century (IPCC 2011; Meehl, et al. 2007). Exceeding the speed of past climatic fluctuation, these changes are linked to significant shifts in biodiversity and ecosystems, such as accelerated extinction rates and changes in species' distributions (Parmesan and Yohe 2003; Parmesan 2006). In addition to wild ecosystems, an important part of the earth's surface that invariably will be affected by climate change is that which forms the base for agriculture (Parry, et al. 2004). Continued functioning of agricultural ecosystems is fundamental to ensure future food production, and thus to human survival. In order to create policies that effectively ameliorate the challenges farmers will face as climatic and environmental conditions change, there is a need to understand the ways in which changing conditions affect agriculture in local contexts, and how farmers so far go about dealing with these impacts (Howard 2009). This paper examines these issues through a case study from Cotacachi in the Ecuadorian Andes. It shows that agricultural production is affected in a variety ways, and describes the strategies farmers employ to adjust to the new conditions. While some of these strategies appear to be adaptive, others may in the long run undermine the sustainability of local agriculture.

10.1.1 Climate Change in the Andes

Global trends of warmer temperatures and altered precipitation patterns are reflected in the Andean climatic record. A study based on data from 279 weather stations spanning the entire Andean region found an average warming of 0.1°C/decade over the past 70 years (Vuille, et al.

2008). Warming intensified during this time span, increasing to 0.32-0.34°C/decade during the last quarter of the 20th century (Vuille and Bradley 2000). Across the Andean region and throughout much of South America, daily minimum and maximum temperatures have increased, and daily temperature ranges have decreased (Vincent, et al. 2005). In Ecuador, data from 15 highland stations show an average total increase in temperature of 0.9°C from 1960 to 2006, or on average 0.2°C /decade (Ontaneda 2007). Individual data series from these stations show total temperature increments varying between 0.2 and 2.4°C (Ontaneda 2007).

Analyses of Andean precipitation data from 1960 to 2000 do not exhibit corresponding unidirectional trends; instead there are observations of increases in some areas and decreases in others (Haylock, et al. 2006; Vuille, et al. 2008). Data from Ecuador indicate an overall increase in precipitation from 1960 to 2006, but a decrease in the northern highlands (Ontaneda 2007). Evidence from the neighboring Colombian highlands shows decrease in cloud cover and increase in number of days with significant sunlight exposure (Ruiz, et al. 2008). In the Andean region as a whole there are observations of greater climate variability including increased occurrence of torrential rainfall (Haylock, et al. 2006; Ruiz, et al. 2008) and higher frequency and intensity of El Niño/La Niña episodes as well as other extreme weather events (Magrin, et al. 2007). Changes in climatic conditions, including higher temperatures, irregular precipitation and decreased cloud cover are further associated with the retreat of tropical Andean glaciers during the 20th century – a process that has become particularly accelerated since the 1980s (Vuille, et al. 2008).

Trends of warmer, more irregular and more extreme weather are expected to continue into the future (Magrin, et al. 2007; Urrutia and Vuille 2009). Average temperature increases for Ecuador relative to 2000 are estimated to +0.82 (±0.13)°C for the 2020s, +2.13(±0.29)°C for the 2050s, and +3.36 (±0.45)°C for the 2080s (Jarvis, et al. 2011). Average precipitation changes are estimated to -51 (±113), +59 (±254), and +151 (±365) mm/yr. for the same time periods (Jarvis, et al. 2011). Thus, there is high agreement between models regarding trends of temperature increase, but much uncertainty in terms of precipitation projections. The Andean highlands are expected to be exposed to more severe warming than the region's lower elevations (Bradley, et al. 2006).

10.1.2 Impacts on Agriculture

Research using computer modeling predicts substantial future impacts on agricultural production. Simulations based on climate models show overall progressive yield decreases during the course of the current century for Latin America including Andean countries, although there are considerable crop specific and regional variations (Magrin, et al. 2007). Ecuador is expected to experience particularly severe overall yield decreases, estimated to the range of 18.1-30.9% by 2080 (Cline 2007).

Models are typically based on expected trends in precipitation, temperature, and CO^2 concentrations, and do not take into account other facets of climate change and its effects, such as increased extreme weather events (including drought and flooding), increasing weather variability, changes in pest and disease pressures, and increased pressure on water resources. Due to such added circumstances, the challenges brought about by climate change for local farmers will likely exceed the model estimations (Thornton, et al. 2010). For example, the retreat of Andean tropical glaciers is considered a severe threat to future water supplies in the region's highlands as well as surrounding lowlands (Bradley, et al. 2006; Vuille, et al. 2008). Since these glaciers act as buffers to seasonal rainfall variability, their disappearance is predicted to profoundly affect regional hydrology. At the same time water demand is likely to increase, both because of greater irrigation needs and rising demand for household and industrial use among growing populations.

10.1.3 Adaptation

In order to avoid dire reductions in agricultural productivity, adaptation measures are essential. Adaptation – "adjustments to reduce vulnerability or enhance resilience in response to observed or anticipated changes in climate and associated extreme weather events" (Adger, et al. 2007: 720) – will include actions by farmers on local levels, as well as policy action on regional, national, and international levels (Adger, et al. 2007; Rosenzweig and Tubiello 2007). While calls for urgent policy action to ameliorate negative impacts and assist farmers to maintain production are timely and highly appropriate (Howden, et al. 2007; Morton 2007; Nelson, et al. 2009), it has been noted that in order to effectively promote adaptation, policies need to be informed by people's direct responses to climate induced variability and change (Finan and Nelson 2001; Howard 2009). Jarvis and colleagues characterize Latin American agriculture as highly variable as well as vulnerable to climate change, making it "hard to define a unique adaptation strategy other than governmental support to aid small-holders' adaptation" (2011: 47). Accordingly, in addition to important insights from models, simulations and analyses of large-scale trends, policies regarding agricultural adaptation should be based on research on how farmers currently observe and deal with impacts of climate change and variability in local contexts.

10.1.4 The Present Study

The present study examines how recent climate change impacts agriculture and how farmers so far go about dealing with these impacts in the case of Cotacachi in the Northern Ecuadorian Andes. The area is deemed particularly appropriate for the study since already in the first years of the current millennium, local farmers reported irregularity in climatic conditions (Rhoades 2007; Rhoades, et al. 2006).

Below I start out by presenting the study area and my methods. I begin the following results and discussion section with a brief overview of resilience mechanisms to climate variability in the local agricultural system. Next, I present findings on impacts of recent irregular weather on agricultural production as well as farmers' adaptation strategies. Finally, I summarize the results and discuss policy implications.

10.2 Study Area and Methods

10.2.1 Study Area: Cotacachi

Cotacachi *cantón* is located in Ecuador's northern highlands, about 80 km north of the capital Quito. This study is carried out in the *cantón*'s Andean zone, an area of 219 km^2, of which about 30% is constituted by highland *páramo* grasslands and the landmark volcano Cotacachi, rising to an elevation of 4939m (Zapata Ríos, et al. 2006). In addition to the urban centers Cotacachi, Quiroga and Imantag, and remaining *haciendas*, the area has 43 rural communities with a combined population of 15,878, most (73.5%) of whom identify as Kichwa (UNORCAC 2007). Even though a majority of households have members that are employed off farm, most also cultivate land where they grow food principally for subsistence purposes. The long agricultural history of the area is reflected in an elaborate traditional knowledge system and an extensive agrobiodiversity (Chapters 2 and 3). Fields span an altitudinal belt from about 2,300m to 3,300m, divided into three agro-ecological zones. The warmest lower zone is mainly planted with maize, beans, cucurbits, and a variety of fruits and vegetables. The high zone is traditionally dominated by cold-adapted crops, including potatoes and other roots and tubers, faba beans, wheat and barley. The intermediate zone contains some of each of the two other cropping complexes.

10.2.2 Methods

The article primarily builds on data collected during fieldwork over a total of 12 months in Cotacachi in 2009-2010, including workshops, semi-structured interviews and participant observation. Four workshops were arranged, in which participants from different communities were invited to reflect on the local climate, observation and explanations for changes in its nature, and impacts on agriculture. Activities included group discussions, the drawing of climatic and agricultural calendars, as well as individual written responses to questions. Observation and impacts of climate change was also a topic in a total of slightly more than 100 semi-structured interviews with farmers, local water managers, and representatives of water management bodies on the community, municipal, and regional level. Further, I directly observed impacts and coping strategies during varied participant observation, and also visited local water treatment and distribution plants and installations in different parts of the area. Finally, I draw on insights from previous research on agriculture and climate change in the area in 2003–2004.

10.3 Results and Discussion

10.3.1 Resilience to Climate Variability in Cotacachi's Agriculture

Climate variability is not new in the Andes (Dillehay and Kothari 2004). For instance, events such as el Niño/la Niña have periodically caused irregularities in seasonal weather, disrupting agricultural production. In the face of such varying conditions, resilient farming systems have developed. Some features and practices that have served as insurance mechanisms against climate variability in Cotacachi include agrobiodiversity, intercropping, year-round cultivation, staggered planting, food storage, irrigation and cultivation at different altitudes.

Overall crop diversity in Cotacachi has been and is still very high; during my research in 2009-2010 I documented 103 cultivated species, and a total of 367 varieties within 20 of these (Chapter 2). In addition to serving varied household needs, this diversity lessens the impact of adverse weather. As each crop responds differently to climatic stresses, the chances for harvesting at least something increment. At a finer level, a high varietal richness increases each crop's robustness to climate irregularities. For instance, subsistence-oriented farmers on average plant about 20 different bean varieties in their fields (Chapter 8). Some tolerate waterlogging, while others resist drought, such that under each of these conditions, a *complete* loss is rare. Further, most crops are traditionally intercropped, a practice that strengthens resistance against pests and diseases in addition to preventing soil depletion (Altieri 1996). Crops are grown in different seasons year-round, again heightening the odds of some harvest at some point during the year. Traditionally, planting within each season would also be staggered, spreading not only labor needs, but also the risk of crop failure, and providing fresh grains over a longer time period. For instance, the main maize/bean intercrop would be planted in different fields at different points in time between September and December. In parts of Cotacachi, irrigation networks ensure water when dry periods threaten crops. On a broader scale, fields are spread over different altitudinal and agroecological zones, across which climatic factors act differently. Thus, a harvest loss in one field or one community due to for example a frost episode is not necessarily repeated in the whole area. In the case of crop failure, farmers might obtain new seed from neighbors or farmers in other communities. Further, many of the main food crops can be stored for a long time (including maize, common beans, faba beans, quinoa, lupines, peas, and to some degree cucurbits and potatoes). Elderly people relate that when a bad year was predicted, they would attempt to save and ration food from the previous harvest, stretching the stores as far as possible into the "hunger year" (*yarkay wata*).

Even if these traditional practices to a large degree continue in Cotacachi today, some of them have been partly compromised during the last years. For instance, the high crop diversity is unevenly distributed, and some households now only plant a small selection of crops, and few or only one variety of each crop (Chapters 2 and 8). Decreasing farm sizes and increased reliance on hired tractors to prepare fields make staggered planting more impractical. And in the case of seed loss, instead of relying on family and acquaintances, many source new seed from market sources – reducing the amount of locally adapted seed in the system.

In sum, resilience mechanisms rooted in a long agricultural history have protected Cotacachi's farms against climatic instability. Current farmers continue to carry out many of these practices, albeit to a somewhat lesser extent. The partial reductions and substitutions of such traditional agricultural practices are connected to several factors and processes. Many households today combine farm production with off farm work, providing income that can be used to purchase food and buffer potential crop losses.

10.3.2 Recent Climate Irregularities and Agricultural Impacts

> My parents planted in accordance with the weather, winter or summer, as they knew in which epoch it would rain, they planted peacefully. Now they cannot do this anymore, because in the winter sometimes it rains and other times it is hot. One cannot plant anymore.
>
> Workshop Participant, Nov 30 2009

Cotacachi´s inhabitants report that the last years have come with irregular weather patterns, deviating from the normal seasonal climate to an extent not experienced before. According to local explanations, the year is divided into a drier summer (May-September), and a wetter winter (September-May). Farmers' descriptions correspond to climate observations from nearby sites in highland Ecuador (Rovere and Knapp 1988), as well as precipitation records from Cotacachi (Fig. 10.1). The agricultural calendar has been shaped around these seasonal variations (Chapters 3 and 9). Now the weather is noted to have become more unpredictable. Commonly cited specific changes include more or stronger sunshine, longer dry periods, more severe rains, and higher temperatures. Table 10.1 presents a summary of climatic irregularities noted by local farmers, the ways in which these changes affect agricultural conditions in Cotacachi, and emerging adaptation strategies. In the following, I shall detail and discuss these developments.

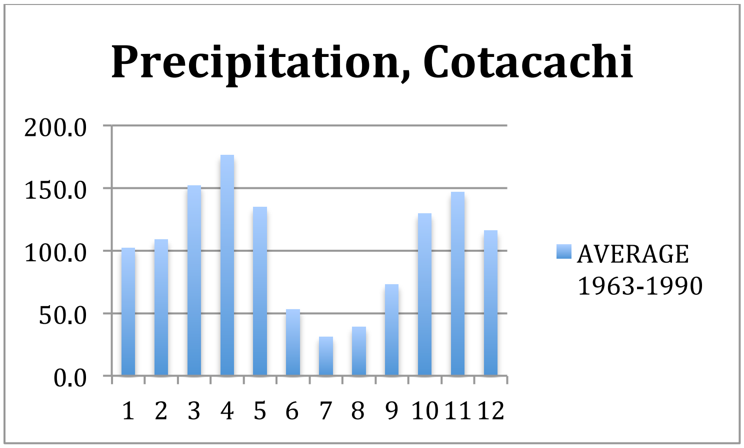

Figure 10.1: Average monthly precipitation in Cotacachi, 1963-1990. Source: Data from Hacienda Esthercita, provided by Instituto Nacional de Meteorología e Hidrología (INAHMI). Note: Data collection at this station was initiated in 1963.

Table 10.1: The effects of climate change on agriculture in Cotacachi and emerging adaptation strategies.

Cause	**Effect**	**Coping strategy**
Water scarcity	*Crops:* Desiccation of plants Harvest loss	Search for new water sources Political fight for water rights
	Livestock: Lack of pasture Lack of drinking water for animals	Reduce livestock assets
Strong sun	Reduced water retention in soils Plants "burn" Harsher working environment	Search for new water sources Cover up during agricultural labor
"Aguacero" Heavy rain	Waterlogged fields Increased incidence of rot, blight Difficult to work fields Erosion	Move planting dates Harvest maize, beans in fresh state Plant resistant crops
Higher temperatures	Crop-altitude adaptation altered	Plant maize higher up
	Increased pest attacks (field and storage) New pests	Increased use of pesticides Use of purchased seed instead of farm saved

10.3.2.1 Water Scarcity

> Earlier it rained a lot. Grains matured beautifully, it rained well, there used to come lots of water down both ravines (*quebradas*). There used to come lots of water. (…) There, the faba beans would flourish, the maize, the beans. Now they are lost every year, every year they continue to be lost.
>
> Francisco Guitarra Morochos, 70, El Batan

A frequently referred to climate related agricultural problem in Cotacachi is lowered production due to lack of rain and drought. The explanation for overall reduced water availability for agriculture is two-fold. In addition to changes in rainfall patterns and prolonged dry periods (which are most frequently noted by farmers), the hydrology of the area has been affected by the disappearance of the glacier at the summit of Mt Cotacachi during the 20th century (Rhoades et al., 2006). While it is probable that the meltdown of the glacier produced a temporary increase in available water, the stream-flow in springs, creeks and rivers has decreased during recent years. The level of the largest lake of the watershed, Cuicocha, is reported to have fallen five meters during the beginning of the 2000s, and was measured to drop with another 90 cm from October 2003 to December 2005 (Rhoades et al., 2008). In a workshop held in November 2009, 22 participants from 18 communities listed 27 waterways that during the last years have either completely dried out or significantly decreased their water flow. As noted above, a dramatic meltdown of the Andes' tropical glaciers is observed throughout the region, and is expected to continue with further global warming, with severe consequences for highland populations' water supply (Bradley et al. 2006). It is clear that in Cotacachi, alterations in local hydrology have already begun to appear.

Reduced water availability affects crop and livestock production. The majority (57%) of farmers in Cotacachi's communities do not have access to irrigation water, and are wholly dependent on rainfall for crops to grow (UNORCAC 2007). Water is especially crucial for seed germination, such that precipitation during the main planting period from September to December is particularly critical, and rain scarcity in this period is a cause of great anxiety among farmers. During the growing phase, water stress prevents plants from developing well and causes lower production. Excessively dry conditions also increase plants' susceptibility to certain pest and disease attacks.

Those with access to irrigation water are better off, but even they complain about the lack of rain, because "it is not the same to irrigate with tools to have water from rain, since it gives water to all the soil" (Workshop participant, November 2009). In addition, as explained below, farmers report increased evapotranspiration caused by a more intense sun, and thus declining efficacy of irrigation, implying a need of augmenting the amount of water applied.

Many of those with current irrigation access wish to secure more water, and many of those without look around for ways to establish irrigation access. However, most of the watershed's aquatic resources have already been claimed and concessioned. Since the institution of Ecuador's water concession system in the early 1970s, water rights have been granted persons and institutions through an application process. In addition to farmers in the area's rural communities, haciendas, floriculture plants, industry, institutions and urban communities have obtained water rights from state authorities. Today, far-sighted community leaders traverse the *páramo* of Mount Cotacachi in the search of any yet unclaimed springs. If they are lucky to find something, they face a lengthy bureaucratic process to secure rights, and after that, mobilization of funds to pipe the water back down to farm lands. None of these steps are easy tasks, but the need of water pushes people toward the mountain (Figure 10.2).

Figure 10.2: Picture from the *páramo*. In 2006 leaders from the communities of Cuicocha Centro and Cuicocha Pana obtained water rights to a combined flow of 2.0 L/s in three springs located in Cotacachi's *páramo*, over 20 km away from their farms. These were the closest unclaimed sources they could identify. They are now preparing documentation to apply for external support to pipe the water down the mountain. Picture from community expedition in June 2010 to plant trees around the springs, a practice considered to protect and enhance their water flow.

Water scarcity also affects livestock production. Many families in Cotacachi's communities keep a few animals, serving as a source of milk, meat, manure and traction, and a way to save. Together with factors such as increased theft threats, current water stress complicates livestock rearing through decreased availability of drinking water and pasture.

Farmers in several communities explain that as the springs and creeks where their animals used to access water have dried up, they now have no choice but to supply them with tap water. Scarce rains equal scarce grass and herb production, and food stressed animals. One way in which such stress is manifested, is in reduced milk production. In one community, Ugshapungo, there is a small farmer-owned dairy producing cheese, and many of the community's inhabitants keep cows for milk delivery to the dairy. The period from April 2009 to April 2010 was exceptionally dry[64], causing a sharp decline in the amount of milk supplied, and by December cheese production had dropped from an average of 130 pieces per day and down to 25 (Pers. comm. Antonio Fueres, dairy manager, Dec 1 2010).

With prolonged dry periods, many opt to sell their livestock, instead of risking losing animals from dehydration and malnourishment. And when many sell, prices decrease, and livestock savings crumble. When people sell off their cattle, they also stand without traction to plow and work fields. Typically, some community members will keep cattle trained for traction, and rent these out to neighbors. For instance, in the community of Quitugo, there were ten households who had cattle that were trained for traction in 2009. In 2010, only three of them still had their cattle; the rest had been sold during the dry spell. Thus, the rent went up from seven to ten dollars a day, increasing the costs of agriculture, and increasing incentives for opting to hire tractors instead of cattle for field preparation. The rising popularity of tractors has at least two indirect consequences. First, farmers note increased soil compaction in comparison with livestock powered field work. Second, the use of tractors leads to synchronization of planting dates, again raising the risk related to harvest failure. This is because neighbors join to share the

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[64] At the time of writing, climate data from Cotacachi is only available until December 2009. They show that total rainfall during this period (April-December 2009) was only 63% of average records for 1964-2008. All months except December had below average precipitation, and two months had as low as 1.1% and 5.4% of average precipitation (My analysis of data provided by INAMHI).

costs of bringing the tractor to the community– which is typically hired from non-communitarian entrepreneurs.

Finally, less livestock also means less manure, and reduced soil fertility. Since most small-scale farmers in Cotacachi rely exclusively on organic fertilizers (Skarbø 2005), a reduction in manure availability may have serious repercussions for plant nutrient levels.

Water rights are already a topic of tension both locally and nationally. A new water law based on the Constitution of 2008 was up for debate in the National Assembly both in 2009 and 2010, but each time President Rafael Correa at the last minute postponed its vote because of heavy protests among civil society groups demanding increased participation in water management. Farmers from Cotacachi, along with peasant and indigenous groups from many other parts of the country, participated in roadblocks and protests, as they have several times before (Rhoades 2007). The tension surrounding the issue of water is both a symptom of uneven access among socioeconomic groups, as well as changes in the resource base. Increased water stress in the future is likely to exacerbate this situation. Farmer groups will surely continue to fight for their rights to water.

