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Role of fruit in the livelihood among smallholders in Arba Minch area, Ethiopia

BACHELOR'S THESIS

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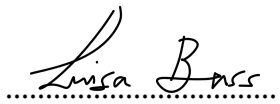
Declaration

I hereby declare that I have done this thesis entitled "Role of fruit in the livelihood of smallholders in Arba Minch area, Ethiopia" independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague, 15. April 2022



Luisa Buss

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Abstract

Smallholders in Ethiopia continue to struggle to improve their livelihoods. The actions made toward agriculture development are still insufficient to cover food, nutrition, and cash security. Most rural households rely on homegardens for subsistence and sell surpluses at the market. Grain and tuber crops are cultivated in significantly larger quantities than higher perishable crops, such as fruits. Fruits are highly nutritious and have a greater market value. However, when compared with neighbouring countries, fruit consumption and production remain alarmingly low. Little is known about what holds Ethiopian farmers back in engaging in the fruit sector, particularly integrating fruit trees in their homegardens. The study intended to bring more evidence on variables that influence fruit crop cultivation in homegardens, mainly by documenting the production and utilisation of fruits among smallholders in Arba Minch. Data were collected through interviews with key informants and semi-structured questionnaires among 50 farmers in Arba Minch, Ethiopia. Data were statistically analysed using excel and SPSS software. The results confirmed that most fruits are produced for the market and that farmers are significantly aware of nutrition benefits and ecosystem services, but the labour intensity and market barriers translate into a perceived challenging sector. Farmers, households, homegarden characteristics and farm calendars were described to capture the typical features of the sample, which fell into the national norm. Lastly, we proposed a farmer profile that perceives fruit selling as more effortless. Conclusions were based on farmers' estimations and not measured empirically, which could be a limiting factor. This work suggests further research in market chain development, gender roles influencing engagement and local fruit species.

Keywords: homegardens, perceptions, selected fruit species, market chain

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CSA Central Statistical Agency

ESS Ethiopian Socioeconomic Survey

FAO Food and Agriculture Organization

1. Introduction

The foreseen population growth amplifies the urgency of transforming food systems to achieve the world's development goals (Godfray et al. 2010). Agriculture development has been pinpointed as a key tool to reduce poverty and hunger (FAO 2014). Smallholder agriculture accounts for one-third of the world's food supply and is the primary source of livelihood in the global south (Lowder et al. 2021). In the last three decades, agroecological-based strategies have attracted much attention to develop better land-use systems (Pretty 2008; Leakey 2017). Homegarden farming is one approach that has been noted to be promising for rural livelihood improvement. Homegardens are a land-use system where households intensively cultivate multipurpose crops in a small plot close to the house primarily intended for subsistence (Sinclair 1999). While there is much debate on tackling food security, the multiple arising outcomes of homegardens encourage its development.

Fruit consumption and production have a significant effect on rural households. They are nutrient-rich and high-value crops, which make them substantial in times of food, nutrition, and cash instability. Current trends also show that the global fruit demand is growing, which increases the need to enhance the marketability of fruit and fruit-derived products and the linkages between producers and consumers (Ruel et al. 2005; Worku et al. 2016). Moreover, fruit trees are valuable elements to incorporate into the homegarden. Households are provided with various ecological, economic, social and aesthetical functions, as multiple goods can be obtained (Franzel & Scherr 2002).

Nevertheless, smallholders' engagement in fruit cultivation is lower than that of agriculture enterprises, as it is perceived as riskier than stable crops (Dorosh & Minten 2020). Disinformation about the value of fruits and missing resources to produce appropriately, harvest and handle the highly perishable produce are the most common barriers (Nigussie et al. 2019; Mossie et al. 2020). FAO declared that 2021 is the year of fruits and vegetables to increase awareness, investigation, and investment in fruit supply (FAO 2020). Indeed, this emphasises the current relevance of fruit.

Notably, Ethiopia has agriculture development high on their agenda (Development Assistance Group Ethiopia 2020). As the second most populous African

country, around 103 million, and with forecasts of doubling by 2060, expanding food systems to cater current and future demand is urgent. Despite being one of the continent's fastest-growing economies, with annual GDP growth of about six per cent in 2020, high undernourishment and poverty rates burden the nation. (Central Statistics Agency of Ethiopia 2020; Dorosh & Minten 2020). More than two-thirds of the population depends on agriculture for their livelihood, and almost 74 per cent of the farmers are smallholders, cultivating on average 0.8 hectares of land. Smallholders have also the highest poverty rates, as 67 per cent of them live below the national poverty line (FAO 2018). Fruit production is behind, unable to meet the growing demand, and is alarmingly low fruift consumption. Fruit production represents only 3 per cent of the total production, and per capita consumption is around 0.4 servings a day instead of the five recommended by WTO (Central Statistics Agency of Ethiopia 2020; Dorosh & Minten 2020). Thus, it is vital to increase smallholders' engagement in the fruit sector and the population's overall attitudes towards fruits. So far, only a few studies have reported on the specific role of fruits in homegardens. Developing strategies to increase fruit production could significantly improve food and nutrition security and generate additional income for smallholders in Ethiopia. Eventually, this could lead to increased livelihoods and a structural change in rural communities.

This research focuses on fruit production, utilisation, and general perceptions of fruits and fruit trees in Arba Minch, Ethiopia. The research design is quasi-experimental. Thus, the literature review will be non-systematic. First, Ethiopia's agriculture will be described, then the importance of smallholders, followed by the importance of fruits consumption and the aspect of fruit crops in homegardens. Afterwards, collected data from the study area Arba Minch will be described, analysed and discussed with the support of the current scientific literature.

2. Literature review

2.1. Ethiopia's agriculture sector

2.1.1. Agriculture production and transformation

Crop production leads Ethiopia's agriculture, but agroecological conditions constrain production patterns. Crop outputs represented nearly 80 per cent of the agricultural GDP growth between 2004 and 2016, of which cereals accounted for more than half. Notably, 73 per cent of the total cultivated area is occupied by the five dominant cereals: teff, barley, wheat, maize, and sorghum. They held around 10.4 million hectares and about 27.8 million tonnes in 2018, and maize is a primary growth driver. The smallest share of the cultivated area goes to fruit crops. In 2019, about 0.1 million hectares were occupied by fruits and the output was about 830 thousand tonnes, the second-lowest group before oilseeds with 790 thousand tonnes. Fruits have had a 12 per cent annual growth rate since 2010, but with only a few farmers (Dorosh & Minten 2020).

