



The Practice and Importance of Chestnut Cultivation in Azerbaijan in the Face of Blight, *Cryphonectria parasitica* (Murrill) Barr

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Research

Abstract

The arrival and spread of chestnut blight, caused by the fungus *Cryphonectria parasitica* (Murrill) Barr, in Caucasian Azerbaijan has compromised the livelihoods of chestnut farmers and is causing rapid genetic erosion in the center of diversity for the European chestnut, *Castanea sativa* Mill. In Azerbaijan, blight was first reported in 2008 and is currently present in all chestnut-growing regions. Fortunately, there is a demonstrated biological control technique which may be applied in the context of Europe and Eurasia. This presents an opportunity to simultaneously achieve environmental and genetic resource conservation goals while reinforcing the livelihoods and maintenance of diversity of the nation's chestnut growers. However, national institutions primarily recognize the economic and genetic importance of certain elite crops, particularly those which were prominent production goods during the Soviet period. The present work was undertaken to characterize the socio-economic role of chestnut production and use in the communities where this crop is grown and sold. We investigate the monetary role of chestnut sales in the livelihoods of growers and collectors. It is hypothesized that while continuing to be a minor production good nationally, chestnut sales in a newly entrepreneurial agricultural sector have taken on tremendous livelihood importance to specific communities. The socio-economic importance of chestnut-based income to Azerbaijan's chestnut-growing communities is illustrated by the results of in-depth household budget interviews from 22 chestnut-growing households in two villages.

Introduction

The center of origin and the center of highest genetic diversity for the European chestnut *Castanea sativa* Mill. is in the Caucasus and Eastern Turkey (Martin *et al.* 2010,

Villani *et al.* 1994). The arrival and spread of chestnut blight in Caucasian Azerbaijan (Aghayeva & Harrington 2008) has compromised the livelihoods of chestnut farmers and is causing rapid genetic erosion (Wall 2012). According to the Greek traveler Xenophon, chestnut was a prominent food for the people of the Caucasus as long ago as the fourth century B.C. (Kelsey & Zenos 1889). The tree and its use spread from this region around the Black Sea and eventually to central and western Europe (Mattioni *et al.* 2008). It was under Persian rule that the chestnut came to be known in Azerbaijani as **şabalıd** or the Shah's oak.

Today, throughout the country, chestnut is a signature ingredient in a pilaf (**şabalıd plovu**) served at weddings, funerals, and holidays in which the chestnut is stewed with mutton or beef and dried fruit and served over buttery saffron rice. Less common is **şabalıd dolması**, stuffed and rolled cabbage leaves with diced chestnut, beef, and spices. A dramatically more exhaustive menu can be described by villagers where chestnut has historically served as a subsistence food during famines (**aclıqlar**). It is boiled,

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mashed, and drizzled with butter and persimmon molasses. It can be simply boiled or roasted on a stove-top and eaten one after another as a snack. **Şabalid şorbası**, a soup of chestnut cooked in stock and spiced lightly with turmeric, has been a staple of many winters in the highlands where it is grown.

As a Soviet Republic and integrated command economy, rural Azerbaijan was conscripted into collectivized agriculture of a limited number of crops. Though a variety of food plants maintained their cultural importance, crops pertinent to the food security and commercial strategies of the U.S.S.R. rose to prominence (Yalçın-Heckman 2010). In the wake of sweeping farm privatization beginning in 1995, the rural viability of distinct agricultural communities has come to depend heavily on the cultivation and marketing of less prominent crops, and a rapidly growing number of smallholders have come to engage in highly mixed production systems (Lerman & Sedik 2010). Chestnut-growing communities that depend on income generated from its sale fall precisely into this category. Given the common perspective of state officials and agronomists in Azerbaijan, which characterizes chestnut blight as an insignificant problem for a crop of little to no national significance, we investigated the socio-economic role of chestnut production at the scale of the village.

We take it that for the highland communities where it has been grown for centuries, the adaptive value of the chestnut is most recently exhibited in terms of monetary revenue. As Alcorn (2000) suggests,

“If the adaptive value of ethnobotanical knowledge is to be tested in any meaningful way, plant ‘use’ must be analyzed as a text that derives part of its meaning from the cultural, natural, and social context in which it occurs and serves its function.” (Alcorn 2000:26)

Accordingly, we investigated the monetary role of chestnut sales in the livelihoods of growers and collectors. We hypothesized that, while continuing to be a minor production good nationally, in a newly entrepreneurial agricultural sector, chestnut-based revenue has taken on tremendous livelihood importance to specific communities.