10.3.2.2 Intense sun

> Now, in these times, when the sun shines, up here in the páramo, it is a very strong sun. If it has rained, in one week it is dry again. Because the sun is so strong, it dries up really fast. I mean, it takes no time, the humidity dries up very quickly. It is hotter than before. It burns.
>
> Antonio Fueres, Ugshapungo

People in Cotacachi refer to two changes in patterns of the sun during recent years. First, there are more days of sun, corresponding with fewer days of rain and drier conditions for agriculture, as discussed above. Second, the sunlight is perceived to have become more intense, causing sunburn and accelerating evapotranspiration. When the sun shines brightly in the morning, people say it is like “sun of water” (*sol de aguas*), which used to be an indication of rains in the afternoon. However, now the sun will continue shining this way throughout the day without a drop of rain appearing. The strong sun dries up the fields quicker than before, so that irrigation and rainwater alike lose their effect sooner. In the community of Peribuela, where irrigation water allocated to each user every second week used to suffice during periods without rain, people now explain that just a week after irrigation, the fields are completely dry again. Farmers further report that the burning sun directly affects plants, sometimes damaging developing foliage. Finally, they note the increased intensity of the sun on their skin: “The sun is so strong, now we cannot stay [in the field] without covering our heads, now we cannot, but earlier we could” (Woman, 30 years old, Quitugo). The intense sunlight makes working conditions in the field harsher.

While farmers working fields can and do mediate sunburn by covering themselves, they have fewer means to shield their fields from the sunrays’ harmful effects. Those who have good irrigation access apply water to compensate for increased evapotranspiration, while many who do not are searching for new water sources.

10.3.2.3 *Aguacero* – Severe Rains

> Earlier it rained slowly. Now it seems like they are spraying with a hose.
>
> Workshop participant, November 29 2009

When the rains finally come, people report that it pours down with more intensity and/or continuity than what used to be normal. Erratic, heavy rains lead to soil erosion and field damage. For instance, a woman interviewed in October 2009 sighed as she explained that when the sought-after rains finally had come the day after she planted beans in the field above her home, it had come down with such intensity as to wash out the field, and leave her patio strewn with seed and debris the next morning.

Rains during longer periods than normal are also reported, causing crop loss due to rot and blight. For instance, during the first parts of 2007, 2008 and 2009, many lost much of their maize harvest in unusually heavy and prolonged rains. Continuously wet fields also make it difficult to enter and do any kind of work, hampering not only harvests, but also tasks such as field preparation, weeding, and other care of growing plants.

People experiment with moving planting and harvest dates in order to deal with the changed weather. However, with the changes from year to year, adjustment is not straightforward. For instance, in response to the crop losses due to excessive rains mentioned above, in 2009 some tried to plant at an earlier date, in August, to see if they could harvest before the rains would set in. But as the whole period from August 2009 until April of the following year turned out to be exceptionally dry, much of the harvest was lost anyway, this time to drought. The maize that survived this dry period many chose to harvest early, in its fresh form (*choclo*), afraid that heavy rains again would lead to rot and damage as in the previous two years. Actually, the rains that came in the late winter months of 2010 were not as damaging as in 2008 and 2009, so the few ears that were left in the field to dry did make it until harvest time.

Harvesting products such as maize and beans in their fresh state instead of letting them dry on the plant impacts food security as well as seed management. Fresh products have a short shelf life, and the harvest must therefore be sold. This provides extra income that can be used for purchasing food, but does not provide the security of having own stored grains to take from through the coming year. Also, to serve as seed, grains and beans must be dried in the field.

Thus, if everything is harvested fresh, seed must be procured from other sources for the next season, and again, if this leads to a replacement of local diverse seed with more uniform material, it may imply an overall loss of local biodiversity.

Another strategy to avoid damage from excessive rains is to plant tolerant crops. Repeated rainy summers during the 2006-2008 period led to much late blight and harvest loss in the summer potato crop. In 2009 and 2010, several farmers chose to swap potatoes for rain resistant faba beans in their summer plantings.

10.3.2.4 Higher Temperatures and Changes in Agroecological Zones

> It was never hot, when I was young. (…) [Now,] during the night it is cold, and during the day, a strong sun. Earlier, the sun was strong in Cotacachi [referring to urban center in valley bottom], but not up here. Now, it is as hot here as in Cotacachi.
>
> Antonio Fueres, Ugshapungo

People from all parts of Cotacachi note that temperatures have increased during the recent past. Those living in the lower parts of the area are not particularly enthused when making the observation, but those residing further up look more positively at this development. Not only do they enjoy a warmer working and living environment; they have further begun to expand the suite of crops in their fields.

Higher temperatures allow an uphill expansion of species' distribution. As explained above, agricultural fields in Cotacachi cover an altitudinal gradient of about 1000 m, and the crops grown along this gradient differ. During recent years, however, people report to successfully have experimented with crops from the lower zones in the upper ones. Most significantly, maize, which until about a decade ago was restricted to the lower and intermediate zones, is currently grown in the highest zone as well (Chapter 11). If temperatures continue to increase, such upward movement of cropping zones is likely to continue. For instance, it is likely that the common bean also will be guided into higher altitude fields where it has not been grown before. While this crop migration represents an adaptive strategy for farmers with land in the higher zone, it has so far not been of any amelioration to those negatively affected by climate change in the lower parts of the area. In the future, however, it is possible that experimenting farmers in the low zones bring new crops from other, lower elevation regions, or more heat-adapted varieties of current crops into their fields.

But, it is not only heat-demanding crops that expand their habitat as growing environments warm up. Another consequence of an altered environment is more favorable conditions for many crop pests and diseases.

10.3.2.5 Increased Pest Attacks

For lack of rain, there are problems with much plant pests.

Workshop participant, Nov 29 2009

Cotacacheños report of increased pest attacks during recent years, both in the field, and during storage. They also refer to newly appeared pests. Even though other factors may influence the presence of pests, an altered growing environment due to climatic changes is likely to have affected the situation. For instance, the farmer quoted above linked increased pest attacks to susceptible, water stressed plants. Plant pathologists expect climate change to influence crop pest and disease activity and distribution world wide, although accurate predictions are difficult due to the many interrelated factors involved (Gregory, et al. 2009; Thomas 2010). These include changes in temperature, precipitation and humidity, wind, CO^2-levels, as well as climate induced changes in the behavior and distribution of vectors, hosts and soil microbial communities. Table 10.2 presents an overview of pest and disease problems of some of the most common crops in which farmers in Cotacachi reported to have observed changes in occurrence during recent years. In the following I will comment further on each of these problems.

Table 10.2: Pest problems reported to have increased in Cotacachi during the period 2000-2010.

Crop	Pest/pathogen (Latin)	Pest/pathogen (Kichwa)	Pest/pathogen (Spanish)	Pest/pathogen (English)	Stage	Problem	Change
Potato	*Premnotrypes vorax*	Papa kuro	Gusano blanco	Andean weevil	Field	Larvae attack tubers, adults attack foliage	Increased incidence
	*Tecia solanivora**	*No local Kichwa name*	Mariposita de la papa	Potato tuber moth	Field and storage	Larvae attack tubers	New
	Phytophthora infestans	Lancha	Lancha, tizón tardío	Late blight	Field	Mold attacks whole plant	Increased incidence
Maize	*Sitophilus zeamais*	Redondilla *(Spanish term used)*	Gorgojo del maíz, redondilla	Corn weevil	Field and storage	Larvae attack dry grains	Increased incidence
	Helicocarpa zea	Pata kuro	Gusano del choclo	Corn earworm	Field	Larvae attack fresh cob grains in the field	Increased incidence
Beans	*Aphis* sp.	Yurak lancha, uchufa lancha	Lancha blanca, pulgón	Aphids	Field	Attacks and dries out plant	Increased incidence
	Acanthoscelides obtectus	*No local Kichwa name*	Gorgojo del frejol	Bean weevil	Storage	Larvae attack stored seed	New
Peas	*Aphis* sp.	Yurak lancha, alwirha lancha	Pulgón verde, lancha de la alverja	Aphids	Field	Attacks and dries out plant	Increased incidence
Faba beans	*Unidentified***	Hapas lancha	Lancha de la haba	Root/stem rot	Field	Attacks and dries out stem from the root	Increased incidence

*Three species of potato tuber moths coexist in Ecuador (Dangles, et al. 2008). I observed *Tecia solanivora* in the field, but the two other species, *Phthorimaea operculella* and *Symmetrischema tangolias* might also be present in Cotacachi.
**Root/foot/stem rot in faba beans often consist of a complex of species (Sillero, et al. 2010), but I did not identify those present in Cotacachi's fields.

10.3.2.5.1 Potato Pests and Pathogens

Farmers report three agents complicating potato production during recent years; increased incidence of Andean potato weevil (*Premnotrypes vorax*) and late blight (*Phytophthora infestans*), and the new appearance of potato tuber moths. The Andean potato weevil is native to and one of the most important potato pests in Ecuador (Gallegos G., et al. 1997). Its development has been shown to be slower at higher altitudes and lower temperatures (Niño, et al. 2004). Hence, it is not unlikely that rising temperatures, allowing shorter development cycles and more generations per year, have promoted the increased incidence observed by Cotacachi's farmers. Late blight is an important fungal plant disease world wide, favored by wet conditions (Henfling 1987). Farmers in Cotacachi report its incidence to have increased during recent summer seasons with unusual high amounts of rainfall. Potato tuber moths constitute a relatively new problem for Ecuadorian potato farmers. Three species have been observed; *Phthorimaea operculella,* which origin is not clear, was first reported in the 1980s, *Tecia solanivora*, originating in Guatemala, migrated southward and reached Ecuador in 1996, and *Symmetrischema tangolias* migrated northwards from Peru in 2001 (Dangles et al., 2008). The development of the three species has been found to be temperature dependent, and although mediated by trade and transport of potatoes, their invasion has been linked to regional temperature increases during the past decades (Dangles, et al. 2008). While the species co-occur at mid-elevations, Dangles and colleagues (2008) found *P. operculella* and *T. solanivora* mostly in lower parts of the Sierra (<2700 m), *and S. tangolias* dominating on higher altitudes (>3000 m). However, in 2010 I identified abundant infestation of *T. solanivora* in the community of Ugshapungo at an altitude of 3360 m. Farmers here report that this pest only appeared 4 years earlier, and causes considerable damage unless controlled with pesticides. Also farmers in the lower parts of Cotacachi report that it has become very difficult to store potatoes for food or seed due to damage by potato moths.

10.3.2.5.2 Maize Pests

Main maize pests in Cotacachi include the corn earworm (*Helicocarpa zea*) attacking fresh cobs in the field, and the maize weevil (*Sitophilus zeamais*), which larvae feed on dry maize grain, occurring in the field, but mainly doing damage in storage. While farmer reports regarding changes in the earworm distribution were mixed (some indicating stability, and others increased incidence), there was universal agreement that the maize weevil had become a more serious problem during recent years. Both species develop better at higher temperatures (Diffenbaugh, et al. 2008; Ileleji, et al. 2007), and it is not unlikely that recent temperature increase in the region may have favored their conditions. In addition to climate related factors, changes in storage practices may also have contributed to the increase in maize weevils during storage. Traditionally, maize grain has been stored on especially constructed platforms (*kullka*) close to the ceiling of people´s homes, and ears selected for seed have been hung by their husks over roof poles (*wayunga*). Smoke from open fire pits has protected grain from infestation. With new ways of constructing homes and a switch from wood fired kitchens to the use of gas burners, these practices have partially been replaced during past years, mainly with storage in sacks and containers.

Another reported problem in maize, although not a pest, is increased incidence of cobs without grain development during dry years, a phenomenon called *uruwawa* (beautiful child). In normal years such plants appear in low numbers, and their reddish canes are a prized snack for their unusually sweet taste. Plant scientists confirm that arrested ear development can be a symptom of drought stress, and further explain that the sweetness is due to an overabundance of plant sugars from photosynthesis, since there is no grain to receive it (Nielsen 2007). When *uruwawa* plants overpopulate the field, they are not such a pleasant surprise anymore.

10.3.2.5.3 Bean Pests

Bean production has mainly been affected by the introduction of the bean weevil (*Acanthoscelides obtectus* Say), which according to farmers in Cotacachi only appeared in the area in 2006/2007. The weevil's larvae attack beans in storage in a manner similar to maize weevil larvae, eating the grains from inside and producing white, inedible flour. Scientists at the Ecuadorian National Institute of Agricultural and Livestock Research (*Instituto Nacional Autónomo de Investigaciones Agropecuarias* – INIAP) confirm the weevil's previous absence in Cotacachi, and were surprised to learn of this observation (Gallegos, pers. comm. Jan 17 2011). The species is considered to be native to the Andean region (Alvarez, et al. 2005), but is restricted from low as well as high altitudes due to temperature limitations; according to INIAP entomologist Patricio Gallegos (pers. comm. Jan 17 2011), it thrives best under storage conditions between 18 and 25 °C. The species' temperature sensitivity supports the possibility that the upward migration has occurred in response to increasing temperatures.

10.3.2.5.4 Pea Pests

The main pest problem farmers referred to in peas is aphids (*Aphis spp.*). The problem is now so severe that although most subsistence-oriented farmers in Cotacachi usually do not to apply any kind of agrochemicals in their fields, several reported to treat their peas with pesticides. Aphids are also affected by temperature (Morgan, et al. 2001), and farmers' observations of increased incidence might hence be linked with climate change.

10.3.2.5.5 Faba Bean Pathogen

Another recently accelerating problem reported by Cotacachi's farmers is root/stem rot in faba beans. Such rot can be caused by a number of different species (Sillero, et al. 2010), some of which are favored by wetter conditions (*Fusarium* spp., *Phytophthora* spp.), and other by drier (*Rhizoctonia* spp.) (Redden, et al. 2010). In general, the distribution of these pathogen species is predicted to be affected by climate change (Redden, et al. 2010), and farmers' observations indicate that such effects are already present in Cotacachi.

10.3.2.5.6 Reactions and Consequences of Increased Pest Problems

The principal way through which farmers of Cotacachi have met the rising pest problems is incremented use of pesticides. The use of agrochemicals in Cotacachi is most widespread in *haciendas* and farms with a market-oriented production. Commercial producers have typically adopted modern varieties and the technological package that often comes with them, including the use of pesticides, fungicides and chemical fertilizers. They report to have increased the application of pesticides to deal with the current intensified pest problems. For instance, as noted above, the newly appeared potato tuber moth in the community of Ugshapungo is only kept in check by the repeated application of pesticides. On farms where production is largely destined for auto consumption, the use of agrochemicals is much less prominent. Still, today the occurrence of aphids in peas is commonly tackled by pesticide application. Also, in response to the increased attacks from maize and bean weevils during storage, it is becoming more common to treat these stored products with aluminum phosphide tablets. In reaction with the humidity of air, the tablets are converted to phosphine, a highly toxic gas that prevents weevil development.

Increased use of agrochemicals is not unproblematic, as it may cause damage to health and environment. Usually, no protective gear is used in field application, and farmers are directly exposed to these substances. Since grain is stored in homes, the use of aluminum phosphide tablets for weevil prevention is likely to expose household members to the toxic phosphine gas. Accidental exposure has been reported as a cause of children's death in other rural parts of the world (Pérez Navero, et al. 2009; Singh, et al. 1997). Research has also shown that ingestion of these tablets is becoming a common means of suicide in various rural settings (Eddleston 2000; Iraola Ferrer, et al. 2009; Ranga, et al. 2004). In Nicaragua, high poisoning rates (204 deaths in 2007) led to prohibition of the product's sale in 2008 (MINSA 2008). In the US, the product is regarded a restricted use pesticide that can only be handled by certified applicators, and use of the product indoors or in residential areas is prohibited (EPA 2010). In Cotacachi, little is provided in terms of warnings regarding the product's toxicity.

Farmers lament the rising use of chemicals in agriculture, whether they themselves employ them or not. Commercial farmers, whose production has become dependent on the application of agrochemicals, express concern about soil degradation linked to intensive applications: "the soil is also damaged from so much fumigation" (Workshop participant, Nov. 2009). Despite their realization of negative consequences of the chemicals' use, they explain that there is no other option but to continue the practice – otherwise the harvest will be lost. There is also worry about the decreasing food quality due to pesticide use: "we don't have healthy food products because we fumigate much now" (Workshop participant Nov. 2009). And people who do not apply these substances are worried about contamination of their fields and foods from neighbors that do use chemicals: “Our fields are close to the fields that are sprayed and they contaminate ours, because ours are natural and we only wait for the rains” (Workshop participant, Nov. 2009).

In summary, even if many still rely more on traditional pest management strategies, including intercropping and crop diversity, the recent pest increases are sparking more use of agrochemicals. Farmers note negative environmental and health consequences of increased pesticide use, however, protective measures and precautions are largely absent.

10.4 Conclusion

10.4.1 Impacts and Adjustments

As reviewed in the preceding section, changed climatic conditions have posed new challenges to Cotacachi’s agriculture during recent years. Drought, severe rains and increased pest and disease attacks have threatened harvests. Even if production levels vary from year to year, people report an overall reduced level during the recent past. The situation affecting crop production is complex, and also involves factors such as labor input, techniques and land degradation, but the unstable climate undoubtedly plays its part in the equation.

On the other hand, harvest losses have not been complete. There is a certain level of resilience in the farming system, and in addition farmers adjust their cultivation to the adverse conditions. People search for irrigation sources and fight to defend their water rights, spray fields with agrochemicals, experiment with adjusting planting and harvest dates, elevations and crop choices, replace lost seed and plant anew. While several of these strategies are likely to be adaptive also in the long run, some, such as increased use of pesticides, reduction of livestock assets and replacement of diverse local seed with uniform, imported modern varieties, have doubtful side effects.

One crucial resource that buffers climate variability and provides possibilities to adapt is local agrobiodiversity. The broad suit of crops and varieties cultivated by Cotacachi's farmers are all adapted to local conditions – but each responds differently to climate variations, and as noted above, this increments chances of securing a partial harvest even when rains fail or pour down at odd times. As shown above, the suit of crops also provides possibilities to adapt to changing conditions by substituting one for another in a given season or zone. Increasingly wet summers lead farmers to plant more rain-adapted crops instead of potatoes that traditionally are planted in this season. And warmer temperatures invite them to plant maize at higher altitudes.

Yet, at the same time, this very resource so fundamental for farmers' management of climatic uncertainty is threatened by processes sparked by the changing climate. Poor harvests reduce the chances of being able to select and save a full set of seed for the next year. The recuperation of seed in the event of scarce harvests requires careful management – varieties that have performed the poorest must be identified, in order to ensure the inclusion of an entire set of varietal diversity for the next season's planting, and thus maintaining the adaptive capacity of the seed stock. Several subsequent poor harvests, or lack of attention to varietal selection, may lead to a household's complete loss of viable seed of a certain variety or crop. The practice of harvesting fields early, increasingly employed to avoid pest damage, constitutes another threat to seed continuity – in order to serve as seed at least some of the plants must be left to ripen fully and dry. Increasing pest problems under storage, especially in potatoes, maize, and beans, further hamper farmers' seed saving practices. While in earlier times lost seed would be replaced by planting material sourced from neighbors or nearby communities, people today also turn to the market. Some give up on saving seed altogether, and buy new planting material each year. Often the seeds available in the marketplace are less diverse and adapted to local conditions, and in a longer perspective the result might be erosion of local agrobiodiversity. This may lead to a cycle where “the loss of seed quality no longer permits good harvests” (Workshop participant, Nov 2009).

10.4.2 Future Adaptation and the Potential of External Interventions

Even though farmers report current changes to exceed previous variability, the local agricultural system contains potent resources to endure and adapt to climatic changes. This demonstrates the importance of valuing and relying on local knowledge, experience and resources in future adaptation. Policy makers should not only take these factors into account, but consider them fundamental to adaptation plans. For instance, as just discussed, the rich local agrobiodiversity – crucial in sustaining agriculture under difficult conditions - is currently under pressure, and policies should ensure to foster instead of undermine its continued cultivation. Further, external support has a high potential of positive influence in the area of water access and distribution. Farmers seek help to organize water access, and improved irrigation networks would greatly enhance their capacity to withstand longer dry periods and increased evapotranspiration.

The amount of adjustment necessary in local agriculture will be contingent on the shape, speed and severity of future climate change. Climate models indicate that in addition to overall changes in average temperature and precipitation regimes, farmers will have to adapt to increasing levels of climate variability. Improved information systems for short and long-term weather prediction might be one effective way to help farmers better plan and schedule their agricultural calendars – preventing that irregular climate leads to a situation where "one cannot plant anymore", as indicated by the farmer cited in section 10.3.2.

Another potentially severe challenge to agriculture is increasing pest and disease problems sparked by the changing climate. Because of their easy entry as blind passengers in food, seed and plant transports, these organisms might arrive before their natural enemies as the climate changes. It will be important to research and monitor ecosystemic and food web changes in conjunction with rising temperatures and other climatic developments. The adoption of pesticides and fungicides as the prime medium through which to tackle growing crop pest and disease problems would potentially undermine the sustainability of the local agriculture and food system. Instead of promoting a chemical solution, institutions, researchers and farmers could search for and experiment with integrated methods to combat pest and disease problems, based on local traditional techniques in combination with experiences and research from other geographical areas.