Ethiopia's agriculture output improved substantially in the past two decades, although the movement out of agriculture remains slow. After the implementation of several successful development strategy plans, namely Agricultural Development Led Industrialization (ADLI) in 1994, the Sustainable Development and Poverty Reduction Program (SDPRP) in 2002 and the Comprehensive Africa Agriculture Development Programme (CAADP) in 2009, the investments started to flow into agriculture. This led to a high debt to GDP, 60.3 per cent in 2016/2017, and considerable improvements in infrastructure, agriculture productivity and market efficiency. This influenced road construction, fertiliser use, agriculture extension services, improved seed distribution, and increased cultivated land and labour inputs, which boosted yields, trade and food processing (Devereux 2000; Christiaensen & Demery 2018). The annual growth of the real agriculture GDP is still significant but slowing down. From 2006 to 2011, it was about 7.8 per cent. From 2011 to 2016, about 5.2 per cent and from 2018 to 2019, approximately 4 per cent. The non-agriculture GDP shares two thirds, although agriculture still employs three-quarters of the population (Dorosh & Minten 2020). Under these circumstances, rising rural wages and farmers' livelihoods continue to be a challenge. Hence actions towards smallholder productivity are crucial.

2.1.2. Agroecological regions

Ethiopia's land can be divided into five agroecological zones: dry highland, moisture highland-cereal, moisture highland-enset, humid lowland, and dry lowland. Around 90 per cent of the total agricultural land is found in the highlands, which cover 37 per cent of the country's landmass and is home to three-fourths of the entire population. The country relays predominantly on traditional farming practices and rainfall, which is easier met in the highlands. Across the lowlands, rainfall is inconsistent and insufficient, making this region more prone to vector-borne diseases and affecting the population settlement pattern (Dorosh & Minten 2020). Hence, most farming activities occur in the highlands, where climatic conditions are optimal for agriculture.

2.1.3. Market and value chains

Markets in Ethiopia are not performing well enough, and actions are needed to improve market participation and the competition of smallholders. Around 44 per cent of households reported selling their entire production through informal channels, mainly local markets. Road networks improved substantially, reducing travel times between hubs, but transport costs are very high (Christiaensen & Demery 2018). Price volatility is persistent, but strategies such as contract farming, producer organizations, extension services and mobile phones have increasingly linked smallholders better to markets (Bienabe et al. 2004). Household assets, such as land, livestock, labour, and equipment, are decisive for crop market participation (Boughton et al. 2007). Remoteness is also decisive. Remote households produce 50 per cent less surplus and obtain 60 per cent less food from the market (Dorosh & Minten 2020). Market failure is also a structural problem due to high transaction costs. Financial intermediation, expensive contracts, and weak infrastructure are mainly accountable. Agroecological zones are also decisive for market performance since agroclimatic factors are outside the household's control. Lack of quality recognition lowers the competitiveness of smallholders, especially in urban and transnational markets (de Janvry & Sadoulet 2020). Thus, the priorities lay on decreasing costs and helping farmers reach quality standards while becoming less weather dependent.

Uncompetitive local value chains are commonly held accountable for the increased food import dependency (Rakotoarisoa et al. 2011). Market information

systems and contractual agreements need to be improved to decrease marketing margins and better coordination among farmers, processors, traders, and buyers. Smallholders operate primarily in informal markets, and marketing systems benefit traders more than producers. Traders mostly travel and buy produce at the farmgate or through contract farming, which adds little value to the producers' side. Notably, increased smallholder participation in apple, mango and banana value chains showed significant benefits for rural food security and the local economy (Gebre et al. 2020; Mossie et al. 2020). Fruit is considered a high-value crop, and Ethiopia's agenda includes fruit export as a strategy for development (Development Assistance Group Ethiopia 2020). However, only 3 per cent of fresh fruits are currently exported. Avocados and bananas have the highest potential and go mainly to Djibouti, Somalia, and Sudan, low-end markets. Exports are minor because of the low local production, which is constrained by high production costs and low quality of the produce but exceeds fruit. Dates, apples and grapes are the most imported fruits and come usually from Saudi Arabia, France and South Africa imports (USDA Foreign Agricultural Service 2018).

2.1.4. Agrarian challenges and prospects

One of Ethiopia's core challenges is food insecurity, which diverges into several sectors, including agriculture. Regular food shortages have recently marked the country due to economic decline and inflation through the COVID-19 pandemic, population displacment due to confict, drough and floods, and the recurring desert locust pests. In addition, political tensions burden the country, mainly resulting from bad governance, price volatility, losses of resources, and rising hunger and poverty. Intensification through monocropping and agrochemicals use influenced land degradation, overgrazing, deforestation and improper waste treatment. On a positive note, Ethiopia offers a variety of underutilised resources that could lead to a sustainable boost in agriculture. Climate and soil are very suitable for fruit and vegetable crops. Water bodies represent 0.7 per cent of the country and could resource irrigation throughout the country (IPC 2020; Yigezu Wendimu & Wendimu 2021). FAO stated in 2018 that 2.7 million hectares were under irrigation while 5.7 million hectares could be potentially supplied (FAO 2018). In the long run, development actions could foster Ethiopia's prosperity through agroecological approaches, smallholders integration, and continuous engagement of investors and policymakers.

2.2. Importance of smallholders

2.2.1. Smallholder livelihoods

Smallholders are Ethiopia's primary agriculture producers, and they are recognised as key actors in improving rural livelihoods. Livelihood has been described as a set of characteristics, specifically activities, assets and capabilities that provide a living (Scoones 1998). Overall, smallholders live and work in harsh conditions (Rapsomanikis 2015). As FAO defines, smallholders are farmers that operate on small-scale enterprises that are family owned and are equal to or less than 2 hectares (FAO 2012). Around three-quarters of all Ethiopian farmers are smallholders, which produce around 90 per cent of Ethiopia's agriculture output. At the same time, smallholders are the most vulnerable to shocks and stressors. Crop disease is the most common shock. Around 86 per cent of households reported resulted in income loss and 66 per cent of asset loss. Price fluctuations, weather and health shocks are the following distresses. Mixed crop-livestock systems are the most frequent, keeping 2 TLU as risk-coping strategies (FAO 2018).

The productivity is low and limited due to declining soil fertility, dependency on rainfall, hard access to improved seeds, poor market linkages and extension services (Jama & Pizarro 2008). Only 21 per cent of households use improved seeds, and just 29 per cent receive extension services. To cover household needs, smallholders often engage in off-farm work, representing around 18 per cent of rural household incomes. Smallholder plots are cultivated more intensively. They produce and consume cheaper foods, such as energy-dense crops and deriving goods (Dorosh & Minten 2020). Strategies such as improved crop varieties, crop diversification, agroecological practices, soil conservation, irrigation practices, and additional off-farm activities have been decisive for output improvement. Finally, smallholder agriculture can have a significant impact on nutrition security. By incorporating traditional and new food crops in homegardens, smallholders could increase local food chains' food supply and dietary diversity (IFAD 2013).

2.2.2. Land rights

Smallholders hold 93 per cent of the agricultural land, but the access is limited. With the increased population pressure, slow movement out of agriculture and lack of

land for further agrarian expansion, farmers are constrained in multiple ways. The state owns the land, and holders have user rights for a fixed number of years. Property rights are secured by certificates, which have been pushed by a land certification program that has been one of the most successful in Africa (Deininger et al. 2008). This created a land rental market, where holders transfer user rights to tenants, which is not effectively protected by laws and decreases farmers' autonomy on land management (Holden and Ghebru 2016). Still, farmers are increasingly engaging in renting plots to expand their farmland, accounting for 12 per cent of rented cropland. Land fragmentation, degradation, deforestation and decreasing field sizes have become serious concerns. The average crop area declined from one hectar per farmer in 2004 to 0.85 hectar in 2016 (Headey et al. 2014).