Context of chestnut cultivation and chestnut blight in Azerbaijan

Azerbaijan encompasses 86,000 km² in 3 climatic zones which can be described in relation to the nation’s largest river, the Kur (Alekerov *et al.* 2006). This river dissects the territory, flowing into Azerbaijan from the northwest to the southeast. North of the Kur River lies the temperate and highland zone where chestnut can survive and be cultivated. To the north and northeast are the High Caucasus Mountains which mark the border with Russia and its autonomous region of Daghestan. The enormous cultural and ecological heterogeneity of Daghestan is a fact of life

in the northern territory of Azerbaijan, which is locally referred to as **dağistan**, literally “mountain land,” as well. Many peoples in the highlands of Azerbaijan claim cultural origins in and strong extant cultural ties to Daghestan, where 34 distinct languages are spoken (Matveeva & McCartney 1998, SSCRA 2009). In the 8 political regions where chestnut can be observed, there are 7 distinct languages spoken including Lezgin, Tzakhour, and Avar.

In Azerbaijan the chestnut is grown between 500 and 1700 m above sea level in the northwestern part of the country in a band that runs nearly 200 km from SE to NW and spans just 20–25 km in width. This is a feature of the narrow elevation range of the tree. This totals over 4000 highly heterogeneous square-kilometers of territory for the chestnut. This zone runs across 8 distinct governed regions of Azerbaijan which are outlined in Figure 1.

The origins of chestnut blight, *Cryphonectria parasitica* (Murrill) Barr, are in East Asia (Anagnostakis 1987). Susceptible tree varieties such as the American and European chestnut—*Castanea dentata* (Marshall) Borkh. and *C. sativa*, respectively—exhibit a rapid decline beginning with the deterioration of the inner cambium which eventually forms open ruptures in the outer bark known as cankers. From the canker the fungal network girdles the trunk, interrupting transfer of nutrients and resulting in defoliation and deterioration of upper limbs (Heiniger & Rigling 1994).

In Europe, the first reports of *C. parasitica* on European chestnut, *C. sativa*, came from the area around Genoa, Italy, in 1938 (Figure 2). Though the early years of the epidemic were reminiscent of near total crop destruction in the United States, events in Europe unfolded differently. Initial damage to chestnut crops in the infected areas was severe. By 1964, however, a new and hopeful phenomenon was discovered and analyzed in Como, northern Italy. There, trees which had previously been infected and which were declining in health were observed to be in recovery. *Castanea parasitica* was sampled from these trees and under analysis was found to be remarkably less virulent, a phenomenon known as “hypovirulence” (Heiniger & Rigling 1994). Today we know that hypovirulence in *C. parasitica* occurs when the fungus becomes infected with a naturally occurring virus, the spread of which within the fungal population diminishes its overall damage to chestnut trees (Milgroom & Cortesi 2004).

In European chestnut, applied hypovirulence has been demonstrated to effectively inhibit the spread of *C. parasitica* within treated trees (Heiniger & Rigling 2009) and among neighboring trees (Hoegger *et al.* 2003). In this technique, the naturally occurring viral pathogen, known as CHV-1, is used to manually infect *C. parasitica* in laboratory conditions. This hypovirulent culture can then be applied to trees at the canker and inhibit infection levels.



Figure 1. Azerbaijan and the zone of chestnut cultivation.