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CHAPTER 11

MAIZE MIGRATION:

KEY CROP EXPANDS TO HIGHER ALTITUDES AS TEMPERATURES INCREASE IN THE ANDES[65]

[65] Skarbø, K and K.VanderMolen. To be submitted to *Agriculture, Ecosystems and Environment.*

Abstract

This study examines recent upward expansion of maize cultivation in the Ecuadorian Andes. Climate change is expected to profoundly alter agricultural crops' growing conditions, potentially causing production declines. One suggested adaptation strategy is to substitute currently grown plants with others that are better adapted to new environmental parameters. While research has documented the upward migration of wild species linked to global warming, there has been little investigation on whether farmers experiment with alternative crops in response to climate change. This case study employs interviews, transect walks and mapping to examine changes in the extent of maize cultivation on the slopes of Mt. Cotacachi, a volcano located in the Northern Ecuadorian highlands. The results show that during the past two decades, farmers in four different communities have extended maize cultivation 2-300m above the crop's previous altitudinal limit. This autonomous adaptation to climate change indicates that, at least in tropical mountainous regions like the Andes exhibiting closely stacked agroecological zones, external interventions are not necessary to organize crop migration.

11.1 Introduction

11.1.1 Adapting Agriculture to Climate Change

The global climate has changed substantially during the past century and is expected to continue to do so into the future (IPCC 2011). Altered climate patterns influence the growing conditions for the earth's biological diversity, including cultivated crops. Computer modeling suggests that by 2050 climate will move beyond the tolerable temperature and precipitation ranges for currently grown crop species in several parts of the world (Burke, et al. 2009; Parry, et al. 2004). Such a scenario could potentially threaten both local livelihoods as well as the food supplies of major parts of the world's population. It is clear that climate adaptation measures are needed in order to avoid dire reductions in food production (Adger, et al. 2007: 720). These will include actions by farmers on local levels, as well as policy action on regional, national, and international levels (Adger, et al. 2007; Rosenzweig and Tubiello 2007). The adoption of crops and varieties more suited to new climatic conditions has been suggested as one important adaptation strategy for farmers to continue to be able to produce food as the environment changes (Easterling, et al. 2007). While a substantial body of research shows that recent climate change has induced latitudinal and altitudinal changes in the ranges of many wild species (Parmesan 2006; Parmesan and Yohe 2003), empirical research on range shifts for agricultural species is scarce. In contrast to wild species, that possess some ability for autonomous movement, the growing range of agricultural crops depends on the actions of farmers – their access to seed and decisions of what to plant where. The question remains as to whether farmers will autonomously adopt new crops and varieties in response to climate change, or if such adaptation will require external intervention. This paper speaks to these questions through a case study in the Northern Ecuadorian Andes that examines recent developments in the altitudinal extent of maize cultivation.

11.1.2 Observed and Projected Temperature Increase in the Andes

Global trends of warmer temperatures are reflected in the Andean record, with data showing a significant increase in temperature during the last century. A study based on data from 279 weather stations spanning the entire Andean region shows an average warming of 0.1°C/decade over the last 70 years (Vuille, et al. 2008), increasing to a rate of 0.32-0.34°C/decade during the last quarter of the 20th century (Vuille and Bradley 2000). Across the Andean region and throughout much of South America, daily minimum and maximum temperatures have also increased (Vincent, et al. 2005). In Ecuador, individual data series from 15 highland stations show increments in mean daily temperatures varying between 0.2 to 2.4°C in the period from 1960 to 2006, and an average total increase in temperature of 0.9°C, corresponding to a warming of 0.2°C/decade (Ontaneda 2007).

Trends of warming are expected to continue through the present century (Magrin, et al. 2007; Urrutia and Vuille 2009). Average temperature increases for Ecuador relative to 2000 are estimated to +0.82 (±0.13)°C for the 2020s, +2.13 (±0.29)°C for the 2050s, and +3.36 (±0.45)°C for the 2080s (Jarvis, et al. 2011). The Andean highlands are expected to be exposed to more severe warming than the region's lower elevations (Bradley, et al. 2006).

11.1.3 Impacts on Agriculture, Ecosystems and Biodiversity

Climatic changes are predicted to impact ecosystems and agriculture throughout the Andes, a region characterized by unusually rich levels of both wild and cultivated biodiversity that has developed in and adapted to the wide range of climatic and ecological niches in the mountain range (Brush 1982; Troll 1968; Young, et al. 2002). Simulations based on projected changes in temperature, precipitation and CO^2 concentrations show overall progressive yield decreases during the course of the current century for Latin America including Andean countries, although there are considerable crop specific and regional variations (Magrin, et al. 2007). Ecuador is expected to experience particularly severe overall yield decreases, in the range of 18.1-30.9% by 2080 (Cline 2007).

Increased temperatures combined with other climatic changes are predicted to shift ecosystem boundaries on the mountains' slopes (Ruiz, et al. 2008) and there is already evidence of that happening. For example, research from Peru shows that three anuran species (*Pleurodema marmorata, Bufo spinulosus and Telmatobius marmoratus*) have recently expanded their habitat ranges to extreme altitudes, from previous upper limits between 4500-5000m to new limits of 5244-5400m (Seimon, et al. 2007). Further, research indicates that rising temperatures has been one of the factors causing recent habitat range expansions of potato tuber moths (*Phthorimaea operculella, Tecia solanivora and Symmetrischema tangolias*) in the Ecuadorian Andes (Dangles, et al. 2008). Given these occurrences, it is not unlikely that the suitable niches of agricultural plants are already moving upslope as well. However, as previously noted, crop species can only be transplanted by farmers, meaning that any shifts in their actual ranges of cultivation will depend entirely on farmers' actions.

11.1.4 Maize in the Andes

Domesticated in Mexico perhaps as early as 8000-9000BP (Piperno, et al. 2009), maize spread to the Andes several millennia ago. The earliest archaeological records for maize in

Ecuador are from the coast where it may have been present as early as 7500BP (Pearsall 2008)[66]. Over time, the crop has adapted to an array of different growing environments. Today it is cultivated from sea level up to all but the highest parts of the Andean agricultural landscape where its growth becomes limited by frost and low temperatures (Brandolini, et al. 2000; Timothy, et al. 1963). Given that the rate at which temperature decreases with elevation varies at different latitudes (Lauer, 1993), the upper limit of maize cultivation varies throughout the Andes. For example, in Southern Peru, maize has been reported to grow up to 3550m (Zimmerer 1996) whereas in Northern Ecuador it has been observed to grow up to only about 3000m (Knapp 1992; Timothy, et al. 1963).

11.1.5 The Present Study

The present study seeks to examine the extent to which farmers in the Northern Ecuadorian Andes have responded to recently rising temperatures by expanding the cultivation of maize to higher altitudes. It does so through a case study in Cotacachi, a *cantón*[67] in the province of Imbabura. The *cantón* provides a suitable site for the study because its agricultural zone stretches over areas below as well as above the previously observed limit of maize cultivation. During fieldwork in this area in 2003-2004, farmers in one of Cotacachi's communities located above the previous maize zone, Ugshapungo, reported that they recently had been able to grow maize (Skarbø 2005). In the current study we return to further examine this development. The following research questions guide the inquiry: 1. Do farmers in

[66] Debate exists regarding the timing of the introduction of maize to coastal Ecuador, especially since the earliest finds are dated by association, and some authors suggest a later introduction (Staller and Thompson 2002). The earliest radiocarbon dated maize remains are dated to 5300 BP (Zarrillo et al. 2008).

[67] *Cantón* is the second level geographical administrative unit in Ecuador. The country consists of 24 *provincias*, each of which is comprised of a number of *cantones*.

Ugshapungo continue growing maize?; 2. Has maize cultivation expanded upward also in neighboring communities?; and 3.What is the background for the expansion and what are its implications?

11.2 Study Area and Methods

11.2.1 Study Area: Cotacachi

The fieldwork for this study was carried out in the *cantón* Cotacachi, located approximately 80 km north of Quito in Ecuador's northern highlands. Of the *cantón*'s 40,036 inhabitants (INEC 2011), 15,878 reside in 43 rural communities spread along the eastern slopes of the Cotacachi volcano (4,939m) (UNORCAC 2007). The research was conducted in the southeastern part of the *cantón* where agriculture is mainly small-scale and subsistence-oriented. In these communities, agriculture is divided into three zones: a lower zone (2300-2600m), an intermediate zone (2600-2800m) and a high zone (2800-3300m). As elsewhere in the Andes (Brush 1982; Zimmerer 1996), different crop complexes predominate at different elevations. In the low zone, farmers typically intercrop maize with beans, squashes, lupines and quinoa. Some fruits (such as citrus, avocado, blackberry) and vegetables (including onions, cabbage, beets) are also grown in the low zone. In the intermediate zone, farmers produce a similar maize intercrop as well as some roots and tubers, such as arracacha (*Arracacia xanthorrhiza*) and oca (*Oxalis tuberosa*). Finally, the high zone is used to pasture livestock and to cultivate cold tolerant cereals (wheat and barley), faba beans, potatoes, and other roots and tubers (melloco [*Ullucus tuberosus*], oca and mashwa [*Tropaeolum tuberosum*]). Among the diversity of crops in Cotacachi's agricultural system, maize plays a central culinary and cultural role as the main ingredient in a plethora of local dishes and as an important ritual object (Nazarea, et al. 2006; Ramirez and Williams 2003).

11.2.2 Methods

Fieldwork for the present study, including semi-structured interviews, transect walks and mapping, was carried out in Cotacachi in May-July 2010. We conducted semi-structured interviews with farmers in six communities: Ugshapungo, Morochos, Topo Grande, San Pedro, Iltaquí and El Cercado. Of the area's 43 communities, these were selected because they cultivate land in the high zone. Ugshapungo is the only one of the six communities that is located entirely in the high zone. The land of the other five communities stretches across both the intermediate and high zones, with the homes of most households located in the intermediate.

We conducted farmer-guided transect walks and, using a Global Positioning System (GPS; Garmin eTrex set to WGS 84), mapped the previous and present limits of maize cultivation in the communities where farmers reported to plant maize at higher elevations. Points demarcating the previous limits are based on farmers' estimates of the location of their communities' highest maize fields 20 years ago. We chose a 20-year time frame because of farmers' reports that they first began to experiment with the cultivation of maize at higher elevations in 1990. Points that demarcate the present limits were taken at the top of the communities' current highest maize fields. The elevations measured with GPS are consistent with the elevations registered in the mapping software (Google Earth), with a mean difference of +5.3m. GPS measurements are referred to in the text below.

11.3 Results and Discussion

11.3.1 A Clear Upward Shift in Maize Cultivation

Interviews revealed not only that farmers in Ugshapungo continued to produce maize, but further that farmers had expanded the elevation of their maize production during the last two decades in all but two of the other high zone communities (Iltaquí and El Cercado). Figure 11.1 and Table 11.1 show the previous (1990) and present (2010) limits of maize cultivation along five transects in four communities. Two separate transects were conducted in Morochos, represented here by "Morochos west" and "Morochos east", because of the large expanse of this community. The previous upper limit indicated by farmers (~2900-3000m in 1990) is consistent with prior reports from the region (Knapp 1992; Timothy, et al. 1963). In 2010, the highest fields were located between 3,119 and 3,267m. This represents a clear upward shift of ~200-300m in elevation corresponding to a ground distance of 1.1-1.3km during the last two decades. An elderly woman from the community of San Pedro describes the upward shift: "If you go up there now, you will see more maize than oca and melloco [native, cold-adapted tuber crops]. It is almost as if what you used to see around here, you now see up there".

The inter-communal variation in the previous and present limits of maize cultivation underlines the fact that site-specific variation in climate and topography also influence the elevation range of maize. The highest maize fields in Morochos, Topo Grande and San Pedro are the uppermost fields of these communities. Further up, the terrain becomes increasingly steep and little accessible for cultivation. Ugshapungo, on the other hand, is situated in a comparatively flat part of the mountain with topography better suited for agriculture. It is also where we registered the highest elevation for present maize cultivation (3,267m).

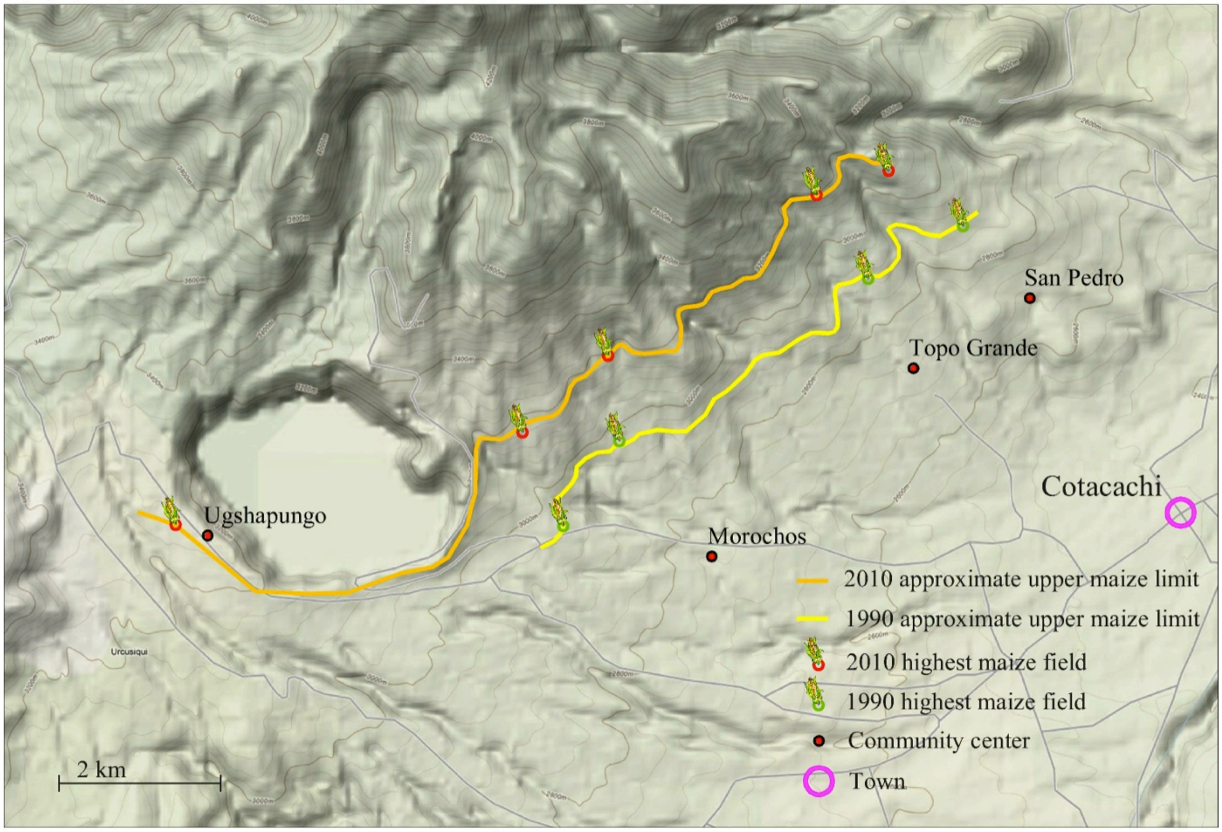

Figure 11.1: Map showing previous and present upper limits of maize cultivation in Cotacachi.

Table 11.1: Elevations of previous (1990) and present (2010) upper limits of maize cultivation in four communities in Cotacachi.

Community	Limit 1990 (m)	Limit 2010 (m)	Difference in elevation (m)	Distance[2] between limits (km)
Ugshapungo	NA[1]	3267	NA	NA
Morochos West	2968	3180	212	1.3
Morochos East	2985	3184	199	1.2
Topo Grande	2893	3192	299	1.2
San Pedro	2870	3119	249	1.3

[1]NA=Not applicable. The entire community of Ugshapungo is located in the high zone where a previous limit to maize cultivation does not exist, because maize was previously not cultivated there.
[2] Distance "as the crow flies", measured on map.

11.3.2 Spatial Shifts through Time

The upward movement of maize has taken place in a step-wise fashion. Farmers in each of the four communities began to cultivate maize in the high zone between 1990 and 2006, and the current uppermost fields were planted with maize for the first time between 2000 and 2008. The first shift occurred in the community of San Pedro. There, farmers introduced maize into the lower part of the high zone (2900-3000m) around 1990, and today maize is one of the primary crops grown at this elevation. A further upward expansion took place in San Pedro between 2006 and 2007, and the current highest maize field now reaches 3119m. In Ugshapungo, farmers report that maize was first cultivated in 1997, and that since then it has only become more prolific. Lastly, in Topo Grande and Morochos, farmers started to cultivate maize in the high zone in 2006 and 2007. The current uppermost maize fields in Topo Grande (3192m) were planted in 2007, and those in Morochos (3184m) in 2008.

11.3.3 Varietal Level Movement

There are over 200 distinct maize landraces in Latin America that are adapted to different agroecological conditions (Goodman and Bird 1977). Given that temperature is a limiting factor in the growth of different maize races (Brandolini, et al. 2000), elevation is an important regulator of their distribution in any given area (Eagles and Lothrop 1994; Timothy, et al. 1963). In 1963 Timothy and colleagues laid the foundation for the scientific classification of Ecuador's landraces, identifying 29 distinct races, 17 of which are specific to the highlands (Timothy et al., 1963). During a survey of 89 farms in Cotacachi in 2010, 12 of these highland races were registered in the lower and intermediate zones (Chapter 2), showing evidence of a remarkably rich local diversity. Timothy et al. observed the races Mishca (local Kichwa name: *raku sara*) at

2800m, and Chillo (local Kichwa names: *tsapa sara*, *chivila sara*, *kaballu kiru sara*) up to 3000m. We observed both of these landraces above 3100m, demonstrating that upward movement is clear on a varietal level as well. Farmers reported that they procured these seeds locally, either from their own communities or neighboring ones at intermediate elevation. We additionally noted that the race Uchima, registered by Timothy et al. to grow between 1400m and 2000m, is now cultivated in Cotacachi's lower zone (2300-2600m). Farmers explained that they have only recently introduced Uchima into their seed repertoire, confirming the previous lower limit reported by Timothy et al. Locally known as *morochillo* or *muruchillu*, its small, flint-like kernels are mainly used for chicken fodder. Farmers reported to have obtained the seed through purchase at local markets. We also observed the race Chulpi Ecuatoriano in the intermediate zone (2600-2800m), past the upper limit of 2600m reported by Timothy et al. It might only be a matter of time before farmers in Cotacachi introduce other varieties into new elevations, further breaking the previous delimitations of the area's agroecological zones.

11.3.4 Background: Motivation for Moving Maize Upward

Key factors inciting people to move maize upward that emerge from interviews and conversations with farmers are more favorable conditions at higher elevations and decreasing productivity at lower elevations. During interviews and transect walks, farmers repeatedly expressed excitement about the prospect of better maize production in the high zone and concern about the low maize harvests in the lower and intermediate zone (Figure 11.2). When asked how it occurred to them to plant maize further up, several farmers responded that they had observed warmer temperatures at higher elevations, and tested out the conditions for maize by planting it on a small plot. Observing the successful production, neighboring farmers caught on as well.

Although farmers were well aware of the upward movement of maize in their own communities, they were not certain that it had occurred in other communities. The variation in time between the upward movement of maize in each community and farmers' uncertainty as to whether it had also occurred in other communities suggest that maize migrations are the result of several independent experiments. The most recent advances of maize production in these communities demonstrate that farmers continue to experiment. We found further evidence of this when a farmer in Morochos showed us a field at 3278m, a small part of which had been planted with maize in 2009 but with poor results, the plants showing signs of having been stunted by the cold.

Reduced productivity in the lower parts of Cotacachi can be related to challenges posed by climate change and intensified agricultural activity. In addition to observations of higher temperatures, people in Cotacachi report increased irregularity in seasonality and rainfall, noting unusually long or short dry periods, deficiency of rain during wet seasons, and increased intensity of rainfall. While detailed scientific analysis of local changes in precipitation is lacking, farmers' observations of climate irregularity are consistent with climate research from the broader Andean region (Bradley, et al. 2006; Haylock, et al. 2006; Magrin, et al. 2007; Ruiz, et al. 2008; Vuille, et al. 2003; Vuille, et al. 2008). Perhaps the starkest indicator of climate change in Cotacachi is the dark peak of Mama Cotacachi, the dormant volcano that dominates the local landscape. Whereas most Andean glaciers are currently in the process of retreating (Vuille, et al. 2008), the glacier on Mama Cotacachi disappeared completely at the end of the 20th century (Rhoades, et al. 2006). The withdrawal of the glacier has affected stream flow in many of the area's waterways, reducing the availability of water for irrigation, livestock and household use. At the same time, increased temperatures and irregular rainfall result in greater need for irrigation, more pest problems, and consequently, higher incidences of crop damage and loss

(Rhoades, et al. 2006; Chapters 9 and 10). Farmers and scientists also link decreasing productivity in the lower and intermediate zones to lower soil fertility due to shortened fallow periods caused by increasing lack of land as community populations grow (Zehetner and Miller 2006b; Chapter 3).