2.2.3. Rural households

The average household size in rural areas consists of 5.2 members, of which the dependency ratio is 92 per cent. This is mainly due to the young rural populations driven by higher fertility rates. Members of working age, between 15 to 64 years, account for 54.3 per cent of the population. Subsistence agriculture is the primary source of income, employing 97 per cent of males and 56 per cent of women. Farming instruments are mostly traditional such as ploughs, axes and sickles. Machinery such as water pumps and carts are owned by less than two per cent (Central Statistics Agency of Ethiopia 2020). Ethiopia falls into the low human development category, with a value of 0.485 in 2019. Progress was made in each indicator. Notably, expected schooling years went up to 5.7 years. The gender inequality index measured 0.863, and females' participation in the labour market is 73.4 per cent, as opposed to 85.8 per cent of males (UNDP 2020). Despite being still disadvantaged in most household and farming decisions, women have been noted as the silent drivers of change, such as overland and trees (FAO 2013). However, in Subsaharan Africa, women tend to be more active in selling produce. Research shows that women undertake most of the activities while having less chances in the labour market, access to credits, extension services, and farmers' groups. Women are also often more aware of tree benefits, which have been linked to increased household food consumption and health, as they tend to care more about their household members' well-being (Kiptot & Franzel 2012). Ethiopian women continue to be underprivileged. Thus efforts to enhance women's participation in value chains should be strengthened.

2.3. Importance of fruits for food and nutrition security

2.3.1. Food supply

Food and nutrition security is achieved when all individuals have reliable access to enough safe, affordable, and nutritious food that they know how to prepare and appropriate to live a healthy life (FAO, IFAD, UNICEF, WFP 2021). In 2020, more than half of the population, around 55.1 per cent, was estimated to be food insecure, and there was a 5.9 per cent increase at a severe level compared to the previous year. Supply is strongly affected by seasonality. The population is more food scarce from June until September, which is also the planting and dry season (Central Statistics Agency of Ethiopia 2020). In the last twenty years, Ethiopia made signs of progress. Malnutrition decreased one third, from 58 per cent to 38 per cent, and underweight almost to half, from 41 to 24 per cent. However, wasting rates only declined two per cent. Individual nutrient intake is still insufficient, and studies have shown that poor nutrient diets strongly impact the immune system, increasing infection rates and inducing wasting. Rural diversification is essential for the long term improvement of livelihoods. Other factors linked to higher food security are developments in agriculture, namely farm size and yields, off-farm activities and population settlement shift (Devereux 2000).

2.3.2. Consumption patterns and trends

Monotonous diets are closely associated with the lack of agri-food system diversity. The typical Ethiopian meal is composed of just three food types: cereals, edible oils or animal fat, and legumes such as beans and lentils. Rice, sorghum, barley and wheat are the most consumed food items. Research on weekly food patterns reported that 92 per cent consumed at least five times of these cereals a week, followed by teff with 48.5 eating six times a week. Fruits are one of the least consumed food items on the national scale. Only 33 per cent of households consumed fruits on average two times a week (Central Statistics Agency of Ethiopia 2020). Consequently, micronutrient deficiency is high, especially in women and children. Vitamin A, zinc, and calcium are significantly below the recommendation. Understanding consumption patterns is essential to promote improved food systems and public health initiatives to alleviate existing nutritional deficiencies (Ethiopian Public Health Institute 2013). However, eating habits are shifting

toward high-value foods due to the fast economic growth (Worku et al. 2016). Urban areas stand out as food systems have adapted to a more diverse diet, and fruit consumption has risen. Simultaneously, price elasticity is high, hindering the public access to a healthier food basket. From 2007 to 2016, nutrient-rich food prices increased from 19 to 62 per cent. However, starches did not show any substantial change and oils, fats and sugar prices decreased. (Bachewe & Minten 2019). The average household spends around 11 per cent, and the poorest 27 per cent of their income to meet the recommended nutritional amount of fruits and vegetables. This means that healthy diets are generally out of reach for most households. One way to decrease prices is if more producers engage in fruit cultivation (Hirvonen et al. 2018). Homegrown fruits are also positively related to increasing consumption at the household level. Together with behaviour-change and nutrition-sensitive agriculture approaches, consumption may rise.

2.4. Integrating fruit crops in homegardens

2.4.1. Distribuition in homgardens

Homegardes are traditional production systems around the homestead, where multipurpose perennials are cultivated with annual crops and livestock. This diversity assumes the utilisation of different species that offer several complementing functions. As a result, resources such as nutrients, water, and light are utilised more efficiently. Homegarden systems are suggested to have the capacity to support populations up to 500 km² per capita. However, there is a general shift towards a uniformisation of land systems to cash crop oriented systems, focusing on yields and less on nutrition and agrobiodiversity (Kumar & Nair 2004). In Ethiopia, this farming system is most commonly found and constitutes one of the primary means of living, increasing farmers' food and nutrition security. The most common fruit crops are bananas, representing around 67 per cent of total output, followed by mangos and avocados with 14 and 10 per cent, respectively. Other significant crops are papayas, oranges, lemons, guavas, and pineapples (USDA Foreign Agricultural Service, 2018). More than 30 per cent of tree species of farmland are currently exotic, negatively affecting indigenous multipurpose trees such as gishta and citron. The strong emphasis on exotic fruit species has been appointed as a downside of the increased integration of fruit trees (Lelamo 2021).

2.4.2. Benefits and constraints

Advantages of practising homgarden farming are mainly in the low use of inputs, cheap fooder, reuse of manure, recycling of nutrients, and a consistent and diversified harvest that supports household nutrition. Additional ecosystem services were linked to environmental deterioration resilience. Integrating fruit crops in homegardens can lead to valuable outcomes that enhance farmers socio-economically and significantly provide ecosystem services (Kumar & Nair 2004). More specifically, one study analysed the distribution of fruit crops and the contributions to farmers' livelihoods depend on wealth categories. They found a substantial increase in smallholders' income of 25 per cent for poor households, 23 per cent in medium and 5.16 per cent for wealthy households. The primary production constraints are limited access to improved seeds, low awareness of appropriate farming practices, post-harvest losses, pests and plant diseases (Adane et al. 2019). A different paper assessed lower gains, stating that fruits and vegetables contributed around seven per cent to the total income. The lower gains resulted from crop diseases, market access, and animal damage issues. However, they discovered that household consumption increased when farmers cultivated more fruits in homegardens. This also decreased pressure on forest plants and was evaluated as an efficient conservation approach (Mathewos et al. 2018). Different papers reported that the primary production constraints were insects and diseases due to the lack of cooping strategies and household size. Marketing supply chains and distribution margins also limit farmers' participation (Nigussie et al. 2019; Mossie et al. 2020).