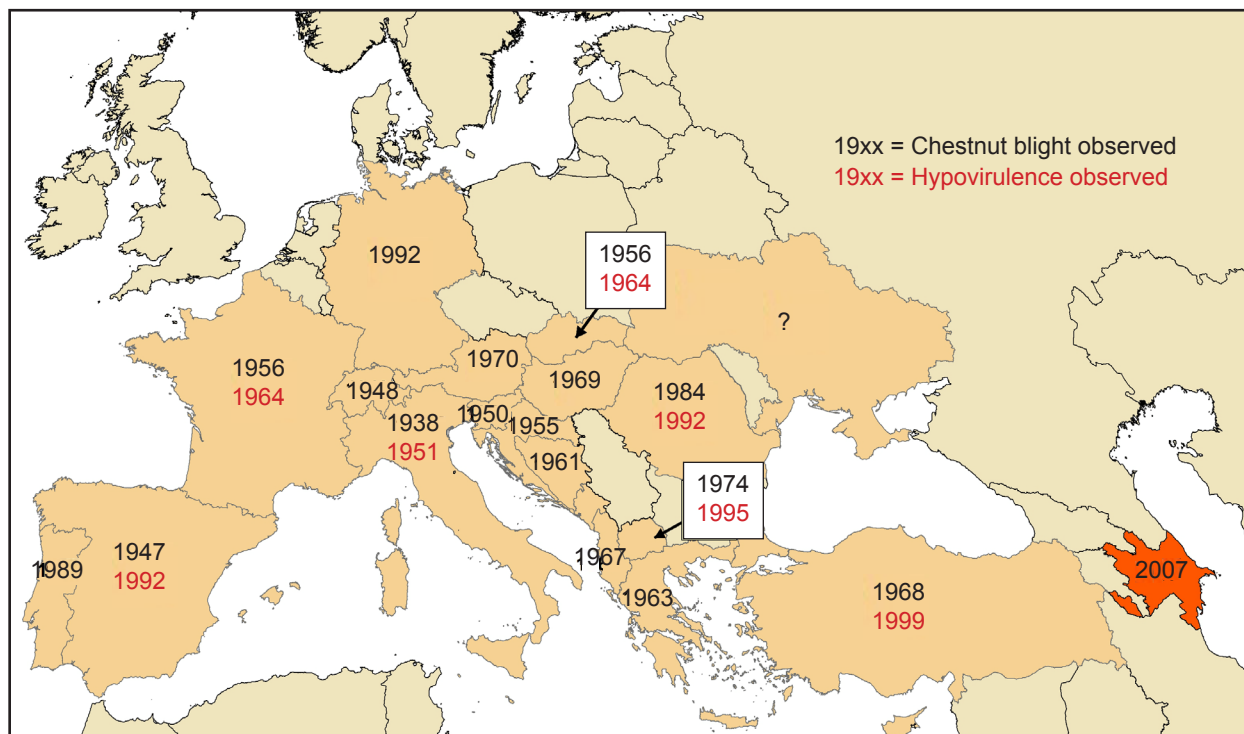


Figure 2. Reports on *Cryphonectria parasitica* throughout Europe and Turkey (adapted from Robin & Heiniger 2001). Azerbaijan marked by the author. Blight was noted in 2003, but an official report was made in 2008 (Aghayeva & Harrington 2008).

The present study sought to characterize the socio-economic role of chestnut production and sales in the livelihood viability of participant communities and, in doing so, to comment on the social desirability and suitability of implementing an on-farm conservation effort. The objective was to better understand the cultural and economic experience of chestnut-growing communities and households to determine whether or not a conservation effort could reinforce or leverage existing incentives for the continuation of widespread chestnut cultivation.

Materials and Methods

Between 2009 and 2010, 22 households ($N = 22$) in 2 villages, Jar in Zaqatala Region and Chinarli in Qax Region, participated in semi-structured interviews and a household budget questionnaire focused on chestnut cultivation and sale. During more than 20 days in each site during the harvest, post-harvest, and planting season, participant observation was conducted to supplement the interview results. Villages and households were selected using a process of participatory rural appraisal designed to select an economically diverse set of households actively engaged in the production and/or collection and sale of chestnut. Ten families in each community were selected for the interview and questionnaire session. In the case of Jar, 2 additional families requested to be interviewed and to complete the questionnaire. Families were interviewed as a group, and every household member was encouraged to be present. In this way, the multiple generations of each household were engaged at one time. While men and women openly participated, children seldom provided responses. The questionnaire was composed of a total of 28 questions divided into 5 sections: family structure, non-agricultural income, non-chestnut agricultural income, chestnut production figures and income, and household and work-related costs (those of chestnut production and all other expenses related to income earning). Semi-structured interviews were conducted apart from the questionnaire and strove to create a wider conversation about the general livelihood strategies of the family and impressions regarding the advance of chestnut blight. It was fully necessary to offer interviewees complete anonymity. Though during Soviet times knowledge of individual and family income was necessarily transparent, today the matter is considered highly private.

Results

The practice of chestnut production in Jar and Chinarli villages

A diverse set of chestnut production practices were observed in the territory of Jar and Chinarli villages. This is in part a function of the diverse traditions of the different ethnic groups. In our observations certain cultivation patterns can be associated with particular ethnic groups. The Avar of Jar grow chestnuts close to home, often within the

walls of their property. The Tzakhour in Chinarli, on the other hand, cultivate chestnut in removed gardens and do not grow them within the walls of their property. There is also a unique complex of production opportunities in the same village site. Home sites, alleys and road ways, nearby slopes, peripheral garden plots, forest edges, and remote forest groves are all utilized for chestnut production, yet each calls for particular and strategic cultivation, harvest, and post-harvest activities.

Chestnut production revolves around the annual cycle as well as the life cycle of individual trees. Taken as a whole, production is surprisingly light on labor. Trees produce nuts once a year, and apart from harvest and post-harvest, trees require little maintenance beyond careful cultivation and planting of seedlings and subsequent protection from grazing cattle, sheep, and goats through the maintenance of cages and fences made from thorns, thistles, branches, and/or wire. In fact, one very successful chestnut grower made the claim that "chestnuts do not love manure," discouraging even fertilization. The one task which is encouraged locally and is said to facilitate pollination is the borrowing and keeping of bees around the village during the chestnut-flowering season, after which time they are typically transported back to the lowlands.