While the climate irregularity and depleted soil in the lower and intermediate zone lowers production, the increase in temperature favors the growth of maize at higher elevations, and the underexploited soils offer a rich supply of nutrients. Thus far, maize planted in the high zone has produced better than maize planted in the intermediate zone; a fact that farmers relate to fewer pest problems (pests are restricted by elevation) and richer, less-eroded soils that better retain moisture. Farmers refer to the high zone as "fresher" (*más fresquito*) because it is buffered from the strong sunshine and prolonged dry periods that afflict the intermediate and low zones by the near constant fog of the neighboring *páramo* ecosystem[68](see Zehetner and Miller 2006a).

This is not to imply that the high elevation production of maize is without challenges. Since farmers first began to grow maize in Ugshapungo in 1997, frost has occasionally damaged maize fields; a reminder that it is near its current environmental limit. Additionally, the colder conditions slow plant growth from 8-9 months in the intermediate zone (consistent with Knapp, 1992) to 11-12 months in the high zone, meaning that these fields are occupied almost year round with a single crop. Still, the advantages evidently outweigh the costs for the increasing number of farmers opting to plant maize in Cotacachi's high zone.

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[68]The *páramo* is a neotropical highland ecosystem stretching from the upper limit of continuous forest up to the area of perpetual snow (Mena Vásconez and Hofstede 2006).

Figure 11.2: Maize fields at different elevations. Tayta Miguel Cumba from Morochos showing harvest loss in the intermediate zone (left, 2780m) and good production in the highest zone (right, 3184m).

11.3.5 Implications: Historical and Possible Future Developments in High Zone Agriculture

> Earlier, people from further down, like Chilcapamba, used to look up to us in Morochos and admire our fields - it [maize] produced really well up here in the community. Now, it does not grow well anymore, but up on the hill it does. It is as if the zones have shifted further upwards. Now maize grows well up there. Now we'll have to grow potatoes and mellocos even further up!
>
> Miguel Cumba, Morochos

While farmers have typically considered higher agricultural lands to be of lower value due to their remote setting and marginal growing environment, climate change might prompt their reevaluation. During the youth and adulthood of today's elders, the intermediate zone was the focus of crop production and much of the high zone was converted from cold-resistant cropland to pasture. Farmers provide several reasons for the partial abandonment of the highest fields in decades past. First, their remote location makes them difficult to cultivate. Specifically, the absence of roads prohibits the use of machinery meaning that people have to rely on manual labor to work fields, transport materials and carry harvests home. This was more feasible a generation ago, when communal labor parties (*minka*) were more commonplace and labor migration less widespread. Today, many of the communities' inhabitants find employment in nearby cities, leaving local labor scarce. Lack of labor especially discourages the cultivation of high elevation wheat and barley because they are particularly intensive to harvest manually. Some farmers further mention that the theft of crops deters them from cultivating their highest fields which go unprotected at night. Yet these obstacles do not stand in the way of those who have ventured to plant maize in the high zone during the last decades. For instance one farmer from a community that experiences theft in its high zone recently purchased a tract of land at 3,115m. He explained that his plan is to circumvent the thieves by putting up a small camp in his fields where he will stay overnight during harvest time. The recent success of high elevation maize cultivation and farmers' new interest in the high zone could be an indication that its fields will again be brought under more intensive cultivation.

It remains to be seen if other crops will follow maize uphill. Farmers in Ugshapungo, the area's uppermost community, smilingly announce "we can sow everything now!" This is a slight exaggeration as there is a notable absence in the community of some heat demanding crops like fruits and the common bean (*Phaseolus vulgaris*). However, one innovative farmer reported to have procured bean seed in order to try it out in the 2010/2011 season. If the warming continues as predicted, farmers will likely continue to experiment with more crops at higher elevations.

The further expansion of maize into the highest cropping zone will invariably affect the cultivation of the cold tolerant crops traditionally grown in this zone including wheat, barley, lentils and faba beans from the Old World, and native roots and tubers (potatoes, melloco, oca and mashua). It is possible that these crops will be pushed to the margin of the agricultural system and abandoned by some farmers, or that they will be cultivated even higher up, in what is now *páramo*. While the first alternative would have negative consequences for food security in terms of dietary diversity and the conservation of plant genetic resources, the second would imply encroachment of a unique ecosystem that is already considered to be endangered (Ruiz, et al. 2008). The options available to local farmers also vary within and between communities. Adjacent *páramo* lands that are less steep and have better road access may be more likely to be brought into cultivation than less accessible terrains. Even if some farmers think that cultivation will move further up in the future, the upward expansion of cold tolerant crops has yet to take place in the communities studied.

11.4 Conclusion

This case demonstrates a completely farmer-led, autonomous adaptation to climate change. Independent from each other, farmers in several of Cotacachi's communities have observed rising temperatures, hypothesized that this might have brought higher elevations within the tolerable temperature range of maize, and planted test plots. Successful results have prompted neighboring farmers to follow suit and the upper limit of maize cultivation climbed 2-300 elevation meters between 1990 and 2010. This upward expansion of maize was also prompted by reduced maize yields in the traditional maize growing zones at lower altitudes, linked to irregular precipitation, lack of irrigation and eroded soils.

Even if this particular strategy does not solve the challenges produced by climate change for all of Cotacachi's rural households – the majority of which do not have access to high zone land – the case of maize's upward expansion demonstrates that upward crop migration may become one feasible and effective way of dealing with future climate change. It is significant that no external intervention influenced farmers' decisions to move maize uphill, and that seed was locally sourced. This indicates that in the Andes and other tropical mountain areas where different crops and varieties are adapted to grow at different temperatures along elevation gradients, external input may not be necessary to organize crop substitution as climates change and temperatures rise.

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CHAPTER 12

CONCLUSION

12.1 Introduction

This final chapter will synthesize the research reported in the previous chapters, discuss policy implications and suggest areas for further investigation. In the introductory chapter, I identified two overarching research objectives: (1) the documentation of Cotacachi's agrobiodiversity, and (2) the analysis of change across space and over time in the crop composition of farmers' fields and its drivers, with a particular emphasis on the potentially influential roles of cultural and climatic change. The following sections will summarize the results regarding each of these facets of the research.

12.2 The Crop Diversity of Cotacachi

As shown in Chapter 2 and its Appendix, Cotacachi's farmers collectively cultivate a rich agrobiodiversity, encompassing 103 crop species. A suite of Old World crops have been incorporated into the farming system without causing a major displacement of native crops. Within the 20 most important field crop species, 367 varieties were documented in this research. Common beans and maize clearly exhibit the highest diversity at the intracrop level. Modern varieties have been added to fields during the past decades, but within most crops, these have complemented rather than displaced landraces; the latter still constitute 90% of varieties. This great richness is not evenly distributed, however; most crops and varieties were only registered in low frequencies. This may signify that their place in the local agroecosystem is insecure.

Through the last decades, the crop composition of Cotacachi's fields has been reconfigured in multiple ways. This research has identified four such processes. Two of these reconfigurations are related to changes in sociocultural patterns, and two are linked to climate change.

12.3 Culture and Crop Diversity: Processes of Loss and Expansion

The current research indicates that there was a trend of genetic erosion from Cotacachi's farms during the last decades of the past century. It further shows that this process was partly arrested during the first decade of the present. These developments of simplification and diversification – or loss and expansion – are linked to wider societal processes, leading to changes in the value and priority placed on indigenous and local foods.

Sociocultural processes of the latter part of the 20th century, entailing the entry of new worldviews and priorities, amounted in a simplification of agricultural patterns, including a reduction in the diversity of crops planted in each field and on each farm (Chapter 3). As Chapter 4 further documents, the reliance on home-grown foods declined during those decades, as they were partly replaced with more prestigious store-bought foods.

Yet now countertrends are brewing; linked to the rise of indigenous and peasant movements through the last few years, the esteem and demand for indigenous and locally grown foods are increasing (Chapter 4). The successful creation and development of a new farmers' market underlines a rising interest in locally grown products (Chapter 6).

A longitudinal comparison of the crop diversity grown in 2003 and 2009 shows that these new trends, aided by the activities of NGOs, have provoked an increase in the extent of several crops among surveyed farms (Chapter 5). These include a number of native field crops as well as a variety of fruits and vegetables. The most important local crops have remained stable through this period, while some particularly land and labor demanding field crops have continued to decline in extent. While this analysis did not take into account intracrop diversity, it is evidence of a partial reversal of earlier erosion at the crop level.

Quinoa stands in an exceptional situation in the local farming landscape; linked with the rising global popularity of this "lost crop of the Incas", it has been the focus of several conservation and development projects in Cotacachi during recent years (Chapter 7). This research shows that the projects have indeed promoted the conservation of quinoa at the crop level, however, they have also led to the fast rise of a new and highly marketable modern quinoa variety, potentially imperilling the maintenance of the crop's local landraces.

12.4 Climate and Crop Diversity: Shifting Zones and Seasons

Climatic variability of the past has favored the development of a highly diverse cropping system in Cotacachi and surrounding regions; since crops and varieties within them exhibit differential resistance to different weather patterns, a wide diversity has heightened the chances for at least harvesting something even in the case of extreme weather.

During the recent past, however, people and scientists alike have observed increasingly irregular weather conditions in the Andes, and these climatic pattern shifts affect Cotacachi's agriculture in various ways (Chapter 10). Water scarcity hinders the growth of crops and leads to reduced supplies of pasture and drinking water for livestock. Increased intensity of sunshine further dries up soils and produces a harsher working environment. Torrential rains cause temporarily waterlogged fields and erosion, and rains during the normally dry summer season cause increased crop loss to rot and blight. Higher temperatures alter previous agroecological patterns, and are linked to increased pest and disease problems.

Among other coping strategies, farmers draw upon local agrobiodiversity to reconfigure their production in response to the altered conditions. First, they experiment with changing planting and harvest dates. More water tolerant faba beans are emphasized in relation to blight prone potatoes during the increasingly rain-ridden summer season, and some have begun to harvest maize and beans in their fresh state rather than letting them dry on the plant – avoiding the risk of loss due to rain-induced rot in the beginning of summer. A second major reconfiguration is the movement of heat-demanding crops to altitudes where their cultivation earlier was prohibited by cold temperatures. Farmers note the warming climate, and accordingly transplant crops from lower zones where their production is declining to higher fields where they now ripen well. This movement is highlighted here through the documentation of the upward movement of maize's upper limit over the last two decades (Chapter 11).

On the one hand, local crop diversity emerges as an important reservoir to draw from for Cotacachi's farmers as they adjust their agricultural practices to new climatic conditions. On the other hand, however, processes induced by climate change hamper seed saving – by causing harvest loss, by leading farmers to harvest fields before viable seeds have developed, and by favoring the spread of storage pests (Chapter 10). If lost local landrace seed is replaced by purchasing uniform, foreign planting material, this presents a potential threat to the persistence of local agrobiodiversity.

12.5 Diversity's Present Distribution: The Cooked is the Kept

When agrobiodiversity is compared across farms, certain characteristics emerge as bearing particular strong relationships with high diversity (Chapter 8). The most significant insight from the present study's cross-sectional analysis is that farmers who to a higher degree maintain markers of Kichwa identity – including the preparation of traditional food and the use of the Kichwa language and traditional dress – are more likely to grow diverse fields. In addition, those who grow mainly for subsistence purposes grow markedly more crop and varietal diversity than those who mainly grow for the market. In combination, these results underline the otherwise often overlooked importance of cultural identity and home cooking for the continuity of crop diversity. Those farmers who care about maintaining Kichwa traditions and grow their own food are also likely to care about tending a rich diversity of crops and varieties within them.

Figure 12.1: A bowl of treasures.

12.6 Culture and Climate in the Reconfiguration of Andean Fields

This dissertation demonstrates that reconfigurations of the crop composition performed by Cotacachi's farmers bear links to shifts in cultural and climatic patterns. It shows that both of these domains – culture and climate – carry the potential to depress as well as demand the maintenance of agrobiodiversity. Cultural change during the latter decades of the 20th century contributed to a reduction of the diversity planted on many farms, but sociocultural currents at the new millennium's dawn are sparking awareness of the value of local foods and crops, again rising the demand for diverse fields. This variation corresponds to a cross-sectional analysis of present farms, showing that those who maintain other aspects of Kichwa cultural roots are those who grow the highest levels of diversity. Climatic irregularity complicates seed saving, but at the same time people draw upon their diverse seed when they adjust to the altered climate by moving their planting of crops in time and space. Agrobiodiversity emerges as a potent resource for engaging with current cultural trends as well as confronting environmental change, and holds promise for the creation of food sovereign and fruitful futures for Cotacachi's population.

The central role of cultural identity and cultural change in shaping positive and negative changes in patterns of diversity across time and space found in this research contibutes new insight into the dynamics of crop diversity maintenance. The results indicate that movements sparking cultural revitalization carry high potential to promote the persistence of diverse fields. In an applied context, they further suggest that cultural factors should be taken into consideration in any *in situ* conservation effort.

The present results regarding climate change and crop diversity – showing that even as farmers draw on local diversity to adapt to climate change, the maintenance of this diversity is imperilled by increasing difficulty in saving seed under altered climatic conditions – highlight the importance of initiatives to sustain diversity. Currently, heavy investment is being channeled toward the development of "climate-ready" crop varieties; by way of classical breeding as well as advanced biotechnology and genetic engineering, resistance to particular adverse climatic conditions such as drought and salinity are inserted into seed. This investigation indicates that supporting the cultivation and evolution of *local and already present* biodiversity might be an equally important and, at least in a mountain setting such as Cotacachi, even more efficient way to aid agricultural adaptation to climate change.

The results of the longitudinal inquiries in the current work underscore the prospects and urgency of *in situ* conservation. Overall, they demonstrate a certain lack of uni-directionality and uniformity in diversity's developments. They show that crops' and varieties' extents can change rather abruptly, as they did in the period between 2003 and 2009. The rise in the extent of a number of crops is evidence that genetic erosion can absolutely be halted, and even reversed. But the decline of other crops as well as of quinoa landraces indicates that such erosion can also accelerate. These results further show that diversity developments vary between and within crops. They illustrate how what happens with one crop is not necessarily repeated for another. The quinoa case study further shows that there may be a difference between the conservation of a crop and the conservation of that crop's varietal diversity. These observations call for broad research and conservation agendas, and stress the importance of reflection on and clarification of conservation agendas and interventions.

12.7 Suggestions for Further Research

The results of this research suggest several lines of further inquiry. The role of cultural identity in agrobiodiversity management and maintenance should be further investigated in other contexts. Is the link between cultural identity and crop diversity found in the present study also the case in other areas? Has cultural revitalization had a positive influence on crop diversity in other communities? Such inquiries would not only provide a better understanding of processes of loss and persistence of crop diversity, but also help to shape efficient conservation initiatives.

The present findings on farmers' creative strategies to deal with a changed environment, in particular by moving crops upward and between seasons, call for further investigation both in Cotacachi and elsewhere. An overarching question here would be, to what extent are farmers autonomously able to adjust their crop composition to an altered, and in particular warmer, climate? In Cotacachi, are other crops following maize uphill? Are new crops or new varieties of already present crops being introduced from lower regions into the bottom part of the valley? Are similar movements taking place in other parts of the Andes and the world? Is this a phenomenon restricted to mountainous areas – where agroecological zones are closely stacked – or do farmers in flatter regions also adjust this way? Insight into these processes of autonomous adaptation would be crucial in order to plan and implement policies and programs helping farmers to adapt to already occurring and future climate change.

A related and important area of further work is research and monitoring of changes in ranges and pressures of agricultural pests and diseases. This research documented recent upward range extensions of two pest species (*Tecia solanivora* and *Acanthoscelides obtectus*) in the case of Cotacachi, likely in response to rising temperatures (Chapter 10). These pests, new to the area, attack stored potatoes and beans, resulting in seed loss or increased pesticide application. Since both of these outcomes are potentially harmful to agricultural substainability, participatory research, drawing on scientific as well as traditional knowledge regarding pest management and seed storage, should be geared at developing and disseminating sustainable pest management methods.

A better understanding of the impact on climate change on agrobiodiversity and agriculture would ensue from the investigation of local seed systems. To what extent has recent climate change led to an increased turn-over of farmers' seed stocks of different crops? To what extent does increased harvest and storage loss lead farmers to give up seed saving all together? When seed is lost, where do different farmers tend to replace it from? Does climate change heighten farmers' awareness of the importance of local crop diversity for adaptive capacity? What is the role of NGOs in providing planting material? How is newly imported planting material spread through local social networks? Insights arising from such inquiries would enhance conservation and adaptation programs.

Participatory research with local farmers could further investigate the potential of local seedstock to adapt to altered environmental conditions. Farmers in Cotacachi explained how maize seed from the intermediate zone planted in the high zone over time would "adjust" to the new conditions (*la semilla se acostumbra*), and accordingly, others wanting to begin planting maize in that zone would ask the farmers of neighboring fields for seed. Research involving phenotypical as well as genetic or molecular analysis of changes over time in the composition of such transplanted and farmer selected populations would yield interesting insights into the potential for rapid adaptive and evolutionary processes in farmers' fields.

Another potentially fruitful area of investigation concerns local knowledge about how to cope in "bad" years. Climatic fluctuation has long been common in the Andes, not least in relation to El Niño/La Niña episodes, and elderly farmers relate how they would prepare for these years by stretching food and seed stock. The knowledge held by Cotacachi's elders might contain keys to adaptive strategies as climatic instability intensifies, yet unfortunately, much of this rich knowledge has been subject to erosion during the past years. Further research, employing interviews and community workshops could inquire into climate prediction and coping mechanisms, and the dissemination of this knowledge might aid in shaping strategies to face an altered environment in Cotacachi and beyond.

Finally, in terms of research design, this study demonstrates the utility and possibility of longitudinal and comprehensive surveys of crop diversity. The research found marked changes in farmers' crop composition over a six-year period, highlighting the utility of longitudinal comparison even over short time spans. Further, the present survey's comprehensive approach, including diversity at both crop and intracrop levels, yielded a nuanced picture of the local agrobiodiversity and its distribution. It showed that even if most diversity measures were correlated, there were some notable exceptions, both on an overall and on an individual farm level (Chapters 2 and 8). Thus, one should not assume *a priori* that a high level of diversity by one measure is necessarily reflected in the level of diversity by another measure. The present survey of diversity may serve as a baseline for future research, yielding further insights into change over time in fields' crop configurations. I hope that the present research may inspire the design and implementation of longitudinal and comprehensive surveys of agrobiodiversity also in other regions.

A

APPENDIX TO CHAPTER 2

DOCUMENTATION OF INTRACROP DIVERSITY

Notes on Terms and Conventions in Tables Describing Intracrop Diversity

The tables in this Appendix to Chapter 2 provide an overview of the farmer-described names and characteristics of intracrop units managed and cultivated by farmers in Cotacachi. It is based on data collected during a survey of 89 farms across five communities (El Batan, San Pedro, Peribuela, Quitugo and Ugshapungo), in addition to observations and elaborations during workshops, interviews, diversity fairs and farm work during 2009-2010. There is also information on the number of surveyed farms where each of these intracrop units were grown in 2009. As explained in the text of Chapter 2, most crops are divided directly into a set of varieties, while some crops contain subcrop units at two levels. I call the intermediate categories that exist only in the classification of a few crops "main classes", and the finest units ("terminal taxa", in Berlin's [1992] terms) of all crops "varieties". I further employ the term "seed lot", in accordance with Louette's (1999) definition as "the set of seed of a particular type, selected and sown by a specific farmer during a season" (p. 112). Thus, the number of seed lots of a certain type of diversity indicates the number of times a variety of this type/main class/crop was documented on any farm during the survey. In a limited number of cases, the survey did not register the specific varieties cultivated, but only that various varieties of a that crop/main class was grown on the farm during the past year. In order to estimate total number of seed lots for these cases, the median number of varieties cultivated on fully registered farms that cultivated more than one variety of the crop/main class in question was adopted. In the tables below, the calculation of such mixed seed lots is shown in separate rows.

Names, Language and Spelling

Names are given in Kichwa, Spanish and English. Many of the intracrop units carry multiple names in Cotacachi. In the tables, the most common name is given first, and immediately below follow synonyms in italics. Many more local names for intracrop diversity units exist in Kichwa than in Spanish. Many of the Spanish terms given are therefore, like the English terms, translations of the Kichwa name. When a different name than the one corresponding to the Kichwa translation is commonly used in Spanish or English, this terms is given first, followed by the translation placed in square brackets.

Kichwa does still not have a standardized orthography in Ecuador, presenting some challenges in capturing on paper the names of crop diversity's many units that largely exist only orally in Cotacachi. For the Kichwa spelling I follow the new conventions outlined in a recent dictionary published by the Ministry of Education (Ministerio de Educación 2009). Cotacachi's Kichwa and Spanish vocabularies contain extensive borrowing and adoption of terms from the other language, a process in which pronounciation has often been changed. Since the languages consist of different alphabets and orthographic conventions, one might adopt the stance that spelling should also change accordingly. Quite a few Kichwa variety names contain descriptive terms adopted from Spanish and I have Kichwa-ized the spelling of most of these terms. For example, in many variety names in Kichwa, the originally Spanish term *pintado* (striped) is adopted. I here write it in the Kichwa-ized version, *pintatu*. Even if the "d" does not exist in official Kichwa orthography, it is actually pronounced with a "d" sound both in the place of the first and second "t" in Cotacachi (something like "pindadu"). An overview of Kichwa-ized terms are found in Table A2.1. In a few cases though, including terms derived from place names, people's names, and a few other terms (*café, medio, chino, azul, azul marino, golondrina*), I have let the original Spanish term remain also in the Kichwa version. Some terms reappear in a number of names. Apart from many color terms, I would in particular like to mention the Kichwa term *chawcha*, which is used in the naming of many different crops. This term is not readily translated into other languages – my English translation of its Spanish dictionary translation is "delicate, sweet, tasty; which matures or cooks rapidly" (Ministerio de Educación 2009: 56). In Cotacachi, farmers liken it with the Spanish *fertil*, corresponding to the English fertile. Varieties or main classes bearing this name will typically have smaller plants and seeds and be faster maturing than other types. With the exception of *Ullucus tuberosus* (here called melloco, resembling its Ecuadorian name), English crop names follow those used in National Research Council (1989). Further explanation of the information provided in the tables is given in the notes below them.