2.4.3. Perceptions and attitudes

Factors that increased the chances of integrating apple trees were market distance, access to extension services, and levels of education, indicating farmers' better adaptation and opportunity engagement. Additional experience in fruit cultivation and increased off-farm activities were also linked, as farmers had more income to allocate and afford fruit seedlings. Interestingly, apple farmers seemed to take the risk of insect pests and plant diseases instead of decreasing production. (Parwada et al. 2010; Nigussie et al. 2019; Mossie et al. 2020). Perception of risk, that is, the willingness to invest and take on

activities, substantially impacts farmers' decision to enter or exit the fruit sector. Some farmers perceive fruits as risky because they are sensitive crops during the growing season due to the risk of being ruined by droughts, floods, heavy rainfall, diseases and insect pests. Similarly risky are the post-harvest losses, due to unsuitable harvesting and handling practices. However, farmers were more tolerant and positive towards fruit cultivation, with increased income, off-farm activity, education, capital and experience: the land ownership and land size (Ullah et al. 2015; Agussabti et al. 2020). Research on farmer-managed natural regeneration in Ghana discovered several perceptions and attitudes towards trees cultivated in farmland. The results showed that farmers reported gains in diverse livelihood aspects with the increased engagement in the regeneration and planting of several tree species. What stood out was that most non-economic outcomes added more value to farmers' livelihood than the actual gains in production and income. Tree stocks were perceived as the leading benefit, improving houshold resilience against seasonal stressors. The resulting shade and fooder helped to improve the livestocks conditions during the dry season, and timber could be monetized. The second advantage related to houshold consumption. Attitudes towards wild foods were translated into increased the consumables, contribuiting to diversified diets and increased health. The third major benefit affected the psycho-social welbeing of the farmers. They reported higher satisfaction and peace-of-mind, derived from the aesthetically pleasing farmland that made them feel more optimistic about the future. Laslty, improvments were precieved regarding the quality of the soil and the surrownding crop outputs (Weston et al. 2015).

3. Aims of the Thesis

The literature review states that Ethiopia's farmers are not sufficiently attracted to fruit production, although the country displays suitable agro-climatic conditions. Increased fruit production could substantially benefit the rural economy and cover dietary needs. Hence, the main objective of this work was to document the production and utilisation of fruits among smallholder farmers in Arba Minch. To achieve this aim, four specific objectives were outlined as follows:

1. Identify what species are grown and how they are utilised.
2. Document perceptions and attitudes towards fruit crops.
3. Capture homegarden and socio-economic characteristics of farmers.
4. Understand the potential association between variables described before and the perception of selling of fruits in order to propose a farmers profile that seems more likely to engage in fruit cultivation.

4. Methodology

4.1. Study site

The selected study area is in Arba Minch Zuria woreda (district), which belongs to the Gamo Gofa zone of the Southern Nation Nationalities and People's Region (SNNPR) (Figure 1). The largest city in this district is Arba Minch, the second-largest city of the region. Arba Minch is approximately 500 km south from the capital Addis Ababa. Arba Minch woreda has a total population of around 165,680 (Federam Democratic Republic of Ethiopia Population Census Commisssion 2008) and is expected to grow up to 829,182 in 2035 (Dorosh & Minten 2020). Arba Minch has a high potential for fruit cultivation and is known as the main banana region. Other important crops are mango, papaya and lemon (USDA Foreign Agricultural Service 2018). Production of tropical and subtropical fruit species is high because of increased demand and favourable agro-climatic conditions. It is estimated that this area contributes 135,000 tonnes which is around 10 to 15 per cent of the national fruit output. Arba Mich supplies predominantly

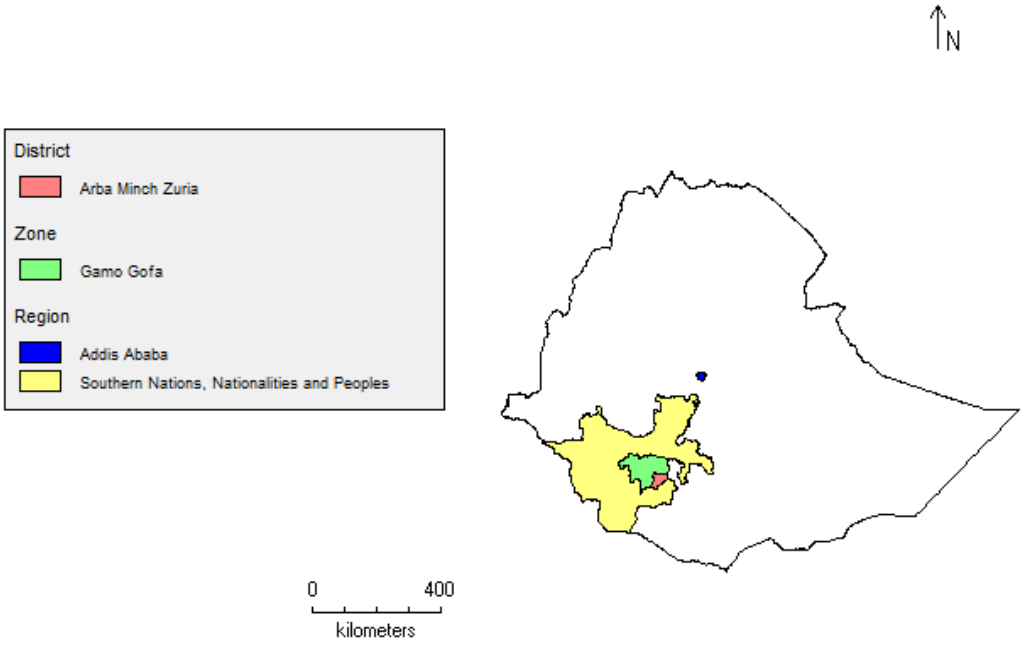


Figure 1. Representation of selected study area Arba Minch, Ethiopia.

to the domestic market, as most smallholders do not meet international market quality standards (Maňourová et al. 2020).

Arba Minch lies within the Southern Ethiopian Rift Valley system and classifies it as a semiarid zone. The climate is tropical, "belonging to the equatorial savannah with dry winter" (Figure 2). The temperature varies between 15ºC and 30ºC, and the average precipitation level is approximately 800 mm per year. The rainy season starts around March until May, named Belg, and again in September and November, known as Bega. The soils are mainly vertisols, which means rich in clay, high capacities in water retention, rich in potassium and have a neutral or alkaline PH. Rainfed farming with this type of soil is difficult, but the district is surrounded by two lakes, Chamo and Abaya, which supply quality water for irrigation (Gebre et al. 2020; Maňourová et al. 2020).