Cultivation

Individual trees may begin as cuttings or as seeds planted in nursery-like conditions, typically adjoining vegetable plots. These can be easily weeded and watered in the routine maintenance of the home garden. Seedlings are grown for a year or more before being transplanted. Vigorous seedlings are chosen for transplanting to a chosen location. Vegetative propagation by direct-planting and grafting of cuttings is also practiced. Where these seedlings or cuttings are planted outside of the home walls and within the reach of free-ranging cattle, sheep, or goats, a cage is constructed of sticks, thorns, and/or wire to protect the young tree. If establishing trees in locations remote from the village, it is particularly recommended here to plant near the banks of the river, but all manner of landscape features which capture sunlight can be chosen as well.

Harvest

Harvest, collection, and storing occurs over a period of two weeks to a month, usually at the end of September or the beginning of October, and comprises the vast majority of labor required in chestnut production. If a tree is judged to be ready, the work of hitting begins from below with the use of a **chabuk** ("branch"). This is a smooth, flexible, and light-weight pole of various length, from a short sturdy 10-foot stick to a spindly yet formidable 20-foot pole. Without exception, the **chabuk** is a specially selected and crafted branch from the hazelnut shrub. It is sanded for smoothness and is chosen for its straightness and firmness. While hazelnut is not a major crop in Jar, it is for the

lowland Avar community of Danaçı. The Avar kinship network is utilized to acquire these hazelnut branches which are visible as they dangle out of the windows of small sedans on their way up the valley at harvest time. In Chinarli, hazelnut and chestnut are grown as companion crops in many private groves, assuring these villagers an abundant supply of branches.

With the **chabuk**, the work is straightforward if not tiring to the shoulders: one simply whacks at the large bright green and spiny fruit that one can reach. There are two guidelines which ought to always be followed according to local farmers. First, one should always whack downward so as to ensure that the final location of the fruit is nearby. Second, hitting fruits directly above yourself or your co-worker is discouraged. Consideration for people around the tree which is being worked on is of dire importance due to the danger of injury from the sharp spines of the chestnut husk.

What cannot be knocked down to the ground must be acquired by climbing the tree. All but the smallest trees are climbed, as it is unacceptable to leave more than a couple of nuts on the tree before the work is considered finished. Two or more **chabuks** must be hauled precariously up to the heights of the tree and moved around to different "stations" through great care and difficulty. Many trees are enormous, and climbers are obliged to work their way to the very tops and to the farthest stretch of the highest limbs. While propped, pinned, or leaning to get in the whacks, the **chabuk**-wielder must often receive the blows of the chestnut pods as they fall since they are not at liberty to dodge or block, so tenuous is their position.

The fruit of each tree are collected separately in order to begin the sorting which maintains the categories of large, medium, and small nuts as well as nuts of strong and light color. This is essential for receiving the best possible price for each category at the market or from the wholesaler. Pods are collected one by one with either gloves or more preferably with a small tool known in Avar as a **masha**. Like tongs, the **masha** stays open until it is squeezed to grab a spiny chestnut pod. The preferred collection sack is the flour sack. The whole pod, husk and all, is tossed in the sack un-separated from the nut. Each sack is stuffed to maximum capacity, and the total number of sacks in a day can be noted and used to estimate the amount harvested. When all is said and done, each sack contains about 6 kg of sellable nuts.

Postharvest

Sacks are carried to a piling place chosen for its cool shady qualities, its dryness, and its concealment from other villagers. These piles are a further step in sorting. Large nuts go with large, small with small, robust color with robust color, etc. Each sack is considered uniform and is dumped on a pile. As shown in Figure 3, these piles should be transported and combined with other piles in a location which is deemed more secure and under closer watch. However,



Figure 3. Grower and chestnut pile in Azerbaijan (A), stashing a chestnut pile under ferns (B), and using the **chabuk** (C).

this is particularly a challenge for collection activities that are arranged in more distant and wild chestnut groves. For this purpose we have seen the help of a truck driver enlisted.

The piles will remain in their final location after undergoing a specific storage procedure. Piles are covered in ferns (*Matteuccia struthiopteris* (L.) Tod.), as is shown in Figure 3B. This layer of ferns should amass to about 60 cm thick. Ferns are held in place and the structure of the pile is established with a layer of medium-sized branches. These ferns represent an entire activity in their own right as they must be wild-harvested soon before or at the same time as the chestnut piling. Respondents maintain that this work may be performed by men or women.

There are two clear reasons given for the piling of chestnuts in this way. One, piling and covering eases the work as the husks fall off by themselves and at the time of final collection for sale they are easily separated from the nut with the use of a special raking process. Two, this storing procedure maintains the product while prices rise slowly around the country.