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Table A2.1: Kichwa-ized spelling of originally Spanish terms adopted in this work.

Kichwa	Spanish	English
Arus	Arroz	Rice
Chilina	Chilena	Chilean
Kallu	Gallo	Rooster
Machiti	Machete	Machete
Muratu	Morado	Purple
Pintatu	Pintado	Striped
Turu	Toro	Bull
Warusu	Barozo	Grey-brown (clay colored)
Wirti	Verde	Green

MAIZE

Table A2.2a: Names and characteristics of maize (*Zea mays*) main classes, Part 1.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant height**	**Leaves**	**Stalk appearance**
Raku sara	Maiz grueso	Large maize	2-2.5m	Dark green, hairs only on edges	Thick, soft, yellow-green, can be peeled
Chivila sara	Maíz ondulado	Curled maize	2-2.5m	Dark green, hairs only on edges	Thick, soft, green, can be peeled
Kaballu kiru sara	*Maíz de diente de caballo*	*Horse tooth maize*			
Tsapa sara	*Maíz arrugado/aplastado*	*Wrinkled/crushed maize*			
Raku chawcha sara	Maíz chaucha grande	Large chawcha maize	1.8-2m	Dark green, hairs only on edges	Thick, soft, yellow-green, can be peeled
Chawcha sara	Maíz chaucha	Chawcha maize	1.8-2m	Dark green, hairs only on edges	Thin, soft, colored (red, yellow, blackish), can be peeled
Wandanku sara	Maíz guandango, [maíz de rey/príncipe]	King/prince maize	1.8-2m	Dark green, hairs only on edges	Thin, soft, colored (red, yellow, black), can be peeled
Mishki sara	*Maiz dulce*	*Sweet maize*			
Allpa sara	*Maíz de tierra*	*Earth maize*			
Chillu sara	Maiz beige	Beige maize		Pale green, hairs only on edges	Medium, reddish, can be peeled
Papachu	*Enano*	*Dwarf*			
Chawcha chawcha	*Chaucha chaucha*	*Chawcha chawcha/very chawcha*			
Chullpi	Chulpi, [suave]	Soft	2-2.5m	Pale green-yellow	Thick, hard, green, can be peeled
Muruchu	Morocho, [duro, fuerte]	Hard, strong	2-2.5m	Green, more hairs	Thick, hard, yellow-green, hard to peel
Muruchillu	Morochillo, [durisimo]	Very hard, strong	1.10-1.20m	Green, more hairs	Thick, very hard, yellow-green, hard to peel
Kankil	Canguil, [simple]	Simple	1.5m	Green, more hairs	Thick, hard, yellow-green, hard to peel

Table A2.2b: Names and characteristics of maize (*Zea mays*) main classes, Part 2.

Name (Kichwa)	**Stalk taste**	**Husk**	**Ear shape**	**Cob shape**	**Kernel shape**	**Kernel heart size**	**Grain color**	**# Varieties in project**
Raku sara	Salty	Soft	Long, thick	Thick	Large, flattened	Large	Various	18
Chivila sara	Salty	Soft	Long, thick	Thick	Large, wrinkled kernels		Yellow	1
Raku chawcha sara	Sweet	Soft	Medium	Medium	Medium-large, round	Medium	Various	11
Chawcha sara	Sweet, juicy	Soft	Long	Medium	Slender, elongated	Small	Various	28
Wandanku sara	Sweet, very juicy	Soft	Long	Slender	Elongated	Small	Various	7
Chillu sara	Sweet	Soft	Short	Thick	Large, round, hard		Whitish	1
Chullpi	Sweet-salty	Soft	Medium-long, thick	Thick	Flattened, somewhat wrinkled, glass-like appearance	Small	Various	6
Muruchu	Salty	Hard	Medium	Thick	Large, round, glass-like	Medium	Various	5
Muruchillu	Salty	Hard	Long, thick	Thick	Midsized, round, glass-like	Medium	Orange	1
Kankil	Sweet-salty	Hard	Medium	Thick	Small, hard, pointed, glass-like	Medium	Various	2

Table A2.3: Comparison of farmers’ and scientists’ classification of maize diversity.

ID	Farmers' classification		Scientific classification		Correspondence
	Class	Color (sub-class)	Race	Complex (sub-class)	
1	Raku sara	Yurak sara	Blanco blandito		Farmers’ sub – Scientists’ main
2	Raku sara	Yana sara	Rácimo de uva		Farmers’ sub – Scientists’ main
3	Raku sara	*All other colors*	Mishca		Roughly same (minus yurak sara, yana sara)
4	Chivila sara		Chillo		Same
5	Chillu sara			Mishca-chillo	Farmers’ main – Scientists’ sub
6	Wandanku		Huandango		Same
7	Chawcha			Mishca-huandango	Farmers’ main – Scientists’ sub
8	Raku chawcha		Patillo ecuatoriano		Same
9	Chullpi		Chulpi		Same
10	Muruchu		Morochon		Scientists’ race more detailed
11	Muruchu		Sabanero ecuatoriano		Scientists’ race more detailed
12	Muruchu		Montaña ecuatoriana		Scientists’ race more detailed
13	Muruchillu		Uchima		Same
14	Kankil		Canguil		Same

Table A2.3 shows that there is rather close correspondance between farmers’ and scientists’ maize classification systems. Farmers’ classification in Cotacachi is based on interviews and focus group excercises. Scientists’ classification is from Timothy et al. (1963). The maizes of Cotacachi are divided into 10 main classes by farmers, and 12 races by scientists. Two of farmers’ main classes are considered subcategories (complexes) by scientists (the class chawcha corresponding to the complex mishca-huandango, and the class chillu sara, corresponding to the complex mishca-chillo). On the other hand, two of scientists’ races are considered subcategories (colors) by farmers (the race blanco blandito corresponding to the color yurak sara [a kind of raku sara], and the race rácimo de uva corresponding to yana sara [also a kind of raku sara]. But, actually farmers note that the plants and characteristics of these two colors of raku sara are different from others – indicating that their agreement with scientists’ observations is closer than what first might appear. Further, scientists distinguish between the three races morocho, sabanero ecuatoriano and montaña ecuatoriana, while farmers lump them together in the class muruchu. However, Timothy et al. also state that these races are similar, and that their differentiation is a question of degree (1963: 60), supporting the logic behind farmers’ consideration of the three as one class.

Table A2.4: Documented maize (*Zea mays*) varieties in Cotacachi. (Continued on the next pages.)

Name (Kichwa)	Name (Spanish)	Name (English)	Kernel color	#
RAKU SARA				
(Killu) (raku) sara	Maíz suave de tusa blanca	Yellow large maize (K), soft maize with white cob (S)	Yellow	20
Peruanu sara	Maíz Peruano	Peruvian maize	Yellow	1
(Killu) (raku) sara	Maíz (grueso) (amarillo)	(Yellow) (large) maize	Yellow	49
Atuntaqui sara	Maíz de Atuntaqui	Maize from Atuntaqui	Yellow	1
Killu wula sara	Maíz amarillo redondo	Yellow round maize	Yellow	2
Yurak sara	Maíz blanco	White maize	White	9
Yana sara	Maíz negro	Black maize	Dark red	7
Puka (raku) sara	Maíz rojo	Red (large) maize	Red	3
Tukti (raku) sara	Maíz de nogal	Walnut (large) maize	Very light brown	1
Uchpa (raku) sara	Maíz de ceniza	Ash (large) maize	Light brown	1
Kushni sara	*De humo*	*Maize of smoke*		
Hulin (raku) sara	Maíz humeado	Smoked (large) maize	Darker brown	0
Wawa mama (raku) sara	Maíz madre del niño/placenta	Mother of the child/placenta (large) maize	Red with yellow stripes	4
Allpa mama sara	*Madre tierra*	*Mother earth maize*		
Pintatu raku tapla sara	*Maíz grueso en tabla pintado*	*Striped large tabled maize*		
Killu pintatu sara	*Amarillo pintado*	*Yellow striped maize*		
Pintatu sara	*Maíz pintado*	*Striped maize*		
Killu pintatu (raku) sara	Maíz amarillo pintado	*Striped yellow (large) maize*	Yellow with red stripes	1
Kristupa yawar (raku) sara	Maíz sangre de Cristo	*Christ's blood (large) maize*	Yellow; some kernels have red stripes	1
Hisu Kristu sara	*Maíz de Jesu Cristo*	*Jesus Christ maize*		
Yawar sara	*Maíz de sangre*	*Blood maize*		
Zirkitu lulun (raku) sara	Maíz de huevo de picaflor	Hummingbird egg (large) maize	Yellow with dark small dots on each kernel	2

Name (Kichwa)	Name (Spanish)	Name (English)	Kernel color	#
RAKU SARA CONT.				
Puka pintatu (raku) sara	Maíz pintado rojo	Striped red (large) maize	Red with black stripes	2
Iritiku (raku) sara	Maíz mezclado/afortunado de varias variedades	Mixed/blessed with various varieties (large) maize	Yellow with some black kernels	2
Inti ñawi (raku) sara	Maíz ojo del sol	Sun's eye (large) maize	Kernels orange with white points	0
RAKU SARA, TOTAL SEED LOTS				**105**
CHIVILA SARA				
Chivila sara	Maíz ondulado	Curved maize	Yellow	2
Kaballu kiru sara	*Maíz de diente de caballo*	*Horse tooth maize*		
Tsapa sara	*Maíz arrugado/aplastado*	*Wrinkled/crushed maize*		
CHIVILA SARA, TOTAL SEED LOTS				**2**
RAKU CHAWCHA SARA				
Killu raku chawcha	Chaucha grueso amarillo	Yellow large chawcha	Yellow	3
Raku puka chawcha	Chaucha grueso rojo	Red large chawcha	Red	2
Yana puka iritiku (raku chawcha) (sara)	(Maíz) (chaucha grueso) iritico negro rojo	Black red mixed (large chawcha) (maize)	Red with some kernels in darker red	1
Wawa mama (raku chawcha) (sara)	(Maíz) (chaucha grueso) madre del niño (placenta)	Mother of the child/placenta (large chawcha) (maize)	Yellow with red stripes	1
Kristupa yawar (raku chawcha) (sara)	(Maíz) (chaucha grueso) sangre de Cristo	Christ's blood (large chawcha) (maize)	Yellow, only some kernels with red stripes	1
Hisu Kristu (raku chawcha) (sara)	(Maíz) (chaucha grueso) Jesu Cristo	Jesus Christ (large chawcha) (maize)		
Yawar (raku chawcha) (sara)	(Maíz) (chaucha grueso) de sangre	Blood (large chawcha) (maize)		
Killu waka mama (raku chawcha) (sara)	(Maíz) (chaucha grueso) lagrimas de mama/madre llorona amarillo	Yellow mother's tears/crying mother (large chawcha) (maize)	Pink over light yellow background	1
Yurak waka mama (raku chawcha) (sara)	(Maíz) (chaucha grueso) lagrimas de mama/madre llorona blanco	White mother's tears/crying mother (large chawcha) (maize)	Pink over white background	0
Killu mantu (raku chawcha) (sara)	(Maíz) (chaucha grueso) amarillo de manto	Yellow mantle (large chawcha) (maize)	Pink over yellow (weaker colors, more background than waka mama)	0

Name (Kichwa)	Name (Spanish)	Name (English)	Kernel color	#
RAKU CHAWCHA SARA CONT.				
Yurak mantu (raku chawcha) (sara)	(Maíz) (chaucha grueso) blanco de manto	White mantle (large chawcha) (maize)	Pink over white (weaker colors, more background than waka mama)	0
Chawa puka (raku chawcha) (sara)	(Maíz) (chaucha grueso) rojo claro	Pale red (large chawcha) (maize)	Pale red	1
Inti ñawi (raku chawcha) (sara)	(Maíz) (chaucha grueso) ojo del sol	Sun's eye (large chawcha) (maize)	Kernels orange with white point	0
Raku chawcha, various	Chaucha grueso, varios	Large chawcha maize, various	1 x 5	5
RAKU CHAWCHA, TOTAL SEED LOTS				**15**
CHAWCHA SARA				
Killu chawcha	Chaucha amarillo	Yellow chawcha	Yellow	22
Yurak chawcha	Chaucha blanca	White chawcha	White	4
Puka chawcha	Chaucha rojo	Red chawcha	Red	13
Yana chawcha	Chaucha negra	Black chawcha	Dark red	6
Cumbas chawcha	Chaucha de Cumbas	chawcha from Cumbas	Pale yellow	1
Iritiku chawcha	Chaucha mezclado/afortunado	Mixed/blessed chawcha	Yellow with some black kernels	9
Wawa mama (chawcha) (sara)	(Maíz) (chaucha) madre del niño/placenta	Mother of the child/placenta (chawcha) (maize)	Yellow with red stripes	6
Allpa mama (chawcha) (sara)	*(Maíz) (chaucha) madre tierra*	*Mother earth (chawcha) (maize)*		
Pintatu (chawcha) (sara)	*(Maíz) (chaucha) pintado*	*Striped (chawcha) (maize)*		
Lapratu (chawcha) (sara)	*(Maíz) (chaucha) labrado*	*Striped (chawcha) (maize)*		
Allku sinka (iritiku) (chawcha) (sara)	(Maíz) (chaucha) (mezclado/afortunado) nariz de perro	Dog's nose (mixed/blessed) (chawcha) (maize)	Yellow with small black dots	2
Yana pintatu (iritiku) (chawcha) (sara)	(Maíz) (chaucha) (mezclado/afortunado) negro pintado	Striped black (mixed/blessed) (chawcha) (maize)	Reddish-black with some red grains	2
Uchpa (chawcha) (sara)	(Maíz) (chaucha) de zeniza	Ash (chawcha) (maize)	Very light brown	4
Tukti (chawcha) (sara)	(Maíz) (chaucha) de nogal	Walnut (chawcha) (maize)	Light brown	0

Name (Kichwa)	Name (Spanish)	Name (English)	Kernel color	#
CHAWCHA SARA CONT.				
Wirachuru (chawcha) (sara)	(Maíz) (chaucha) de virachuro	Wirachuru [bird] (chawcha) (maize)	Red with some yellow kernels	1
Puka killu (chawcha) (sara)	(Maíz) (chaucha) rojo amarillo	Red yellow (chawcha) (maize)	Orange-yellow	1
Puka likta (chawcha) (sara)	(Maíz) (chaucha) rojo con rayas	Red striped (chawcha) (maize)	Red with yellow stripes	3
Yana pintatu (chawcha) (sara)	*(Maíz) (chaucha) negro pintado*	*Black striped (chawcha) (maize)*		
Yana puka (chawcha) (sara)	*(Maíz) (chaucha) negro rojo*	*Red black (chawcha) (maize)*		
Inti ñawi (chawcha) (sara)	(Maíz) (chaucha) ojo del sol	Sun's eye (chawcha) (maize)	Orange grains with white point	0
Piki ñawi (chawcha) (sara)	(Maíz) (chaucha) ojo de pulga	Flee's eye (chawcha) (maize)	Yellow with a red/black point on each kernel	0
Yurak puka (chawcha) (sara)	(Maíz) (chaucha) blanco rojo	White red (chawcha) (maize)	Beige	1
Chawa killu (chawcha) (sara)	*(Maíz) (chaucha) amarillo claro*	*Pale yellow (chawcha) (maize)*		
Wayta chawcha (sara)	(Maíz) (chaucha) de clavel	Carnation (chawcha) (maize)	Pinkish	2
Rosas (chawcha) (sara)	*(Maíz) (chaucha) rosado*	*Pink (chawcha) (maize)*		
Wayta mama (chawcha) (sara)	(Maíz) (chaucha) madre clavel	Mother carnation (chawcha) (maize)	Pink with dark pink stripes	1
Kristupa yawar (chawcha) sara	(Maíz) (chaucha) sangre de Cristo	Christ's blood (chawcha) (maize)	Yellow with red stripes	1
Hisu Kristu (chawcha) sara	*(Maíz) (chaucha) Jesu Cristo*	*Jesus Christ (chawcha) (maize)*		
Yawar (chawcha) sara	*(Maíz) (chaucha) de sangre*	*Blood (chawcha) (maize)*		
Killu wakamama (chawcha) (sara)	(Maíz) (chaucha) lagrimas de mama/madre llorona amarillo	Yellow mother's tears/crying mother (chawcha) (maize)	Pink over light yellow background	0
Yurak wakamama (chawcha) (sara)	(Maíz) (chaucha) lagrimas de mama/madre llorona blanco	White mother's tears/crying mother (chawcha) (maize)	Pink over white background	0
Killu mantu (chawcha) (sara)	(Maíz) (chaucha) amarillo de manto	Yellow mantle (chawcha) (maize)	Pink over yellow (weaker colors, more background then waka mama)	0

Name (Kichwa)	Name (Spanish)	Name (English)	Kernel color	#
CHAWCHA SARA CONT.				
Yurak mantu (chawcha) (sara)	(Maíz) (chaucha) blanco de manto	White mantle (chawcha) (maize)	Pink over white (weaker colors, more background than waka mama)	0
Sacha muras (chawcha) (sara)	(Maíz) (chaucha) mora silvestre	Wild blackberry (chawcha) (maize)	Dark red with some black kernels	0
Murtiñu sara	*Maíz de mortiño*	*Blueberry maize*		
Tumati (chawcha) (sara)	(Maíz) (chaucha) de tomate	Tomato (chawcha) (maize)	Orange	3
Añas lumu (chawcha) (sara)	(Maíz) (chaucha) lomo de zorillo	Skunk's back (chawcha) (maize)	Each kernel half red, half yellow. From the top, the ear appears red; from the bottom it appears yellow.	1
(no name)			Yellow-white, with red husks, black cob, red stalk	1
CHAWCHA SARA, VARIOUS	MAÍZ CHAUCHA, VARIOUS	CHAWCHA MAIZE, VARIOUS	7 x 5	35
CHAWCHA SARA, TOTAL SEED LOTS				**119**
WANDANKU SARA				
(Killu) wandanku (sara)	(Maíz) guandango (amarillo)	(Yellow) prince/king (maize)	Yellow	8
Puka wandanku (sara)	(Maíz) guandango rojo	Red prince/king (maize)	Red	2
Yana wandanku (sara)	(Maíz) guandango negro	Black prince/king (maize)	Black	1
Irutiku wandanku (sara)	(Maíz) guandango irutico	Mixed/blessed prince/king (maize)	Yellow with some black kernels	1
Wawa mama wandanku (sara)	(Maíz) guandango madre del niño	Mother of the child/placenta prince/king(maize)	Yellow with red stripes	2
Pintatu wandanku	*(Maíz) pintado guandango*	*Striped prince/king (maize)*		
Rusas wandanku (sara)	(Maíz) guandango rosado	Pink prince/king (maize)	Pink	0
Tumati wandanku (sara)	(Maíz) guandango tomate	Tomato prince/king (maize)	Dark orange	0
WANDANKU SARA, TOTAL SEED LOTS				**14**

Name (Kichwa)	Name (Spanish)	Name (English)	Kernel color	#
Chillu sara	Maíz beige	Beige maize	Whitish-beige	2
Papachu sara	*Maíz de enano*	*Dwarf maize*		
Chawcha chawcha	*Chaucha chaucha*	*Very chawcha*		
CHILLU SARA, TOTAL SEED LOTS				**2**
CHULLPI				
Killu chullpi	Chulpi amarillo	Yellow chullpi	Yellow	3
Yurak chullpi	Chulpi blanco	White chullpi	White	1
Puka chullpi	Chulpi rojo	Red chullpi	Red	2
Yana chullpi	Chulpi negro	Black chullpi	Black	0
Chawa chullpi	Chulpi rojo claro	Pale red chullpi	Pale red	0
Iritiku chullpi	Chulpi irutico	Mized/blessed chullpi	Yellow with some black kernels	1
CHULLPI, TOTAL SEED LOTS				**7**
MURUCHU				
Yurak muruchu	Morocho blanco	White morocho	White	10
Killu muruchu	Morocho amarillo	Yellow morocho	Yellow	2
Puka muruchu	Morocho rojo	Red morocho	Orange	1
Iritiku muruchu	Morocho irutico	Mixed/blessed morocho	White with some black grains	1
Rusas muruchu	Morocho rosado	Pink morocho	Pink	0
MURUCHU, TOTAL SEED LOTS				**14**
Muruchillu	Morochillo	Muruchillu	Yellow	3
MURUCHILLU, TOTAL SEED LOTS				**3**
KANKIL				
Yurak kankil	Canguil blanco	White popcorn	White	3
Rusas kankil	Canguil rosado	Pink popcorn	Pink	0
KANKIL, TOTAL SEED LOTS				**3**
MAIZE, TOTAL SEED LOTS				**284**

Notes to preceding Table A2.4:
(): Term is sometimes applied, other times skipped.
/ : Ambiguous meaning when translated; both terms before and after "/" can apply.
Italics: Synonyms of maize names and their translations are given in italics immediately below most common name.
#: Number of times documented in farm survey (N=89). Those with 0 survey registrations were documented on other occasions (participant observation, diversity fairs, workshops).
K: Translation of Kichwa term.
S: Translation of Spanish term.