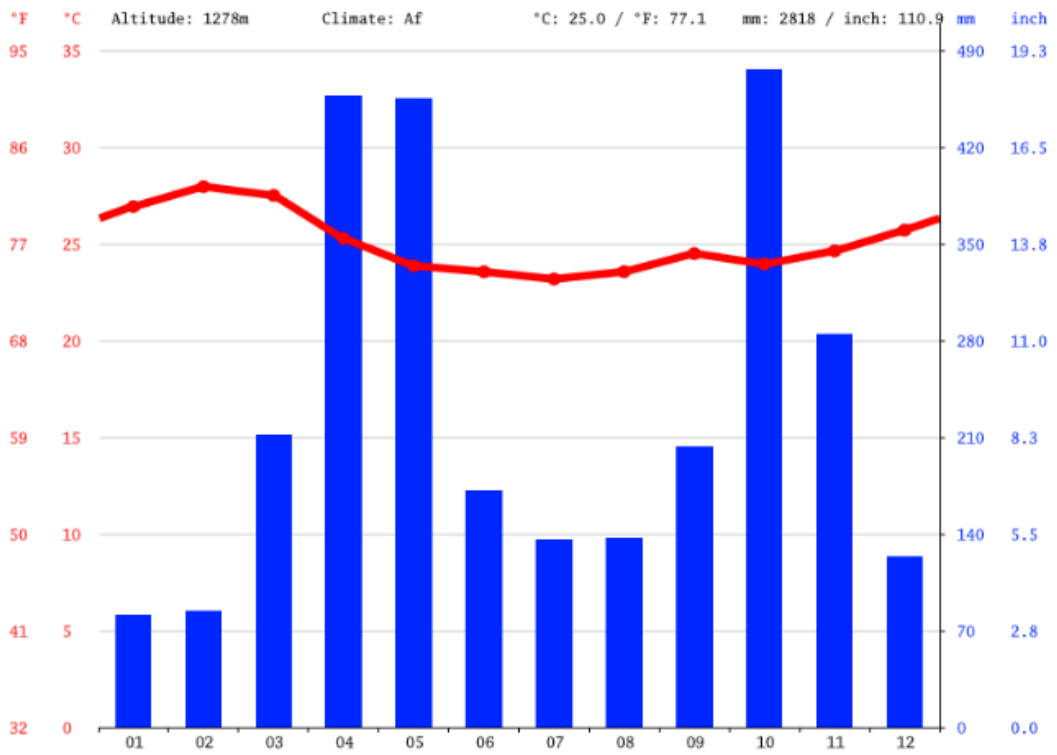


Figure 2. Average temperatures and rainfall of Arba Minch Zuria.

(Source: Climate Data 2019).

4.2. Data collection methods

Data used in this study were retrieved in cooperation with the Czech ODA Project called "Implementation of fruit value chain for improved nutrition and health" in Arba Minch

Zuria, Ethiopia. Primary data were collected using mixed methods. First, in November 2021, interviews with key persons were conducted to identify the main fruit species found in the study area. To easily identify and access fruit growers, key persons were selected based on convenient sampling. Secondly, data were collected by the local team through semi-structured questionnaires during January and March 2022. Respondents were purposefully chosen based on classifying as farmers that cultivated fruits in their homegardens. A total of 50 households was selected from three different kebels (villages): Chano Mile, Chano Doriga and Chano Cheliba.

4.3. Survey design

The semi-structured questionnaire was composed of quantitative binary, Likert-scale and open-ended questions. Each questionnaire consisted of six sections with a total number of 66 questions. The first section captured the household head's background and experience with fruit cultivation. The second section focused on the socio-economic background of the household, including acquiring and utilisation of fruits. The third section assessed the knowledge and awareness of each fruit species and the management practices during cultivation and after harvest. The fourth section gathered homegarden characteristics and frequency of crop ruining shocks. The fifth section focused on the farm calendar, capturing the months farmers experienced resource shortages and significant harvests. Lastly, the sixth section evaluated the perception and attitudes towards fruits and fruit trees affecting the agroecosystem, social well-being and production aspects. Before the handout, the questionnaires were discussed and tested with key persons.

4.4. Data processing and analysis

Data from the collected questionnaires were entered into excel software by the local team. Then we proceeded with data cleaning and coding in excel and statistical analysis in SPSS software. Data analysis was conducted in two steps. First, data were analysed using descriptive statistics. Graphs and tables were put together to fulfil the first, second and third objectives. These were the following: fruit species and utilisation, perceptions and attitudes, household, household head, homegarden characteristics, and

farm calendars. Data were statistically analysed and tested with the nonparametric Mann–Whitney U test for the fourth objective. This test was considered appropriate because the sample size was relatively small, some variables contained nominal data, and the comparison revealed whether there was a difference between the two population distributions.

5. Results

5.1. Grown fruit species and production aspects

In the first stage, the interviewed key informants predefined nine fruit species that were common and promoted in that area. However, only seven were found in the respondents' homegardens. Figure 3 shows the cultivated fruit species and the distribution among respondents. Mango, banana and avocado were the most common fruit crops, with around 94 %, 80 % and 70 % of farmers owning at least one fruit tree. On average, farmers cultivated three different fruit species. The primary point of sale was the local market, with 66 %, followed by the farmgate with 20 %, other means with 10 %, and a middleman just 4 % (Figure 4).

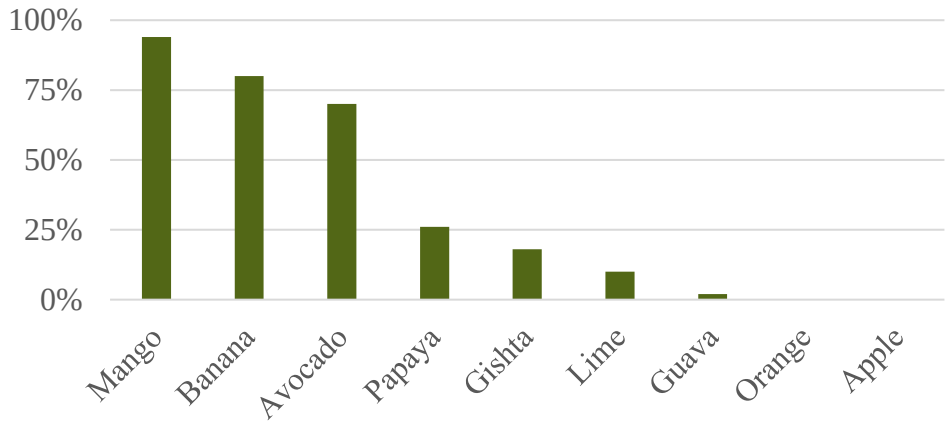


Figure 3. Fruit species found in homegardens of respondents (n = 50).