Sale and use

Recent years have been characterized by an especially high price for the chestnut. This is no doubt partly due to chestnut blight decimating national yields. Consequently, the vast majority of the harvest documented in this work was destined for market and not for home consumption. Fortunately, most research participants would talk excitedly about those times when the sale price for chestnut was so remarkably low that it was the prerogative of each

family to cook chestnuts for home consumption in a number of different ways.

The distribution mechanisms of chestnut in the Azerbaijani market would look familiar to one with experience of an Azerbaijani bazaar. The vast majority of produce of all research participants was sold in the domestic markets of Azerbaijan, and not a single interviewee knew of their product leaving the Caucasus. Middle-men (*ara adamlar*), characterized by their empty Lada or Volga sedans with mounted steel racks on the roofs, arrive in villages at the early onset of chestnut collection and knock on gates or call in the streets. This continues throughout the season. All households ideally hold onto their product and await the predictably high prices around the New Year celebrations. However, nuts already separated from the husk at time of harvest and nuts of lesser quality and size are eligible for early sale. Furthermore, many cannot afford to wait and happily accept the ready cash. Less than one-third (7 out of 22) of respondent households sold their chestnuts at this low rate, most likely due to acute financial need.

Results clearly show major importance of chestnut-based income to households in these two towns (Figures 4, 5). Average chestnut sales per household were 2997 AZN in 2010 (1 AZN = 1.25 USD in 2010). This figure was much higher in Jar than in Chinarli with sales of 4450 AZN and 1254 AZN, respectively. The average household in both villages included 4.5 residents, resulting in a per capita income of 666 AZN (~832 USD) in 2010 from chestnut sales.

Chestnuts contributed 39% of the total income recorded in both villages, though when disaggregated this figure is

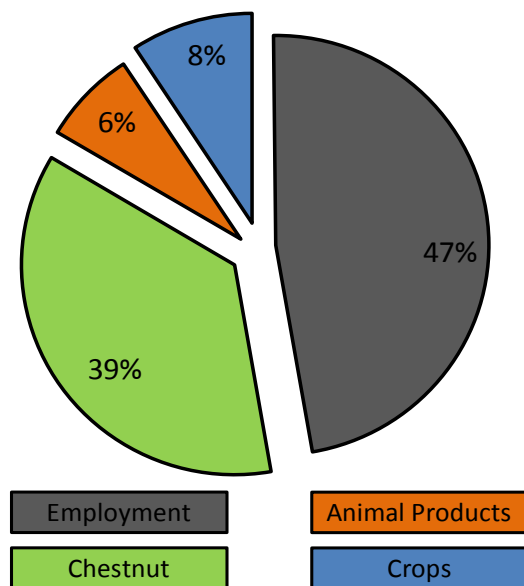


Figure 4. Total community income breakdown for 2010 by income type ($N = 22$) in study villages in Azerbaijan.

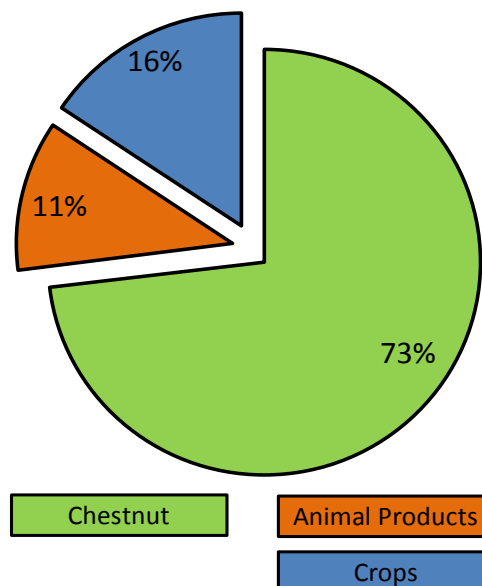


Figure 5. Breakdown of total 2010 agricultural income ($N = 22$) in study villages in Azerbaijan.

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higher in Jar (45%) than in Chinarli (24%). Of total annual agricultural income, chestnut represents more revenue than any other agricultural product in these two villages. Within the agricultural portfolio, chestnut income composes 73% of all agriculturally-related income, 81% in Jar and 52% in Chinarli. All other crops combined make up just 17% of the total annual income of these two villages.

An assumption that the more financially disadvantaged homes are more dependent on chestnut-based income is not supported by these results. Those homes with higher employment-based incomes sell more chestnuts. Figure 6 shows that on average, chestnut income is a larger proportion of total income in those homes where more than two people earn non-agricultural income (41%) than in those homes where one or fewer persons earn non-agricultural income (35%). Here it is important to address the question as to whether this is a factor of available labor within the household. This appears unlikely as the average number of people living in households with two or more sources of employment-based income (4.6 people

per household) differs only slightly from households with zero or one source of employment-based income (4.3 people per household).