Table A2.5: Explanation of selected name terms, maize varieties.

Name term (Kichwa/English)	Explanation
Kushni/smoke	This is a maize of the incas. They stored it under the ceiling, and it turned this color from the smoke of the hearth.
Wawa mama/placenta	Because it is like the placenta of mother earth. Like children are nourished by their mother's placenta, we are nourished by mother earth's placenta.
Allpa mama/mother earth	Because it resembles the colors of soil.
Kristupa yawar/Christ's blood	In the time of Christ, when they crucified him, his blood fell on this maize. Because of this it has red stains.
Zirkitu lulun/hummingbird egg	Resembles a hummingbird's eggs.
Inti ñawi/sun's eye	Resembles a flame.
Waka mama/mother's tears	When they crucified Christ, Mary cried. She dried her tears with the leaves of the maize, and the yellow maize turned this color.
Mantu/mantle	When they crucified Christ, Mary cried. Her mantle was stained by blood and tears, and this maize resembles her mantle.
Cumbas	Brought from the community of Cumbas Conde.
Wirachuru	Resembles the *wirachuru* bird.
Piki ñawi/flee's eye	The points on each kernel resemble flee's eyes.
Wayta/carnation	Because it has a beautiful color, similar to a carnation.
Wayta mama/mother carnation	Has a stronger, "stricter" color, and for this they call it "mother carnation".
Sacha muras/wild blackberry	Resembles wild blackberries.
Murtiñu/blueberry	Resembles blueberries.
Añas lumu/skunk's back	Just as this maize was emerging in the field, a skunk passed and farted on the maize. Since the skunk has both black and white parts, the maize came out this way.

BEANS

Table A2.6: Names and characteristics of bean (*Phaseolus* spp.) main classes, Part 1.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant height**	**Leaves**	**Stalk**
Raku purutu	Fréjol grueso	Climbing bean [large bean]	Tall	Broad, darker green	Thick, climbing
Allpa purutu	Fréjol matahambre	Bush bean [earth bean (K), hunger killing bean (S)]	Low	Smaller, paler green	Slender, less climbing (but some varieties do)
Intag purutu	Fréjol de Intag	Runner bean [Bean from Intag]	Tall	Large, thicker	Thicker than *raku purutu*, climbing
Puka sisa purutu	*Fréjol de flor rojo*	*Red flowered bean*			
Pupayan	*Popayan**				
Sacha purutu	*Fréjol silvestre*	*Wild bean*			
Turtas purutu	Tortas	Lima bean	Tall	Large, thicker	Thicker than *raku purutu*, climbing

Notes:
**Popayan* is the most common name in Spanish usage.
K: Kichwa
S: Spanish
[]: Meaning of term in Kichwa and/or Spanish.
Even if it is not noted in these tables, *raku purutu* and *allpa purutu* are considered one subclass corresponding to “common beans”/*Phaseolus vulgaris* (*purutu/fréjol*) and thus more related to each other than the other two classes. See Figure A2.1 for a diagrammatic presentation of the local classification.

Table A2.7: Names and characteristics of bean (*Phaseolus* spp.) main classes, Part 2.

Name (Kichwa)	**Flower color**	**Growth cycle**	**Seed**	**Use**	**Origin**	**Market**
Raku purutu	Darker violet (*papa sisa*=potato flower)	Annual; keeps ripening and flowering during long period	Larger, "more presentable"	Soup keeps white, does not change color. Cooking time: 45 minutes if fresh, 3 hours if dry.	Native	High
Allpa purutu	Lighter violet (*papa sisa*=potato flower)	Annual; ripens and dries up quickly	Smaller	Soup darkened by beans, but very tasty. Cooking time: 30 minutes if fresh, 2-3 hours if dry.	Native	High
Intag purutu	Mostly red, but some also white or pink	Perennial (unless uprooted)	Large	Soup, stew, or with *kamcha/tostado* (roasted maize kernels). Taste somewhat bland, often mixed with ruku purutu. Also planted for decoration, on edges.	Intag [lowland part of Cotacachi]	Low
Turtas purutu	White, pink, purple	Perennial (unless uprooted)	Large	May be cooked fresh, but taste is sandy/bland. Darkens soups. Used for children's game.	Native	Low

Table A2.8: Comparison of Cotacachi and scientific bean classification systems.

Cotacachi Kichwa bean classes		Latin name
Purutu	Raku purutu Allpa purutu	*Phaseolus vulgaris*
Intag purutu		*Phaseolus coccineus*
Tortas purutu		*Phaseolus lunatus*

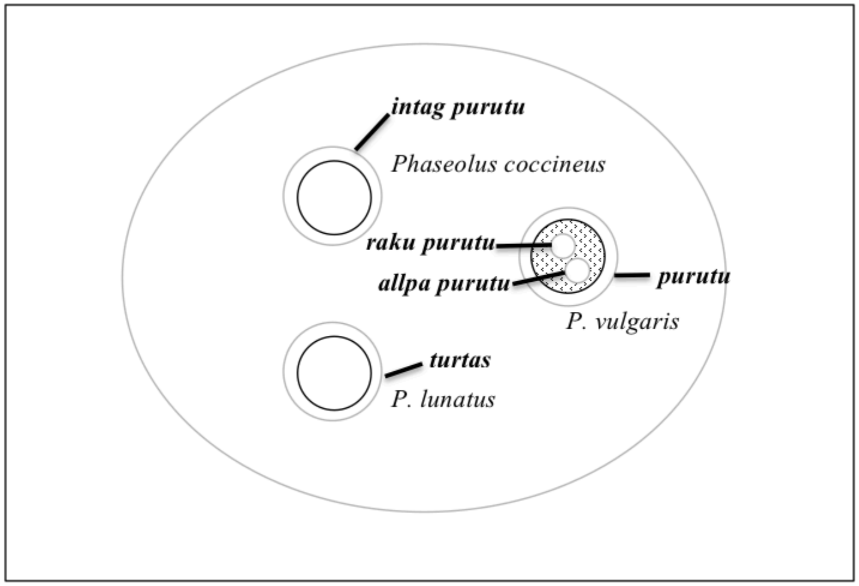


Figure A2.1: Diagram representing Cotacachi Kichwa classification of *purutu* or beans. Diagram applies the conventions of Berlin (1992). Solid black circles correpond to scientific species. Faint circles correspond to Cotacachi categories. The whole set is called *purutu*, as is *Phaseolus vulgaris*, the “prototype” species.

Table A2.9: Documented common bean (*Phaseolus vulgaris*) varieties in Cotacachi. (Continued on the next pages.)

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
RAKU PURUTU	FRÉJOL GRUESO	CLIMBING BEAN			
C L I M B I N G B E A N M O D E R N V A R I E T I E S					
Kaspi watana	Toa [amarrar a palo]	Bind to pole	Red with white stripes	Elongate	15
Puka raku purutu	*Fréjol grande rojo*	*Red large bean*			
Kaspi purutu	*Fréjol de palo*	*Pole bean*			
Je.ma de palo	Je.ma de palo	Je.ma pole	Red with white stripes	Elongate	11
Wulun vayu	Bayo	Bayo	Cream	Large, round	4
Yurak purutu	*Fréjol blanco*	*White bean*			
Yurak wulun	Bolon blanco	White round bean	White	Large, round	22
Yurak raku purutu	*Fréjol grande blanco*	*White large bean*			
Wulun	*Bolon*	*Round bean*			
Raku wulun	*Bolon grande*	*Large round bean*			
Raku purutu	*Fréjol grande*	*Large bean*			
Hatun yurak	*Grande blanco*	*White large*			
Killu wulun	Bolon amarillo	Yellow round bean†	(Pale) yellow	Large, round	16
Killu kanariu	*Canario amarillo*	*Yellow canary*			
Chawa killu wulun	*Bolon amarillo bajo*	*Pale yellow round bean*			
Puka wulun	*Bolon rojo*	Red round bean†	Red	Large, round	14
Puka kanariu	*Canario rojo*	*Red canary*			
Unspecified MV					2
CLIMBING BEAN MVs, TOTAL SEED LOTS					**84**

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
RAKU PURUTU LANDRACES					
Yurak purutu	Fréjol blanco	White bean	White	Large, elongated	8
Hamchi purutu	Fréjol delgado	Small bean	Cream	Small, elongated	7
Hamchi wulun	*Bolon delgado*	*Small round bean*			
Hamchi yurak wulun	*Fréjol blanco delgado*	*Small white round bean*			
Pastave	*Pasable*	*Passable**			
Suni yurak wulun	*Bolon blanco alargado*	*Elongated white round bean*			
Wulun kargatillu	Bolon cargadillo	Cargadillo round bean	Cream	Small, round	2
Ruku kargatillu	*Cargadillo grande*	*Large cargadillo*			
Puka killu wulun	Canario/bolon amarillo rojo	Red yellow round bean	Bright yellow	Large, round	1
Killu killu wulun	*Bolon amarillo fuerte*	*Bright yellow round bean*			
Hamchi kanariu	Canario pequeño	Small canary	Yellow	Small, round	1
Killu purutu	Fréjol amarillo	Yellow bean	Yellow	Large, elongated	8
Yana wulun	Canario negro	Black canary	Black	Large, round	4
Puka yana wulun	*Bolon negro rojo*	*Red-black round bean*			
Yana purutu	*Fréjol negro*	*Black bean*			
Chawa puka wulun	Canario tomate [bolon rojo bajo]	Pale red round bean	Orange-red	Large, round	1
Café wulun (wula/bola)	Canario café [Bolon café]	Coffee round bean	Brown-orange	Large, round	1
Café suni rakupurutu	Fréjol grueso café	Coffee large bean	Brown-orange	Large, elongated	0
Wirti wulun	Bolon verde	Green round bean	Green	Large, round	0
Ullawanka purutu	Fréjol pintado [Fréjol gallinazo]	Vulture bean	Cream with black, blue or pink stripes	Large, elongated	8
Pintatu purutu	*Fréjol pintado*	*Striped bean*			
Pintatu wulun	*Bolon pintado*	*Striped round bean*			
Lichtatu purutu	*Fréjol listado*	*Striped bean*			

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
RAKU PURUTU LANDRACES CONT.					
Yurak purutu	*Fréjol blanco*	*White bean*			
Medio allpa purutu	*Medio frejol matahambre*	*Half bush bean**			
Ullawanka purutu (var.)	Fréjol pintado (var.)	Vulture bean (variation)	Cream with many dark stripes	Large, elongated	3
Yana hamchi purutu	Fréjol negro pequeño		Black	Small, elongated, cuadratic	4
Hamchi raku purutu	*Fréjol grande delgado*	*Small large bean*			
Chino purutu	*Fréjol chino*	*Chinese bean*			
Suku hamchi wulun	Bolon delgado gris	Small grey round bean	Violet/grey	Small	1
Yana purutu	Fréjol negro	Black bean	Black	Elongated	11
Azul uskuru purutu	Fréjol azul oscuro	Dark blue bean	Dark blue	Elongated	1
Yana pintatu purutu	Yana pintado	Striped black bean	Black with some white patterning	Elongated	2
Azul purutu	Fréjol azul	Blue bean	Blue	Elongated	1
Tukti purutu	Fréjol de nogal	Walnut bean	Brown	Elongated	1
Muratu purutu	Fréjol morado	Purple bean	Purple	Elongated	7
Chawa muratu purutu	Fréjol morado bajo	Pale purple bean	Pale purple	Elongated	1
Muratu suku purutu	Fréjol morado gris	Purple grey bean	Blue/purple	Large, elongated	1
Muras purutu	Fréjol de moras	Purple blackberry bean	Purple	Round	1
Muras pintatu	Fréjol pintado de moras	Striped blackberry bean	Purple with cream patterning	Large, elongated	3
Rusas wulun	Fréjol redondo rosado	Pink round bean	Pink	Round	1
Yana kara	Piel negra	Black skin*	Purple with black stripes	Large, elongated	3
Yana kara muratu	Piel negra morado	Purple black skin*	Darker purple, with black stripes	Round	1
Puka purutu	Fréjol rojo	Red bean	Red	Large, elongated	6
Suni puka purutu	*Fréjol rojo larguito*	*Elongated red bean*			

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
RAKU PURUTU LANDRACES CONT.					
Puka hamchi	Rojo chiquito	Red small	Red	Small, elongated	1
Puka pintatu, raku	Rojo pintado grueso	Red striped large bean	Red with white stripes	Large	3
Puka pintatu, hamchi	Rojo pintado pequeño	Red striped small bean	Red with white stripes	Small	1
Uchpa purutu	Fréjol de ceniza	Ash bean	Grey spotted		1
Wirachuru	Amarillo pintado [virachuro]	Wirachuru bean*	Yellow with red patterning	Elongated	10
Puka wirachuru	*Virachuro rojo*	*Red wirachuru [bird]*			
Killu pintatu	*Amarillo pintado*	*Yellow striped*			
Killu chapu	*Amarillo mezclado*	*Mixed yellow bean*			
Puka uchu	*Ají rojo*	*Red Andean pepper*			
Misi parpas	*Barba de gato*	*Cat's beard*			
Yana wirachuru	Virachuro negro	Black wirachuru*	Yellow with black patterning	Elongated	2
Killu pintatu	*Amarillo pintado*	*Yellow striped*			
Killu pintatu	Amarillo pintado	Yellow striped	Lighter yellow with red patterning	Elongated	2
Turu purutu	Fréjol de toro	Bull bean	Yellow with black patterning	Small	0
Killu ñawi (Carmelo)	Ojo amarillo (de Carmelo)	Yellow eye (of Carmelo)*	White with yellow "eye"	Round	2
Puka ñawi (Carmelo)	Ojo rojo (de Carmelo)	Red eye (of Carmelo)*	White with red "eye"	Round	1
Misi ñawi	Ojo de gato	Cat's eye	White with black "eye"	Round	4
Yana shimi	*Boca negra*	*Black mouth*			
Misi ñawi muratu	Ojo de gato morado	Purple cat's eye	White with purple "eye"	Round	1
Misi ñawi café	Ojo de gato café	Coffee cat's eye	White with brown "eye"	Round	0
Yurak wulun turtas purutu	Fréjol bolon blanco tortas	White turtas round bean*	White with black patterning	Round	1
Turtas purutu	Fréjol de tortas	Turtas bean*	White with black patterning	Elongated	1
Carmelu pintatu	Carmelo pintado	Striped Carmelo*	Pink with red patterning	Elongated	1
Cachujilla purutu	Fréjol de Cachujilla	Bean from Cachujilla*	Red with darker red patterning	Elongated	1
Waka lichi	Vaca leche	Milking cow	White with black spots	Elongated	16

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Color**	**Shape**	**#**
RAKU PURUTU LANDRACES CONT.					
Pintatu waka purutu	*Fréjol de vaca pintado*	*Striped cow bean*			
Waka purutu	*Fréjol de vaca*	*Cow bean*			
Yana waka	*Vaca negra*	*Black cow*			
Yana pintatu waka	*Vaca negra pintada*	*Black striped cow*			
Wakita	Vaquita	Little cow	White with black spots (different pattern than "waka lichi")	Elongated	1
Wakiru	Vaquero	Cowboy	White with brown spots	Elongated	1
Yana pintatu waka	Vaca pintado negro	Striped black cow	White with much black	Elongated	2
Lichi purutu	Fréjol de leche	Milk bean	Grey with white spots	Elongated	1
Killu waka	Vaca amarilla	Yellow cow	Yellow with white spots	Elongated	3
Yurak waka	Vaca blanca	White cow	White with a little black	Elongated	1
Rusas waka	Vaca rosada	Pink cow	Pink with white spots	Elongated	1
Waka purutu	Fréjol de vaca	Cow bean	White with purple spots	Elongated	1
Puka waka	Vaca roja	Red cow	White with red spots	Elongated	1
Café waka	Vaca café	Coffee cow	White with light brown	Elongated	1
Kaballu pintatu	Caballo pintado	Striped horse	White with lilac/grey spots	Elongated	1
Kunihu purutu	Conejo	Rabbit	Yellow with cream	Round	6
Wirti kunihu	Conejo verde	Green rabbit	Green	Round, small	0
Kunihu ishpa	Caca de conejo	Rabbit dropping	Brown	Round	1
Suku kunihu	Conejo gris	Grey rabbit	Grey	Round, large	2
Suku kunihu	Conejo gris	Grey rabbit	Grey with black patterning	Round, small	2
Wasi kunihu	Conejo de casa	Domestic rabbit	Pale grey	Round	1
Sacha kunihu	Conejo del monte	Wild rabbit	Dark purple with black stripes	Round	1
Yana kunihu	Conejo negro	Black rabbit	Black	Round, small	1
Suku kuy	Cuy gris	Grey guinea pig	Grey	Elongated	2
Suku kuy rusatu	Cuy gris rosado	Grey guinea pig	Pink	Elongated	1
Suku kuy muratu	Cuy gris morado	Grey pruple guinea pig	Purple	Elongated	1
Yana suku kuy uskuru	Cuy negro gris oscuro	Dark grey-black guinea pig	Blue/grey	Elongated	1

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
Kuy café	Cuy café	Coffee guinea pig	Brown	Elongated	1
RAKU PURUTU LANDRACES CONT.					
Misi purutu	Fréjol de gato	Cat bean	Grey with black patterning	Elongated	1
Marku purutu	*Fréjol de marco/altamisa*	*Marku [plant; Ambrosia peruviana] bean*			
Kallu purutu	Fréjol de gallo	Rooster bean	Red with pink patterning	Elongated	2
Wawa mama	Placenta	Placenta	Cream/yellow with red stripes	Elongated	3
Cantagallo	Cantagallo	Cantagallo*	Purple with cream/black pattern	Elongated	1
Viruchuru lulun	Huevo del viruchuru	Egg of wirachuru*	Red with white stripes	Round	0
Golondrina	Golondrina	Swallow	Violet with darker violet and cream patterning		1
Urpi lulun	Huevo de tortola	Dove's egg	White		1
Pishku lulun	Huevo de pajaro	Bird's egg			1
Huzu umaku	Cabeza de kuso	Worm's head*	Black with cream patterning	Elongated	1
Ullawanka lulun	Huevo de gallinazo	Vulture egg	Black with a little cream		1
Sacha muras	Moras del monte	Wild blackberries	Cream with black/purple patterning	Squared	1
Muras purutu	Fréjol morado	Purple bean	Purple	Squared	1
Kapulis	Capuli	Goldenberry [Andean fruit; *Prunus salicifolia*]	Purple with yellow points	Squared	12
Kapulis pintatu	Capuli pintado	Striped goldenberry	Purple with cream patterning	Squared	1
Yurak kapulis	Capuli blanco	White goldenberry	Cream with purple patterning	Squared	2
Misturiatu	Mistoriado	Mixed	Violet, red and cream	Squared	1
Chawa uma	Pelo con canas	Grey haired head	Black, red and white stripes	Elongated	1
Yurakyaku	Yurakyaku	Yurakyaku*	Purple		1
Wairita	Del viento	Of the wind	Orange	Small	1
Hamchi allpa carmelo	Suelo de Carmelo pequeño	Small soil of Carmelo*		Small	1
Raku allpa carmelo	S. de Carmelo grande	Large soil of Carmelo*		Large	1
Dolo Morantia	Tía Dolores Moran	Aunt Dolores Moran*	Cream with purple stripes	Elongated	1
Jose purutu	Fréjol de José	José bean	Purple with cream patterning	Elongated	9

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
Wawa mama purutu	*Fréjol de placenta*	*Placenta bean*			
RAKU PURUTU LANDRACES CONT.					
Kallu purutu	*Fréjol de gallo*	*Rooster bean*			
Pampa cantagallo	*Cantagallo del suelo*	*Cantagallo of soil*			
Arus api purutu	*Fréjol sopa de arroz*	*Rice soup bean**			
Ruku Jose	Fréjol grande de Jose	Large José bean	Red/purple with cream patterning	Elongated	1
Yurak suku	Blanco gris	White grey	Grey with small yellow points	Small	1
Suku puka raku purutu	Fréjol grueso gris rojo	Grey red large bean	Red with yellow/cream	Round	1
Suku pintatu	Gris pintado	Striped grey	Grey with black patterning	Square	5
Suku purutu	*Fréjol gris*	*Grey bean*			
Suku rayatu	*Gris rayado*	*Striped grey*			
Suku purutu	Fréjol gris	Grey bean	Grey	Elongated	2
Suku	Gris	Grey	Grey/blue	Elongated	1
Sukuku	Gris	Grey	Grey with black patterning	Elongated	2
Café	Café	Coffee	Dark purple	Elongated	1
Café turtas	Café tortas	Coffee turtas *	Brown	Elongated	1
Rusas pintatu	Rosado pintado	Pink striped	Purple with a little orange		1
Yana yurak pintatu	Negro blanco pintado	Black white striped	Black with a little cream		1
Chawa killu pintatu	Amarillo claro pintado	Pale yellow striped	Yellow/pink, with red stripes		1
Quitumba	Quitumba	Quitumba*			1
Lakri	Lacre	Dark red/bordeaux	Dark red		2
Chilina purutu	Fréjol chilena	Chilean bean			1
Raku	Grande	Large	Purple	Elongated	1
Pintatu	Pintado	Striped		Round	1
Ayakalpachi	Corretea al diablo	Devil's run			1
Taytaku	Papa	Father	Black with a little cream	Elongated	1
CLIMBING BEAN LANDRACES, COUNTED UNNAMED VARIETIES					123
CLIMBING BEAN LANDRACES, TOTAL COUNTED SEED LOTS					365
CLIMBING BEAN LANDRACES, MIXED SEED LOTS				31 x 12	372