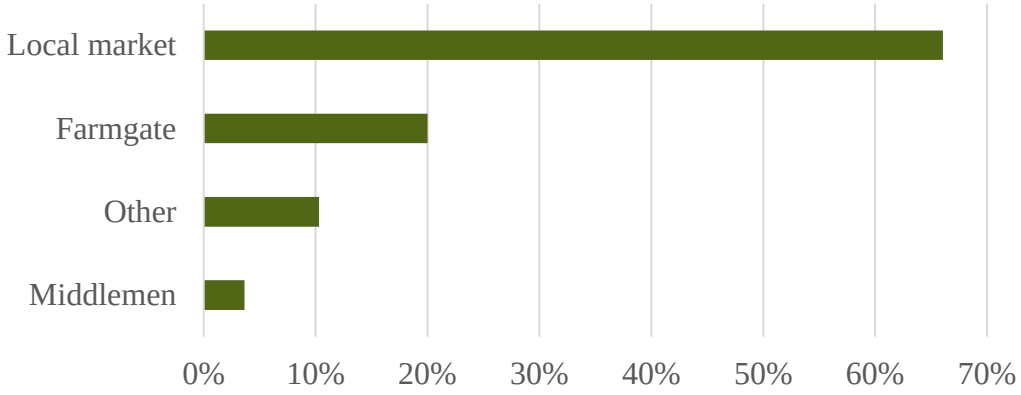


Figure 4. Usual point of sale of selected fruit species reported by farmers (n = 50).

Table 1 displays the production aspects of the seven predefined species. Banana trees were the most abundant crops, with an average of 671.03 trees cultivated per farm, followed by mango with around 19 trees and avocado with approximately 4.97 trees. Correspondingly, bananas led with an average harvest quantity of 18,082.05 kg per farm. Mango accounted for 7,269.85 kg and avocado for 120.91 kg. For all recorded fruit species, most of the production was sold, for instance, around 16,964.10 kg of banana, about 6,990.07 kg of mango and approximately 77.61 kg of avocado.

Regarding the decision-making power over fruit trees, most households stated that men were responsible for choosing the species to plant. Men were more in charge of tree maintenance. However, gishta was appointed more to women, and guava and lime were shared between both genders. In contrast, most selling decision power of harvested fruit produce was appointed to women.

Family tradition and government extension services were pointed out as being the primary source of discovery for most species. Mango and papaya emphasized the project's effect with a higher share of extension, while guava, lime, and gishta were mainly passed on by family customs (Figure 5). Fruit handling, apart from selling, was relatively infrequent. Only 8 % of the households indicated storing fruits at home and only 4 % engaged in fruit processing and preservation activities.

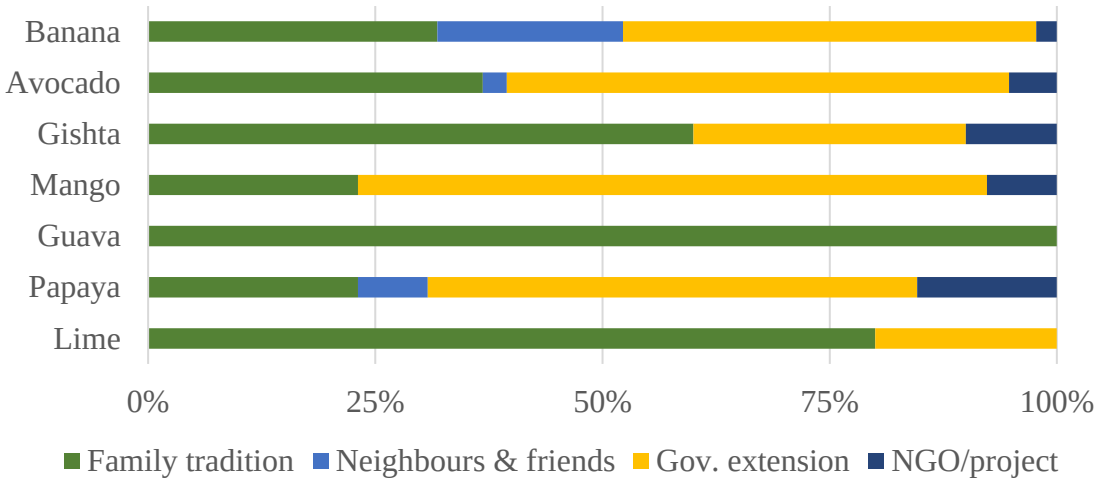


Figure 5. Knowledge sources of each fruit specie integrated by farmers (n = 50).

Table 1. Production aspects of identified fruit species per household (n=50)

Scientific name	English name	Households involved in growing (1 = yes)		Average amount of trees cultivated		Estimated annual harvest (kg)		Average amount of fruit sold (kg)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Mangifera indica L.	Mango	0.94	0.24	19.00	23.67	7269.85	12262.70	6990.07	12409.04
Musa paradisiaca L.	Banana	0.80	0.40	671.03	559.49	18082.05	21575.80	16964.10	22246.25
Persea americana Mill.	Avocado	0.70	0.46	4.97	5.64	120.91	180.09	77.61	89.90
Carica papaya L.	Papaya	0.26	0.44	11.08	13.71	114.11	193.08	88.56	132.73
Annona senegalensis Pers.	Gishta	0.18	0.39	2.00	1.32	11.00	12.84	11.00	12.84
Citrus×aurantiifolia (Christm.) Swingle	Lime	0.10	0.30	1.80	0.45	12.20	21.17	11.80	21.38
Psidium guajava L.	Guava	0.02	0.14	…	…	…	…	…	…
Citrus×sinensis (L.) Osbeck	Orange	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Malus spp.	Apple	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(continued)

Table 1. Continues.

Scientific name	English name	Who decided to grow? (%)			Who takes care of trees? (%)			Who decides to sell? (%)		
		Male	Female	Both	Male	Female	Both	Male	Female	Both
Mangifera indica L.	Mango	87.23	2.13	10.64	74.47	0.00	25.53	19.15	38.30	42.55
Musa paradisiaca L.	Banana	87.50	2.50	10.00	82.50	0.00	17.50	47.50	2.50	50.00
Persea americana Mill.	Avocado	88.57	0.00	11.43	62.86	0.00	37.14	22.86	40.00	37.14
Carica papaya L.	Papaya	84.62	7.69	7.69	61.54	7.69	30.77	0.00	53.85	46.15
Annona senegalensis Pers.	Gishta	77.78	0.00	22.22	22.22	0.00	77.78	0.00	77.78	22.22
Citrus×aurantiifolia (Christm.) Swingle	Lime	100.00	0.00	0.00	0.00	0.00	100.00	0.00	100.00	0.00
Psidium guajava L.	Guava	100.00	0.00	0.00	0.00	0.00	100.00	100.00	0.00	0.00
Citrus×sinensis (L.) Osbeck	Orange	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Malus spp.	Apple	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5.2. Perceptions and attitudes towards fruit and fruit trees

Farmers showed a largely positive attitude towards integrating fruit trees in their homegardens. The provision of shade for people and animals and creating a relaxing environment were highlighted as the most strongly agreed with, proceeded by a generally agreed awareness of ecosystem services, such as soil quality improvement and natural balance of the garden. Fruits were perceived as an essential component for the human diet, nutrition, and human health, with 36 farmers strongly agreeing. However, aspects linked to economics and the production of fruits showed a more withheld attitude. Half of the respondents strongly agreed upon labour intensity, and all agreed upon the slow pay-back period. Additionally, the difficulty to predict market prices was agreed upon by two thirds. Opinions split regarding the ease of fruits selling towards grains, vegetables and pulses, with roughly half agreeing and disagreeing (Figure 6).