The data also suggest that chestnut income represents a larger proportion of total income in those homes that earn more than 6000 AZN per year than in those homes which earn less than 6000 AZN per year. This is also not likely a factor of the number of people in the household as the average number of people living in households with income more and less than 6000 AZN is, respectively, 4.7 and 4.2.

Larger family networks can consist of several households which together own a certain number of trees and lay claim to harvesting rights in certain areas farther afield. From all these resources, chestnut harvesting activity is apportioned according to social norms. Primarily, the right to harvest farther afield in more difficult terrain is apportioned by a decision-making process of each family group. Some families collectively agree to forgo their right, possi-

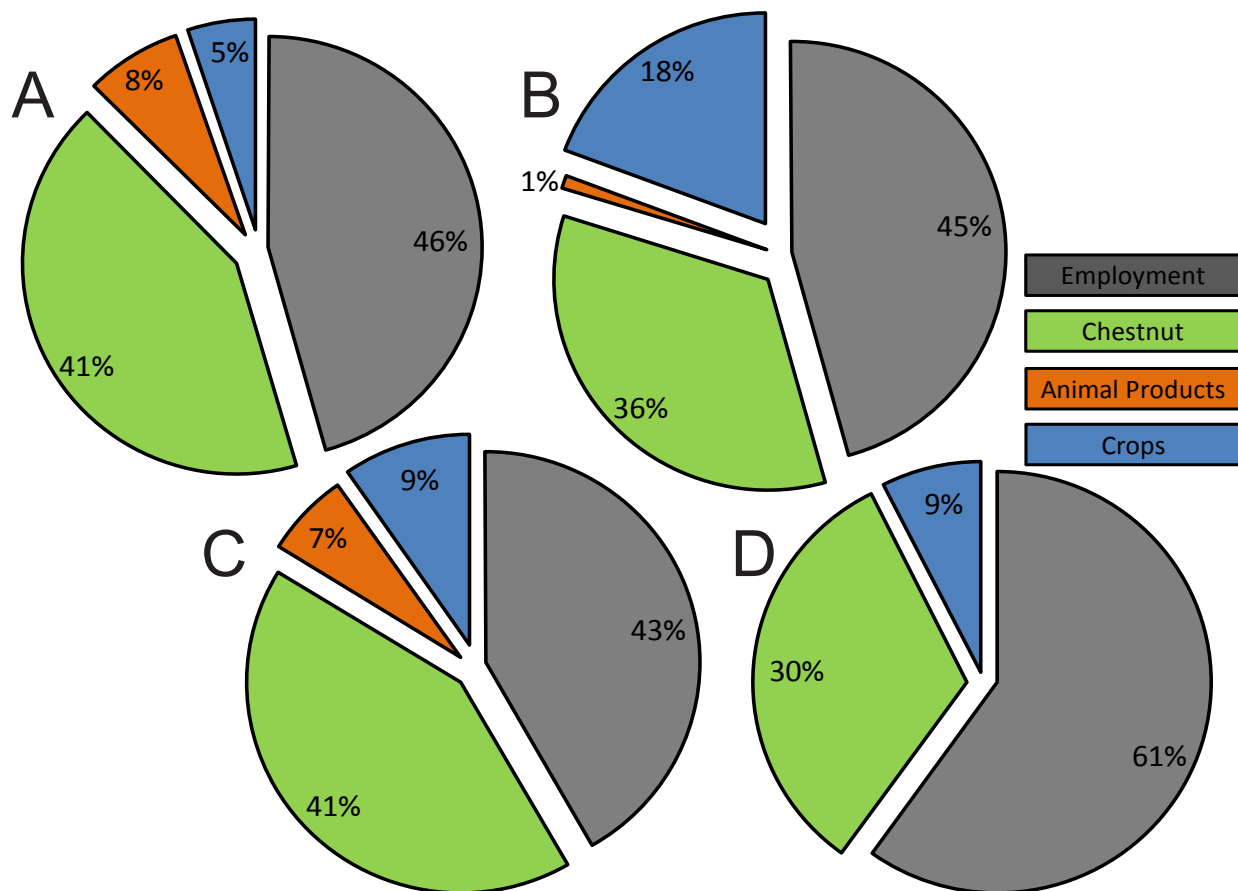


Figure 6. Household chestnut sales as a factor of employment-based income and total annual household income in study villages in Azerbaijan. (A) Homes with 2 or more employment-based incomes ($N = 12$). (B) Homes with 1 or no employment-based income ($N = 10$). (C) Homes with >6000 AZN annual income ($N = 13$). (D) Homes with <6000 AZN annual income ($N = 9$).

bly due to time and labor constraints. There is no evidence that larger family groups forego their collecting rights due to lack of need. However, between households in a larger family group, as Figure 7 shows, families where the average child age is 5–10 years harvest more chestnuts. Whether they are encouraged to harvest more chestnuts or whether they are simply allowed to by the larger family has not been determined. However, no evidence suggests that those in need within a community tend to harvest more chestnuts. This suggests it is socially appropriate for families with younger children to express more ambition and maximize their chestnut sales. Likewise, Figure 7 shows that at the twilight of retirement, older couples with children between 30 and 35 years of age access and sell more chestnuts.