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
CLIMBING BEAN LANDRACES, ESTIMATED TOTAL SEED LOTS					**737**

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
ALLPA PURUTU MODERN VARIETIES					
Miluno (1001)	Miluno (1001)	Miluno	Purple with cream patterning	Large, elong.	1
Cargadillo	Cargadillo	Cargadillo	Beige	Squared	7
Yurak cargadillo	*Cargadillo blanco*	*White cargadillo*	*White*		
Cargabello	Cargabello	Cargabello	Red with white patterning	Elongated	14
Mishu cantagallo	*Cantagallo mestizo*	*Mestizo cantagallo**			
Mishu gallo purutu	*Fréjol de gallo mestizo*	*Mestizo rooster bean**			
[Hamchi]	*Chiquito*	*Small*			
Yana kaliman	Caliman negro	Black calima	Cream with black and purple	Elongated	4
Machiti	*Machete*	*Machete*			
TOTAL ALLPA PURUTU MVs					**26**
ALLPA PURUTU LANDRACES					
Hamchi cargadillo	Cargadillo chico	Small cargadillo	Red with cream	Small	1
Matahambre propio	Matahambre propio	Own/proper bush bean			3
Uray purutu	Fréjol de abajo	Bean from below*	Red with spots	Elongated	1
Yana manta purutu	Fréjol de manta negra	Black blanket bean	Purple patterned with black		1
Pintatu	Pintado	Striped	Violet with cream stripes		1
Yana pintatu	Negro pintado	Striped black	Black with white stripes		4
Azul marino	Azul marino	Marine blue	Black		1
Chawa azul	Azul bajo	Light blue	Light blue (fresh), dark blue (dry)		1
Yana azul	*Azul negro*	*Black blue*			
Yurak pintatu	Pintado blanco	White striped	White with black stripes	Elongated	8
Markus purutu	*Fréjol de marcos*	*Markus bean*			
Yurak pintatu (var.)	Pintado blanco	White striped (var.)	White with blue stripes	Elongated	1
Hamchi allpa purutu	Matahambre chico	Small bush bean	Cream with black stripes	Small	4
Uchilla allpa purutu	*Matahambre pequeño*	*Little bush bean*			

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
Hamchi pintatu	*Pintado pequeño*	*Small striped*			
Chawcha allpa pintatu	*Matahambre chaucha pintado*	*Chawcha bush bean**			
ALLPA PURUTU LANDRACES CONT.					
Puka pintatu	Pintado rojo	Striped red	Red with cream stripes	Elongated	4
Puka pintatu allpa purutu (var.)	Fréjol matahambre rojo pintado (var.)	Red striped bush bean (var.)	Red with cream stripes	Round	1
Puka purutu	Fréjol rojo	Red bean	Red	Elongated	1
Puka Azamamanta	Rojo de Azama	Red from Azama*	Orange	Elongated	1
Puka sukuku	Rojo gris	Red grey	Dark red with darker red stripes	Elongated	1
Muratu	Morado	Purple	Purple	Elongated	3
Pintatu muratu	Morado pintado	Striped purple	Purple with cream stripes	Elongated	5
Muratu suku allpa purutu	Fréjol matahambre morado gris	Purple grey bush bean	Violet with violetstripes	Elongated	1
Rusas purutu	Fréjol rosado	Pink bean	Pink		1
Rayatu punta	Punta rayado	Striped point/end	Red	Large	1
Warusu café pintatu	Barozo pintado con café	Coffee striped clay-colored	Orange with brown stripes	Elongated	2
Wirachuru	*Virachuro*	*Wirachuru [bird]*			
Killu pintatu	*Pintado amarillo*	*Yellow striped*			
Warusu yana pintatu	Barozo pintado con negro	Black striped clay-colored	Orange with black stripes	Elongated	2
Warusu puka pintatu	Barozo pintado con rojo	Red striped clay-colored	Orange with red stripes	Elongated	2
Warusu	Barozo	Clay-colored	Bright yellow		2
Suku purutu	Fréjol gris	Grey bean	Grey	Elongated	4
Suku muratu	Gris morado	Grey purple	Grey/purple	Elongated	1
Suku pintatu	Gris pintado	Grey striped	Violet	Elongated	1
Suku rayatu	Gris rayado	Grey with rows	White with black	Elongated	1
Uskuru suku	Gris oscuro	Dark grey	Dark grey	Elongated	1
Suku kuy	Cuy gris	Grey guinea pig	Purple with cream	Elongated	2
Suku kunihu	Conejo gris	Grey rabbit	Grey spotted	Elongated	1

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
Killu allpa purutu	Fréjol matahambre amarillo	Yellow bush bean	Yellow	Elongated	5
Tumatiku	Tomate	Tomato/dark orange	Dark orange	Elongated	4
ALLPA PURUTU LANDRACES CONT.					
Uskuru killu	*Amarillo oscuro*	*Dark yellow*			
Uchu allpa purutu	Fréjol matahambre de ají	Andean pepper bush bean	Orange	Elongated	1
Puka malwa	Malva roja	Red malva [flowering plant; *Malva* sp.]	Red striped	Elongated	1
Suku malwa	Malva gris	Grey malva [flowering plant; *Malva* sp.]	Grey striped	Elongated	1
Yurak allpa purutu	Fréjol matahambre blanco	White bush bean	Cream	Elongated	4
Tawri purutu	Fréjol de chocho	Lupine bean	White	Elongated	5
Yana allpa purutu	Fréjol matahambre negro	Black bush bean	Black	Elongated	3
Yana uskuru allpa purutu	*Fréjol matahambre negro oscuro*	*Dark black bush bean*			
Yana azul	*Azul negro*	*Black blue*			
Hamchi yana	Negro pequeño	Small black	Black	Small	4
Lakri purutu	Fréjol lacre	Bordeaux bean	Black with purple stripes	Elongated	1
Uchilla allpa purutu pintatu	Fréjol matahambre pequeño pintado	Small striped bush bean	Red striped	Small, elongated	1
Golondrina	Golondrina	Swallow	Beige	Elongated	1
Bula rayatu allpa purutu	Matahambre bolita rayado	Striped round bush bean	Purple	Round	1
José Cavascango	José Cavascango	José Cavascango*	Grey with white small spots	Elongated	1
Tayta Antonio	Don Antonio	Don Antonio*	Cream with brown patterning		2
Lima tiyu	*Tío Lima*	*Uncle Lima**			
Kihun ruwana purutu	Fréjol poncho de tela fina	Poncho of fine cloth bean*	Blue/purple with light blue stripes		1
Yana uskuru pintatu	Negro oscuro pintado	Dark black striped	Violet with dark violet stripes	Elongated	1
Azul pintatu	Azul pintado	Blue striped	Grey with cream stripes	Elongated	3

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
Lichtatu allpa purutu	Matahambre rayado	Striped bush bean	Purple with blue stripes	Elongated	1
Hatun allpa	Gran matahambre	Large bush bean	Purple with cream stripes	Elongated	1
Mulatuku	Molato	Mulatto	Grey with grey/white stripes	Elongated	1
ALLPA PURUTU, COUNTED UNNAMED LANDRACES					44
ALLPA PURUTU LANDRACES, TOTAL COUNTED SEED LOTS					151
ALLPA PURUTU, MIXED SEED LOTS				32 x 8	256
ALLPA PURUTU LANDRACES, TOTAL SEED LOTS					**407**
RAKU PURUTU, TOTAL SEED LOTS					**821**
ALLPA PURUTU, TOTAL SEED LOTS					**433**
COMMON BEAN, TOTAL SEED LOTS					**1254**

Notes:
*Name is explained below in Table A2.10
In Cotacachi, bean landraces are usually planted mixed (*misturiatu*/*misturiado*). Even if these varieties are often planted mixed, stored mixed and cooked mixed, each variety is usually "known" (by name) and given attention in seed selection practices. Therefore, I here count each variety as a separate seed lot (according to Louette's [1999] definition). In the documentation of agrobiodiversity it was not always possible to document each single landrace. In these cases, simply "mixed" was registered. Median values of the number of individual varieties present in other mixed seed lots is used to estimate the total number of climbing or bush varieties grown by those households.
Notes to Table A2.4 also apply.

FURTHER NOTES REGARDING BEAN NAMES

Meanings of name terms: A majority of the bean names contain one or more color terms. Some are also named after animals, plants or other things which coloration they resemble. A few are named after their place or person of origin.

Origin of name and translations: When a name with a different meaning than the Kichwa name is more frequently employed in Spanish, the translation of the Kichwa name is given in [square brackets]. If origin of name is Spanish, Spanish name is used in English translation. If origin is Kichwa, Kichwa name is used. The names of people and places have not been changed in the translations.

The inclusion or exclusion of pre/suffixes: Whether or not a prefix (Spanish) or suffix (Kichwa) meaning "bean" or "climbing bean"/"bush bean" is included when a certain variety is mentioned depends on the context. Typically, it is more often included when the varietal name is short.

Poroto vs fréjol: In local Spanish, the term "poroto" (from the Kichwa "purutu") is also employed for beans. For the sake of consistency, I have only included the "fréjol" term in the Spanish names above, but the term poroto is also rather frequently used.

Bolon/molon/wulun/wula/bola/canario/kanariu: The terms *bolon/molon/wulun/wula/bola/canario/kanariu* are all applied to rounded climbing beans, usually monocolored. The variety of name versions is thus even more extensive than the examples given in the table above. On the other hand, the terms *bolon/molon/wulun* are also sometimes used to denote the whole category of climbing beans.

Table A2.10: Explanation of some bean name terms. (These terms are marked with an asterisk * in Table A2.9).

Term	**Explanation**
Yana kara/piel negra/black skin	This bean has a dark-colored pod shell.
Carmelo	A bean brought from the farm of don Carmelo.
Turtas/tortas/lima bean	A *Phaseolus vulgaris* bean resembling a lima bean.
Cachujilla	Brought from the community of Cachujilla.
Cantagallo	Obtained from a man who was called "father Cantagallo" (lit. father singing rooster).
Huzu umaku/Cabeza de kuso/worm's head	The *huzu* or *kuso* is thick, large worm and a local delicacy. The bean is named for its resemblance to the *huzu*.
Yurakyaku	Bean brought from a place with this name.
Dolo Morantia/Tia Dolores Moran/Aunt Dolores Moran	Resembles de embroidered blouse of aunt Dolores Moran.
Aruz api/sopa de arroz/rice soup	Resembles rice soup.
Quitumba	Brought from the community of Quitumba.
Mishu/mestizo	*This is a bean considered more mestizo; it sells well.*
Uray/de abajo/from below	From the lower zone of Cotacachi named Intag.
Chawcha/chaucha	*Chawcha is a Kichwa term with multiple meanings; delicate, small, quick to mature, fertile.*
Azama	Brought from the community of Azama.
José Cavascango	Named after the man José Cavascango.
Tayta/don Antonio	Named after the now passed Tayta (father/honorary term for elderly man) Antonio Lima.
Lima tiyu/Tio Lima/Uncle Lima	Named after the now passed Tayta Antonio Lima.
Kihun ruwana/poncho de tela fina/poncho of fine cloth	Named this way because it resembles the poncho of Tayta Antonio Lima.

Table A2.11: Documented runner bean (*Phaseolus coccineus*) varieties.

Name (Kichwa)	Name (Spanish)	Name (English)	Color	Shape	#
Yurak (intag purutu)	Blanco	White	White	Large	8
Yurak pintatu (intag purutu)	Blanco pintado	White striped	White with black stripes	Large	7
Chawa yurak (intag purutu)	Crema	Pale white	Cream	Large	4
Chawa lapratu (intag purutu)	Crema pintado	Pale striped	Cream with black stripes	Large	1
Killu (intag purutu)	Amarillo	Yellow	Yellow	Large	2
Puka (intag purutu)	Rojo	Red	Light red	Large	5
Puka pintatu (intag purutu)	Rojo pintado	Red striped	Red with black stripes	Large	2
Muratu (intag purutu)	Morado	Purple	Purple	Large	9
Muratu pintatu (intag purutu)	Morado pintado	Purple striped	Purple with black stripes	Large	11
Rusas (intag purutu)	Rosado	Pink	Pink	Large	3
Rusas pintatu (intag purutu)	Rosado pintado	Pink striped	Pink with black stripes	Large	2
Café (intag purutu)	Café entero	Coffee	Brown	Large	1
Café pintatu (intag purutu)	Café pintado	Coffee striped	Brown with black stripes	Large	2
Yana (intag purutu)	Negro	Black	Black	Large	1
Yana pintatu (intag purutu)	Negro pintado	Black striped	Black with cream	Large	1
Runner bean, unnamed counted varieties					3
RUNNER BEAN, TOTAL COUNTED SEED LOTS					62
RUNNER BEAN, MIXED				2 X 4	8
RUNNER BEAN, TOTAL SEED LOTS					**70**

See notes to Table A2.4.

PEAS

Table A2.12: Names and characteristics of pea (*Pisum sativum*) main classes.

Name (Kichwa)	Name (Spanish)	Name (English)	Plant	Seed size	Seed color	Other	Origin	Market
Chawcha	Chaucha	Chawcha	Medium	Small	Various	Quicker to mature	Native	Low
Hamchi chawcha	*Pequeña chaucha*	*Small chawcha*						
Runa	*Indigena*	*Indigenous*						
Luhana	Lojana	From Loja [town/province in Southern Ecuador]	Tall	Large	Various	Needs more water to grow	Introduced (but present for long time)	High
Raku	*Grande*	*Large*						
Rusas	Rosada	Pink	Tall	Large	Pink		Introduced	High
Chivila	Verde [Undulada]	Curled (K), green (E)	Short, carpet-like growth habit	Large	White and green		Introduced	High
Wirti	*Verde*	*Green*						
Chilena	*Chilena*	*Chilean*						
Alwirhun	Alverjón	Large pea	Tall, palm like, long leaves	Large, edged	Cream	Larger than all other peas, very small flowers	Native	Low

See notes to Table A2.4.

Table A2.13: Documentation of pea (*Pisum sativum*) varieties. Note: *Rusas*, *chivila* and *alwirhun* have no subclasses – they constitute only one variety each.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Flower color**	**Seed color**	**#**
CHAWCHA	CHAUCHA	CHAWCHA			
Killu chawcha	Chaucha amarilla	Yellow chawcha	Yellow, pink	Cream/yellow (green when fresh, brown when stored long)	18
Café chawcha	*Chaucha café*	*Coffee chawcha*			
Wirti chawcha	*Chaucha verde*	*Green chawcha*			
Suku chawcha	Chaucha gris	Grey chawcha	Purple	Green with grey/purple spots	10
Muratu chawcha	*Chaucha morada*	*Purple chawcha*			
Yana chawcha	Chaucha negra	Black chawcha	Purple	Dark grey/purple	7
Yana suku chawcha	*Chaucha negra gris*	*Black-grey chawcha*			
Yana azul chawcha	*Chaucha negra azul*	*Black-blue chawcha*			
Wirti chawcha	Chaucha verde	Green chawcha		Green, also when stored	6
CHAWCHA, MIXED				4 x 2	8
CHAWCHA TOTAL SEED LOTS					49
LUHANA	LOJANA	FROM LOJA			
Yurak luhana/lojana	Lojana blanca	White lojana	White	Cream (green when fresh)	39
Killu luhana	*Lojana amarilla*	*Yellow lojana*			
Wirti luhana	*Lojana verde*	*Green lojana*			
Suku luhana/lojana	Lojana gris	Grey lojana	Purple	Green with grey/purple	4
LUHANA TOTAL SEED LOTS					43
RUSAS	**ROSADA**	**PINK**		Pink	**2**
CHIVILA	**VERDE**	**CURLED**	White	Green with white stain	**8**
ALWIRHUN	**ALVERJÓN**	**LARGE PEA**	White	Cream	**2**
PEA, UNSPECIFIED SEED LOTS					3
PEA, TOTAL SEED LOTS					107

See notes to Table A2.4.

FABA BEANS

Table A2.14: Names and characteristics of faba bean (*Vicia faba*) main classes.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant size**	**Leaves**	**Pods**	**Stalk**	**Seed**	**Flower**	**Use**	**Other**	**Origin**	**Market**
Chawcha hapas	Haba chaucha	Chawcha faba beans	Same height, but finer	Small	Fine, thin	Square	Smaller	White	Quick to cook, 20 minutes (fresh) Sweeter Yields less	Grown in all altitudinal zones	Native	High
Hamchi hapas	*Habas delgadas*	*Small faba beans*										
Raku	Gruesa	Large	Same height, but thicker	Large	Thicker	Square	Larger	White with black/ brown	Quick to cook, 20 minutes (fresh) Less sweet Yields more	Mostly grown in higher zone	Native	High

See notes to Table A2.4.

Table A2.15: Documentation of faba bean (*Vicia faba*) varieties.

Name (Kichwa)	Name (Spanish)	Name (English)	Color	#
CHAWCHA HAPAS	HABAS CHAUCHAS	CHAWCHA FABA BEANS		
Killu chawcha	Chaucha amarilla	Yellow chawcha	Whitish/yellow, brownish when dry	35
Yurak chawcha	*Chaucha blanca*	*White chawcha*		
Wira chawcha	*Chaucha manteca*	*Lard chawcha*		
Vayu chawcha	*Chaucha bayo*	*Vayu chawcha*		
Café chawcha	*Chaucha café*	*Coffee/brown chawcha*		
Puka chawcha	Chaucha roja	Red chawcha	Pink/red when fresh, black when dry	18
Yana chawcha	*Chaucha negra*	*Black chawcha*		
Rosas chawcha	*Chaucha rosada*	*Pink chawcha*		
Wirti/verde chawcha	Chaucha verde	Green chawcha	Green, fresh and dry	18
CHAWCHA, MIXED SEED LOTS			12 X 2	24
CHAWCHA HAPAS TOTAL SEED LOTS				**95**
RAKU HAPAS	HABAS GRUESAS	LARGE FABA BEANS		
Yurak	Blanca	White	Whitish/yellow	15
Killu	*Amarillo*	*Yellow*		
Rosas	Rosado	Pink	Pink/red	3
Wirti/verde	Verde	Green	Green	8
Kristupa shunku	Corazon de cristo	Christ's heart	Green with red spots	2
Pintatu	*Pintado*	*Spotted*		
RAKU HAPAS, MIXED SEED LOTS			3 X 2	6
RAKU HAPAS, TOTAL SEED LOTS				**34**
FABA BEAN, TOTAL SEED LOTS				**129**

See notes to Table A2.4.

POTATOES

Table A2.16: Names and characteristics of potato (*Solanum* spp.) main classes.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant**	**Tubers**	**Flowers**	**Time to mature**	**Cooking time**	**Origin**	**Market**
Ara papa	Ara papa	Ara potato	Clear green	Small, far from plant	Purple			Native	Low
Chawcha papa	Papa chaucha	Chawcha potato	Clear green	Large, close to plant	Purple	Short, 3 months	Short, 10 minutes	Native	Some
(Ali) papa*	Papa (buena)	(Good) potato	Darker green	Large, close to plant	Purple	Longer, 5 months	Longer	Introduced and native	High

* This category is often covert/unnamed. It is much more common to refer to potatoes (*papa*) in general or specific varieties. See notes to Table A2.4.

Table A2.17: Comparison of farmers' and scientists' classification of potato (*Solanum* spp.) diversity.

Cotacachi Kichwa classification	**Scientific classification**
Ara papa	*Solanum* sect. *Petota*
Chawcha papa	*Solanum phureja*
(Ali) papa	*Solanum tuberosum* ssp. *andigena*

Table A2.18: Documentation of potato (*Solanum* spp.) varieties. (Continued on the next page.)