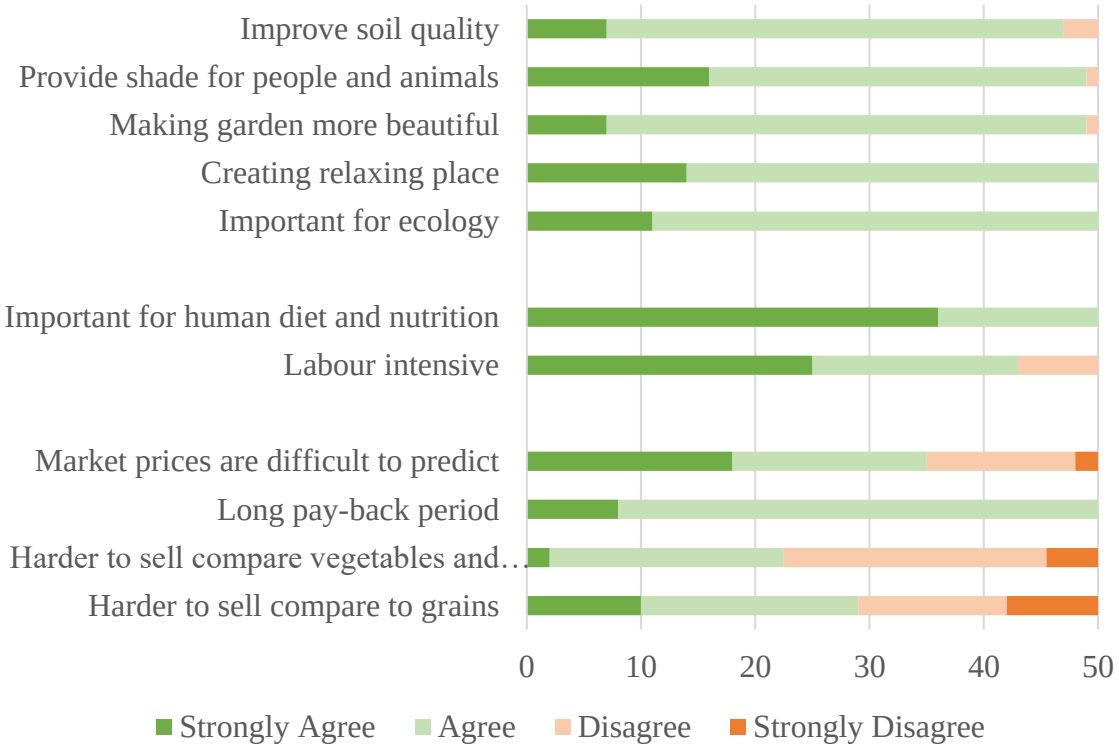


Figure 6. Farmers' perceptions and attitudes towards fruit crops (n = 50).

Figure 7 illustrates farmers' perception of fruit purchasing and selling frequency. Respondents exhibited involvement in fruit market chains, predominantly selling, with

generally low purchasing habits. While 64 % of farmers indicated selling their fruit output often and 32 % sometimes, 48 % stated never buying fruits and 32 % rarely. Often was set as once a month, sometimes as a few times per year, and rarely as once a year. On a different note, farmers were delighted with working in agriculture and their farming environment. Over 80 % strongly agreed with both statements, and the rest responded with agreed, except one farmer that indicated neither agreeing nor disagreeing.

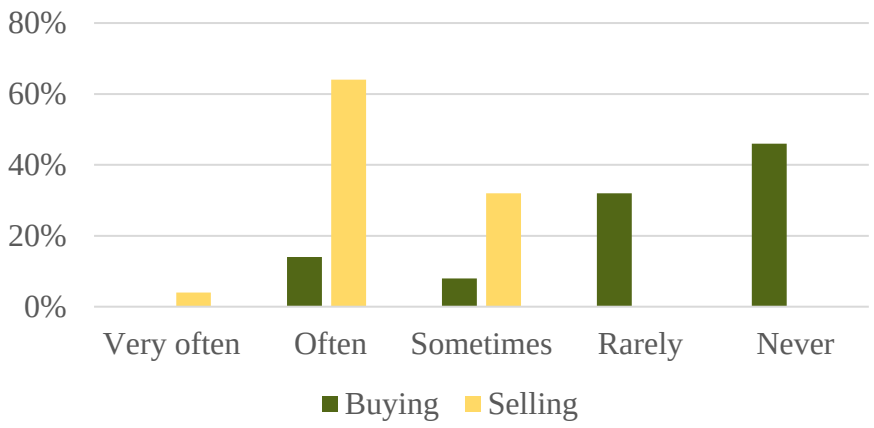


Figure 7. Farmers perception of fruit purchasing and selling frequency (n = 50).

Very often = more times per month
Often = once a month
Sometimes = a few times per year
Rarely = once a year

5.3. Farmer, homegarden and farm calendar characteristics

5.3.1. Socio-economic characteristics of farmers

Of the 50 surveyed interviewed farmers, the average age was 47.66 years. Nearly all respondents were male and defined themselves as the head of the household. Farmers had 6.97 years of schooling, typically finishing between primary and secondary levels. The majority, 98 % of individuals, indicated farming as their primary income source, had on average 24.10 years of experience in agriculture, of which 20.24 years in cultivating fruits. Household sizes varied from 4 to 12 members, but the average was 6.86, and the mean labour force was 4.50 members. Most households did not have credit. Only 12 % declared holding one, although almost all, 98 % had access to government extension services, generally between very often and often, meaning between once and more times

per month. The indicated mean household income was 75,810.80 Birr per year, of which around half, 33,664.00 Birr, was generated from the farming output. The average expenditure on food was 3,034.00, of which fruits accounted for an average of 2.34 % of food expenditures (Table 2).

Table 2. Socio-economic characteristics of the study sample (n = 50)

Variable	Mean	SD
HH head characteristics		
Age (years)	47.66	10.13
Gender (male = 0, female = 1)	0.08	0.27
Years of schooling (years)	6.98	3.42
Highest finished education (primary = 1, secondary = 2, higher = 3)	1.66	0.48
Farming experience (years)	24.10	10.94
Experience with cultivating fruits (years)	20.24	8.24
Member of farmer group, association or cooperative (yes = 1)	0.38	0.49
Farming is main income source (yes = 1)	0.98	0.14
HH characteristics		
Household size (number)	6.86	1.99
Labour force (number)	4.50	2.36
Having credit (yes = 1)	0.12	0.33
Using extension service (1 = very often, 2 = often, 3 = sometimes, 4 = rarely, 5 = never)	1.92	0.83
Household income (birr)	75,810.80	64,749.37
Household income generated from farming (birr)	33,664.00	40,280.06
Per centage of expenditures spend on fruits (%)	2.34	7.17

5.3.2. Homegardens characteristics

In general, homegardens were described as having a slopy terrain, good soil quality, and mostly owned by the household on paper. The average home garden size was 8815 m², and the average distance to the market was 1.17 km. Only a few respondents, 6 %, stated having a nursery and more than half, 68 %, use a different irrigation system to complement the rainfall. In the past five years, households recalled withstanding approximately 2.10 weather and 2.42 insect shocks that ruined crops (Table 3).