Discussion

Results indicate that chestnut production clearly presents a profitable use of time when compared to non-agricultural employment. It is critical to recognize that the only intensive labor requirements for chestnut production fall

within a three- to four-week window around the mid-Fall harvest time. Using the figure of 1.35 sacks/human-hour (Wall 2012) and utilizing the local knowledge that a single sack of chestnuts in the husk reliably yields 6 kg of sellable nut, we calculate an average harvest rate of 4.44 kg/hr (Wall 2012). This rate combined with the average 2010 price of 3.36 AZN/kg shows an hourly-earning of nearly 15 AZN/hr. Again the average 2010 income from chestnut for research participants was 2997 AZN. An average teacher salary based on participants in this research was 2720 AZN/yr or 3.8 AZN/hr. Other average salaries from the participant pool include that of truck drivers at 7200 AZN/yr and firemen at 4,800 AZN/yr.

Important questions remain regarding the socio-economic fabric of a community characterized by such economic heterogeneity. What can account for the disparity in chestnut-based incomes? Why are the poor less engaged in harvest or wild collection? In 2009, what conditions enabled a single household managing 0.6 ha to earn 14,400 AZN more from chestnut and 17,000 AZN more in total than a household which manages 2 ha? The dif-

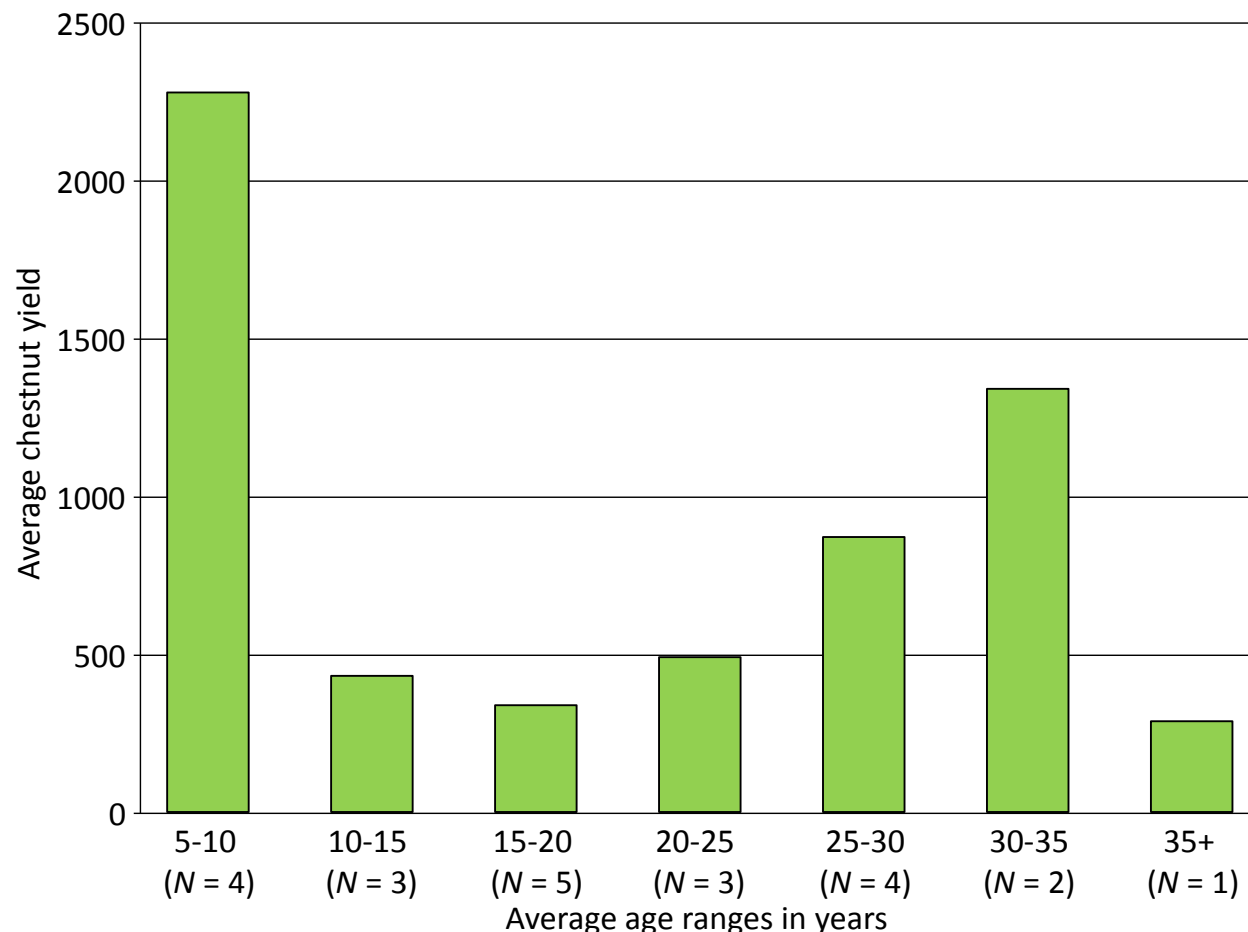


Figure 7. Chestnut collection by household as a factor of average age of children in that household in study villages in Azerbaijan.

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ference between the highest income derived from chestnut (15,000 AZN) and the lowest (67.50 AZN) is considerable and cannot be attributed to the size of landholding. Again, kinship networks make the difference. Traditionally, homes are inherited by the youngest son in the family, who must care for his parents in their old age. This ensures that only certain families occupy land on which chestnuts have been established. The existence of more than 25 highly productive mature chestnut trees on one family's homestead is a tribute to a father or grandfather from whom the land was inherited. Likewise, the paltry presence of a single mature chestnut tree on another family's land is the result of land inheritance patterns or past decision-making, perhaps during a time when the going price of chestnut was *xirda* (small change).

The disparity observed in chestnut-based income is currently acute due to the recent and dramatic increase in the price of local chestnuts which has followed the ravages of chestnut blight, but it points to a remarkably diverse complex of household economic strategies which operate in these rural communities. From these strategies, two patterns emerge. First, it is clear that kinship networks act as a managing unit to direct access and exploitation of available resources. This includes a multi-generational dimension, such as the trees planted by a direct ancestor and the inheritance of harvest rights. It is also very real in day-to-day and annual decision-making. This is evidenced by the higher collection rates of families with children between 5 and 10 years of age. Similarly, it is likely that older households whose older children have moved away pass on their collection rights to households with more immediate and substantial food requirements.