Name (Kichwa)	Name (Spanish)	Name (English)	Color (skin)	Color (flesh)	Use	#
ARA PAPA						
Yana ara papa	Ara papa negra	Black ara potato	Black	Beige	*Secos* (boiled with skin-on)	2
Yurak ara papa	Ara papa blanca	White ara potato	Whitish	Beige	*Secos* (boiled with skin-on)	2
ARA PAPA, TOTAL SEED LOTS						**4**
CHAWCHA PAPA					Good for soups and secos, dissolves quickly.	
Killu chawcha	Chaucha amarilla	Yellow chawcha	Yellow	Yellow, like egg yolk		9
Yana chawcha	Chaucha negra	Black chawcha	Black	Black		6
Yurak chawcha	Chaucha blanca	White chawcha	White	White		5
Puka chawcha	Chaucha roja	Red chawcha	Pink/red	White		1
Yurak chawcha pintatu	Chaucha pintada blanca	White striped chawcha	White with black	White		2
Yana chawcha pintatu	Chaucha negra pintada	Black striped chawcha	Black with white	White		2
Puka chawcha pintatu	Chaucha pintada roja	Red striped chawcha	Red with white	White		5
CHAWCHA PAPA, TOTAL SEED LOTS						30
ALI PAPA LANDRACES						
Wata papa	Papa del año	Year potato				1
ALI PAPA LANDRACES, TOTAL SEED LOTS						1
ALI PAPA MVs						
Esperanza	Esperanza	Hope	Red with yellow spots	White	Very good for soups/*secos*, to serve guests or in *medianos**, does not dissolve	28
Uva	Uva	Grape	Purple	White	Very good for soups/*secos*, to serve guests or in *medianos*, does not dissolve	20

Name (Kichwa)	Name (Spanish)	Name (English)	Color (skin)	Color (flesh)	Use	#
ALI PAPA MVs CONT.						
Violeta	Violeta	Violet	Yellow with purple spots	White	Very good for soups/*secos*, does not dissolve, very tasty	15
Chola	Chola		Red with yellow spots	Yellow	Good for soups thickened with potato, dissolves rapidly	13
Roja	Roja	Red	Red	Yellow	Good for *tortilla*s, dissolves	9
Gabriela	Gabriela	Gabriela	Red with yellow	Yellow, sometimes with red spots	Good for soups/*secos*, does not dissolve	3
Única	Única	Unique	Yellow with purple spots	White	Good for soups/*secos*, does not dissolve	3
San Jorge	San Jorge	Saint George	Purple	White		2
Pan de azùcar	Pan de azúcar	Sugar bread	Yellow	White		1
Capiro	Capiro		Dark purple	White	Good for soups/*secos*, does not dissolve. Similar to *uva*, but not as tasty.	1
Diamante	Diamante	Diamond	Cream with red	Cream		1
Yungara	Yungara					1
ALI PAPA MVs, TOTAL SEED LOTS						**4**
ALI PAPA, TOTAL SEED LOTS						**102**
POTATO, TOTAL SEED LOTS						**136**

Notes:
*A *mediano* is a ritual gift of food given in the establishment and maintenance of ritual kinship bonds.
Spanish spelling is kept also in the Kichwa listing for varieties with originally Spanish names (modern varieties) which are named by their Spanish names also in Kichwa speech.
See also notes to Table A2.4.

QUINOA

Table A2.19: Documentation of quinoa (*Chenopodium quinoa*) varieties.

Name (Kichwa)	Name (Spanish)	Name (English)	Plant	Stem	Leaves	Grain color	Cooking quality	Origin	Market	#
Chawcha kinuwa	Quinua chaucha	Chawcha quinoa	Short	Slender	Dark green with red powder	White	Relatively quick to rinse, soft/quick to cook	Native	Low	11
Puka chawcha kinuwa	Quinua chaucha roja	Red chawcha quinoa	Short	Slender	Pale green with white powder	Reddish	Long rinse and long cooking required	Native	Low	2
Hatun kinuwa	Quinua grande	Large quinoa	Tall	Thick	Dark green with white powder	Yellow	Long rinse, quick cooking	Native	Low	11
Sara kinuwa	*Quinua de maíz*	*Maize quinoa*								
Tani kinuwa	*Quinua amarga*	*Bitter quinoa*								
Wata kinuwa	*Quinua del año*	*Year quinoa*								
Killu kinuwa	*Quinua amarilla*	*Yellow quinoa*								
Yurak kinuwa	*Quinua blanca*	*White quinoa*								
Pampa kinuwa	*Quinua de campo*	*Field/rural quinoa*								
Mishki kinuwa	Quinua dulce	Sweet quinoa	Tall	Thick	Green with pink powder	White	Very brief rinse, quick cooking	Introduced	High	18
Arus kinuwa	*Quinua de arroz*	*Rice quinoa*								
Yurak kinuwa	*Quinua blanco*	*White quinoa*								
TOTAL QUINOA SEED LOTS										**42**

Note: There is also some color variation within quinoa varieties, but these are not distinguished between for any seed management purposes in Cotacachi.
See also notes to Table A2.4.

LUPINES

Table A2.20: Documentation of lupine (*Lupinus mutabilis*) varieties.

Name (Kichwa)	Name (Spanish)	Name (English)	Plant	Flowers	Seed	Use	Origin	Market	#
Yurak tawri	Chocho blanco	White lupine	Bright green, tall	Blue	White	Served with toasted maize, *Fanesca* soup	Native	High	24
Yanashimi tawri	Chocho boca negra	Black mouth lupine	Bright green, tall	Blue	White with black "mouth"	Served with toasted maize, *Fanesca*	Native	Low	8
Pintatu tawri	*Chocho pintado*	*Spotted lupine*							
Yana ñawi tawri	*Chocho ojo negro*	*Black eye lupine*							
Yana tawri	Chocho negro	Black lupine	Bright green, tall	Blue	Black	Served with toasted maize, *Fanesca*	Native	Low	1
Aya tawri*	Chocho silvestre/del monte	Wild lupine	Greyish green, short, hairy	Blue	Black, small	Cattle feed, *biol* [a natural crop protection fumigant]	Native	Low	
LUPINE, UNSPECIFIED SEED LOTS									2
LUPINE, TOTAL SEED LOTS									**35**

*Not cultivated and not registered in the survey.
See also notes to Table A2.4.

MELLOCO

Table A2.21: Documentation of melloco (*Ullucus tuberosus*) varieties.

Name (Kichwa)	Name (Spanish)	Name (English)	Tuber color	Tuber shape	Origin	Market	#
Yurak milluku	Melloco blanco	White melloco	Whitish	Round	Native	High	14
Rusas milluku	Melloco rosado	Pink melloco	Pale pink	Round	Native	High	9
Killu milluku	Melloco amarillo	Yellow melloco	Yellow	Round	Native	High	7
Puka milluku	Melloco rojo	Red melloco	Bright pink/red	Round	Native	High	5
Urpi chaki milluku	*Melloco pie de tórtola*	*Dove's foot melloco*					
Yurak pintatu milluku	Melloco blanco con pintas	White striped melloco	White w. pink stripes	Round	Native	High	1
Suni rusas milluku	Melloco rosado largo	Long pink melloco	Pink	Elongated	Introduced	High	6
	Melloco rosado cacho	*Pink horn melloco*					
TOTAL MELLOCO SEED LOTS							**42**

See notes to Table A2.4.

OCA

Table A2.22: Documentation of oca (*Oxalis tuberosa*) varieties.

Name (Kichwa)	Name (Spanish)	Name (English)	Tuber color	Origin	Market	#
Yurak uka	Oca blanca	White oca	White	Native	High	16
Puka uka	Oca roja	Red oca	Red/pink	Native	High	6
Killu uka	Oca amarilla	Yellow oca	Yellow	Native	High	9
Alli uka	*Oca buena*	*Good oca*				
Ñanka uka	Oca inservible	Unusable oca	Yellow with pink spots	Native	Low	0
Yana uka	Oca negra	Black oca	Black	Native	Low	2
TOTAL OCA SEED LOTS						**33**

See notes to Table A2.4.

LENTILS

Table A2.23: Documentation of lentil (*Lens culinaris*) varieties.

Name (Kichwa)	Name (Spanish)	Name (English)	Seed	Cooking quality	Origin	Market	#
Wirti lantiha	Lenteja verde	Green lentil	Green, round	Hard (long time)	Native	Low	3
Yurak lantiha	Lenteja blanca	White lentil	White, squared	Hard (long time)	Native	Low	2
Alli lantiha	Lenteja buena	Good lentil	Brown, squared	Soft (short time)	Native	High	0
Suku lantiha	Lenteja gris	Grey lentil	Grey, squared	Hard (long time)	Native	Low	0
Killu lantiha	Lenteja amarillo	Yellow lentil	Yellow, square	Hard (long time)	Native	Low	0
LENTIL, TOTAL SEED LOTS							**5**

See notes to Table A2.4.

WHEAT

Table A2.24: Documentation of wheat (*Triticum aestivum*) varieties.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant size**	**Awns**	**Grain color**	**Sheath and awn color**	**Time to mature**	**Use**	**Origin**	**Market**	**#**
Yana triku	Trigo negro	Black wheat	Tall	Long	White	Black	8-10 m	White flour, good for bread	Native	High	9
Hatun triku	*Trigo grueso*	*Large wheat*									
Puka triku	Trigo rojo	Red wheat	Tall	Long	Cream	Reddish	8-10 m	Cream colored flour, bread and soup	Native	Some, but more home use	5
Hatun triku	*Trigo grueso*	*Large wheat*									
Champuru	Chamburo	Champuru [native fruit]	Tall		Cream	Reddish	6 m	Darker flour, but ok for bread	Native		3
Chawcha triku	Chaucha	Chawcha	Short	Short	Cream	Reddish/ brown	6 m	Bread, *chicha*, soup, sweet gruel, *machica* [toasted flour]	Introduced (Ibarra)	More for home use	3
Crespo	*Crespo*	*Crespo*									
Yuchu triku	Trigo desnudo	Naked wheat	Short	No	Cream	Grey	6 m	Bread (greyish), soup, *tortillas*, cooked and drained as rice	Introduced (Colombia)		3
Palanca	*Palanca*	*Palanca*									
Africano	*Africano*	*African*									
	Sin espiga	*Without awns*									
Yurak triku	Trigo blanco	White wheat	Short	Little	White	White	8-10 m	White bread	Introduced (Carchi /Pasto)	High	1
Killu triku	Trigo amarillo	Yellow wheat							Introduced		3
Atacami	*Atacami*	*Atacami*									
WHEAT, UNSPECIFIED SEED LOTS											4
WHEAT, TOTAL SEED LOTS											**31**

Notes to previous Table A2.24:
m: months
Four (*chawcha triku, yuchu triku, yurak triki, killu triku*) are classified as "introduced" locally, meaning that they are not native to the area, and have entered during the past generation. They are classified as MVs here, although they might be better classified as "farmer varieties" (FVs) since they have entered the local seed system and been bred and saved and modified by farmers for many years.
See also notes to Table A2.4.

BARLEY

Table A2.25: Documentation of barley (*Hordeum vulgare*) varieties.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant**	**Use**	**Market**	**#**
Hatun siwara	Cebada grande	Large barley	Tall	Soup brownish	Low	6
Raku siwara	*Cebada grueso, cebada grande*	*Big barley*				
Chusku raya siwara	*Cebada de cuatro rayas*	*4- row barley*				
Kari siwara	*Cebada macho*	*Male barley*				
Warmi siwara	Cebada hembra	Female barley	Short	Medicinal properties	High	7
Yurak siwara	*Cebada blanca*	*White barley*				
Chawcha siwara	*Cebada chaucha*	*Chawcha barley*				
Ishkay raya siwara	Cebada de 2 rayas	2-row barley	Short	Soup white, thicker	High	4
Raya siwara	*Cebada rayada*	*Rowed barley*				
Shampa siwara	*Cebada trensa*	*Braid barley*				
Yana siwara	*Cebada negra*	*Black barley*				
Rusas siwara	*Cebada rosada*	*Pink barley*				
Uchilla shampa siwara	*Cebada pequeña trensa*	*Small braid barley*				
Chivila	*Undulada*	*Curled*				
Boliviana	Boliviana	Bolivian	Short		High	2
Shampa siwara	*Cebada trensa*	*Braid barley*				
Colombiana	*Colombiana*	*Colombian*				
Chilena	Chilena	Chilean	Short		High	1
Triple	*Triple*	*Triple*				
UNSPECIFIED BARLEY SEED LOTS						6
TOTAL BARLEY SEED LOTS						**26**

Note: Boliviana and chilena are considered introduced varieties by farmers, and are classified as MVs here. See also notes to Table A2.4.

ZAMBO

Table A2.26: Documentation of zambo (*Cucurbita ficifolia*) varieties. (Continued on the next page.)

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant**	**Flowers**	**Fruit color**	**Fruit shape**	**Seed**	**Cooking quality**	**Origin**	**Market**	**#**
Yurak sampu	Sambo blanco	Yellow zambo	Broad, unwrinkled leaves	Yellow	White	Medium, elongated	Mostly white, few seed	Sweet	Native	High	27
Killu sampu	*Sambo amarillo*	*White zambo*									
Wirti sampu	Sambo verde	Green zambo	Broad, unwrinkled leaves	Yellow	Green	Large, elongated	Black, broad, many	Bland	Native	High	40
Yana muyu sampu	*Sambo de pepa negra*	*Black seeded zambo*									
Hatun sampu	*Sambo grande*	*Big zambo*									
Lichuka sampu	Sambo de lechuga	Lettuce zambo	Broad, unwrinkled leaves	Yellow	Yellow	Medium, elongated	Black, few	Sweet, hard to cook	Native	High	1
Chawa wirti sampu	*Sambo verde palido*	*Light green zambo*									
Tsimpalu	Chímbalo	Chimbalo zambo	Broad, unwrinkled leaves	Yellow	White with green stripes	Small, round	White	Sweet			3
Guayaquileño	Guayaquileño	Zambo from Guayaquil	Broad, unwrinkled leaves	Yellow	Green with white stripes	Medium, rounded	Black, slender	Sweet	Native	High	28
Lishta sampu	*Sambo listado*	*Striped zambo*									
Raya sampu	*Sambo rayado*	*Striped zambo*									
Pintatu sampu	*Pintado*	*Spotted zambo*									

Name (Kichwa)	Name (Spanish)	Name (English)	Plant	Flowers	Fruit color	Fruit shape	Seed	Cooking quality	Origin	Market	#
Wirti pintatu sampu	*Pintado verde*	*Green spotted zambo*									
Wola wirti sampu	Bola verde sambo	Round green zambo	Broad, unwrinkled leaves	Yellow	Green	Small, round	Black, broad, many	Bland	Native	High	1
Sapallu sampu	*Sambo zapallo*	*Zapallo zambo*									
Pintatu sampu	*Pintado*	*Spotted zambo*									
ZAMBO, UNSPECIFIED SEED LOTS											**4**
ZAMBO, TOTAL SEED LOTS											**104**

Note: In general, the bland zambo varieties have many seed, and the sweet ones have few seed. It depends on a person's preference – as both fruit and seed can be used. See also notes to Table A2.4.

ZAPALLO/WINTER SQUASH

Table A2.27: Documentation of zapallo (*Cucurbita maxima*) varieties. (Continued on the next page.)

Name (Kichwa)	Name (Spanish)	Name (English)	Plant	Flowers	Fruit color	Fruit meat color	Fruit shape	Cooking quality	Origin	Market	#
Suni wirti sapallu	Zapallo verde largo	Long green zapallo	Less broad leaves	Orange	Green	Yellow	Large, elongated	Soft, dissolves rapidly and thickens soup. Bright yellow.	Native	High	6
Warusu sapallu	*Zapallo barrozo*	*Mud-colored zapallo*									
Warmi sapallu	*Zapallo hembra*	*Female zapallo*									
Alli sapallu	*Zapallo bueno*	*Good zapallo*									

Name (Kichwa)	Name (Spanish)	Name (English)	Plant	Flowers	Fruit color	Fruit meat color	Fruit shape	Cooking quality	Origin	Market	#
Wula wirti sapallu	Zapallo verde Redondo	Round green zapallo	Less broad leaves	Orange	Green	Yellow	Medium, round	Soft, dissolves rapidly and thickens soup.	Native	High	9
Hamchi sapallu	*Zapallo pequeño*	*Small zapallo*									
Yurak sapallu	Zapallo blanco	White zapallo	Less broad leaves	Orange	White	Green	Medium, round	Dissolves, but darkish color.	Native	High	4
Hatun sapallu	*Zapallo grande*	*Big zapallo*									
Kari sapallu	*Zapallo macho*	*Male zapallo*									
Killu sapallu	Zapallo amarillo	Yellow zapallo	Less broad leaves	Orange	Yellow with orange spots	Yellow	Large, round	Soft, dissolves well.	Native	High	4
Kastilla sapallu	Castellano	Zapallo Castilla	Less broad leaves	Orange	Green with yellow stripes	Yellow	Large, elongated, pear shaped, ribbed	Hard, leaves soup watery, hard to peel	Introduced (from lowlands)	High	2
Pinzi sapallu	Zapallo duro	Hard zapallo	Less broad leaves	Orange	Grey	Yellow	Round, ribbed	Harder, leaves soup watery	Native	High	0
Yaku sapallu	*Zapallo aguado*	*Water zapallo*									
ZAPALLO, TOTAL SEED LOTS											**25**

See notes to Table A2.4.

ARRACACHA

Table A2.28: Documentation arracacha (*Arracacia xanthorrhiza*) varieties.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant**	**Tubers**	**Origin**	**Market**	**#**
Yurak sanyura	Zanahoria blanca	White arracacha	Black leaves	White	Native	High	13
Yana sanyura	*Zanahoria negra*	*Black arracacha*					
Killu sanyura	Zanahoria amarilla	Yellow arracacha	Green leaves	Cream/yellow	Native	High	2
TOTAL ARRACACHA SEED LOTS							**15**

See notes to Table A2.4.

MASHWA

Table A2.29: Documentation of mashua (*Tropaleum tuberosum*) varieties.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant**	**Tubers**	**Origin**	**Market**	**#**
Killu mashwa	Mashua amarilla	Yellow mashua	Same	Yellow	Native	Low	9
Yana mashwa	Mashua negra	Black mashua	Same	Black	Native	Low	4
Pintatu mashwa	Mashua pintoncito	Spotted mashua	Same	Black with white stripes	Native	Low	1
Yurak mashwa	Mashua blanca	White mashua	Same	White	Native	Low	1
Puka mashwa	Mashua roja	Red mashua	Same	Red	Native	Low	1
TOTAL MASHWA SEED LOTS							**16**

See notes to Table A2.4.

SWEET POTATOES

Table A2.30: Documentation of sweet potato (*Ipomoea batatas*) varieties.

Name (Kichwa)	**Name (Spanish)**	**Name (English)**	**Plant**	**Tuber skin**	**Tuber flesh**	**Cooking quality**	**Origin**	**Market**	**#**
Mishki kamuti	Camote dulce	Sweet sweet potato	Reddish, slender leaves	Violet	Violet	Juicy, sweet. Cooked with skin, mostly for desserts.	Intag [lowland area]	Some	4
Yurak kamuti	Camote blanco	White sweet potato	Green, broad leaves	Cream	Cream	Sandy, drier. Bland like a potato. Soups.	Native	Some	1
Papa kamuti	Camote de papa	Potato sweet potato	Green, broad leaves	Red/ purple	Yellow	Sandy, very dry. Bland like a potato. Fried, soups.	Native	Some	1
SWEET POTATO, UNSPECIFIED SEED LOTS									3
SWEET POTATO, TOTAL SEED LOTS									**9**

See notes to Table A2.4.

C

APPENDIX

PHOTOGRAPHY


a


b


c


d


e


f


g


h

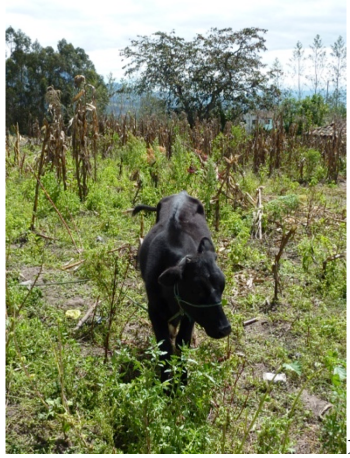

i


j


k


l


m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Explanations to photos in the preceding pages:

a. Preparation of field with hoe.
b. Preparation of field with *yunta* plow and cattle.
c. Preparation of field with tractor.
d. *Palentra* – tool for sowing.
e. Sowing maize, beans and other crops.
f. Sprouting *chakra* (field).
g. Growing *chakra.*
h. *Chakra* at the stage of ripening.
i. Harvest of maize.
j. Harvest helpers.
k. Oz used to cut maize stalks.
l. Cutting maize stalks.
m. *Sara parva* – heap made from maize stalks used as cattle fodder.
n. Cattle grazing in harvested *chakra*.
o. Sorting maize after harvest.
p. Maize for seed is best stored this way, hung on poles under ceiling (*wayunka*).
q. Maize for food is also stored in barrels.
r. Maize can also be stored in a special under-ceiling storage space (*kullka*).
s. Maize varieties (1).
t. Maize varieties (2).
u. Maize varieties (3).
v. Cooking over open fire in a *tullpa* firepit.
w. Cooking hominy (*muti*/*mote*) in a *tullpa*.
x. Girl making potatoes with watercress.
y. Gas stove.
z. Soup – an important food in Cotacachi.
aa. *Muzi guitarra* – a bread made of ground fresh maize.
bb. *Tortillas de tiesto* cooked in the *tullpa.*
cc. *Tortillas* sold in downtown food fair on a new-invented transportable *tullpa*.
dd. Women from communities serving traditional food downtown Cotacachi.
ee. Potatoes with watercress – a “poor people’s food”with new fame.