Second, based on the observation that wealthier households collect and sell more chestnuts, there is an observable barrier to entry in the chestnut market that is based in activities conducted in the past and inheritance patterns. This barrier to entry is characterized by the access to productive trees which were established 25 or more years ago by elder or past generations. The same is true for the access rights to particularly privileged collection sites; these are also inherited from elder and past generations and prescribed annually to particular households based on family decision-making. Additionally, in communities where chestnut trees are commonly established on the property of the home, the local adherence to ultimogeniture, or inheritance by the last born, ensures that youngest sons and their families enjoy much more access to older established trees and the larger harvest they provide.

Without a legacy of established productive trees or a persistent practice of collection, it is less likely that a household will have an abundant supply of chestnuts to sell or eat, though it can contribute to its next generation by planting more chestnut trees.

Socio-economic conditions encourage the implementation of *in situ* conservation of *Castanea sativa* in Azerbaijan. The high demand for chestnut in Azerbaijan continues to drive farmer incentive to continue cultivation, collection, and sale of this traditionally important crop.

Efforts to treat trees with a biological control will likely meet with enthusiasm from tree owners. Currently hypovirulence application is the only option which meets the criterion for a desirable intervention that villagers stipulated in community meetings: that first, chestnut cultivation should remain the primary land use strategy in their territory; and second, the unique and locally preferred chestnut varieties must remain viable (Wall 2012). When asked, many farmers expressed willingness to engage with a fee-based inoculation program, claiming that the high value of productive chestnut trees was a worthy investment.

To ensure the successful genetic conservation of European chestnut in its center of genetic diversity, indigenous knowledge of chestnut diversity, of both domesticated and undomesticated varieties, must be explored and taken into account. The level of actively conserved intra-specific variation may be a factor of the range of farming practices into which any one species is incorporated (Kanowski & Boshier 1997). This range is broad indeed in Azerbaijan as cultivation is practiced in many ways. This includes but is not limited to growing saplings from seed, raising young trees in nursery-like conditions, grafting with indigenously managed superior stock, and wild seasonal harvesting from favored "wild" specimens, seemingly undomesticated varieties in the natural forest community. The knowledge of the primary custodians of chestnut germplasm in the Caucasus will be essential to the application of hypovirulence or any other biological control measure against *Cryphonectria parasitica* and to targeted conservation of the genetic diversity of the European chestnut.

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