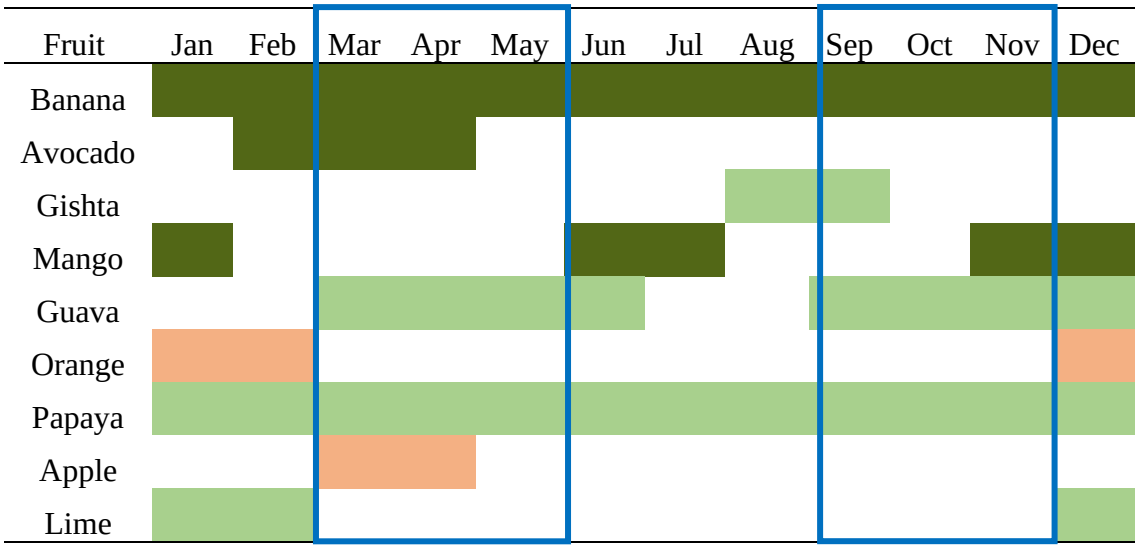
Table 3. Homegarden characteristics (n = 50)

Variable	Mean	SD
Homegarden size (m ²)	8815.00	9868.11
Homegarden ownership (own paper/document = 1, own customary = 2, rented = 3, common/wild/unclear = 4, other (specify:) = 5)	1.42	0.57
Homegarden terrain (flat = 0, slope = 1)	1.00	0.00
Homegarden soil quality (excellent = 1, rather good = 2, rather bad = 3, very poor = 4)	1.84	0.42
Distance to market (km)	1.17	0.99
Having nursery (yes = 1)	0.06	0.24
Type of irrigation (rainfed = 0, other = 1)	0.68	0.47
Number of weather shocks that ruined crops in last 5 years (none = 1, 1-2 = 2, 3-4 = 3, 5 and more = 4)	2.10	0.74
Number of insect shocks that ruined crops in last 5 years (none = 1, 1-2 = 2, 3-4 = 3, 5 and more = 4)	2.42	0.54

5.3.3. Farm calendar

Table 4 and figure 9 illustrate the overlap between the harvest periods of the selected fruit species and the months' likely external shocks occurrence. Banana and papaya fruits can be harvested throughout the year. Mango and guava have two seasons that roughly interchange. Mango's first picking season is between June-July and then November-December, and Guavas harvest season is from March-June and then September-October. All other fruit species have only one harvesting season, which varies between them. Avocado is ripe from February-April, gishta in August-September, orange and lime from December-February, and apple from March-April. Farmers perceived the period January-March, as irrigation water lacking months. February had the highest incidence, with 34 votes. Lack of cash and food seemed to be in line with each other. Both were perceived as affecting the households from February-March and June-July. More specifically, lack of cash seemed to peek during June, with 14 respondents voting, and lack of food in July, with 20 respondents. Farmers indicated that major crops were harvested starting from September until December.

Table 4. Main harvest period of predefined fruit species



Source: Estimated from McMullin et al. 2019

More cultivated
Less cultivated
Not cultivated
(n = 50)
(McMullin et al. 2019)

Rainy season

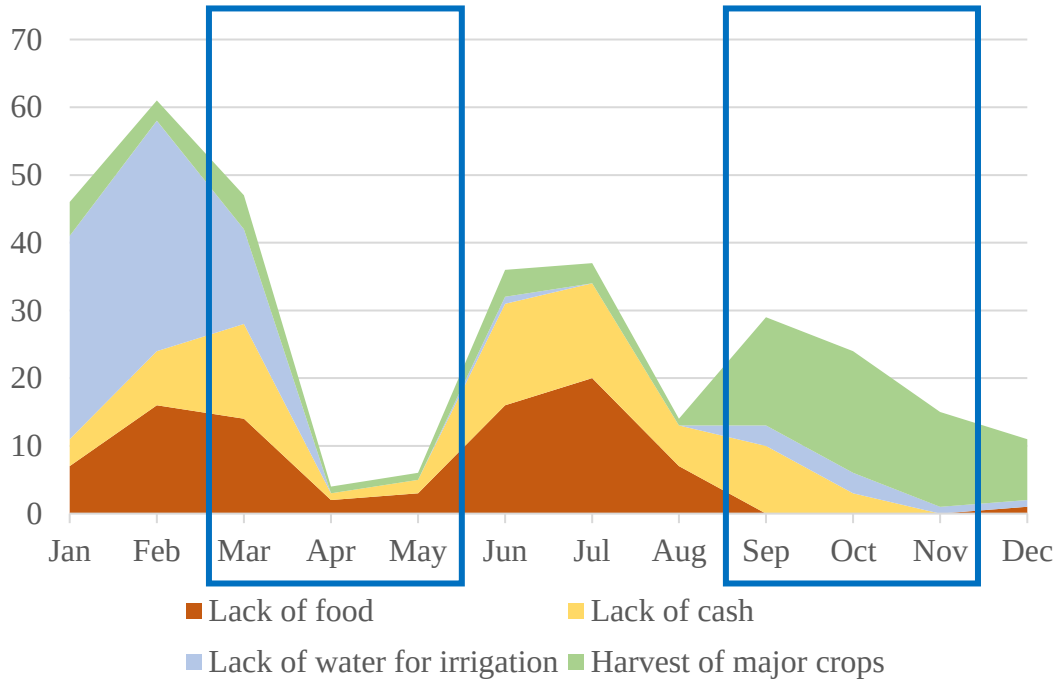


Figure 8. Frequency of most common stressors that affect the household (n = 50)

5.4. Farmers that may perceive fruit selling as easier

Table 5 displays the potential connection between farmer, household, homegarden and farm characteristics that may influence the perception of fruit commercialisation. Unlike all other attitudes assessed, farmers revealed a significant divergence regarding their perception of the ease of selling fruit. Of the 50 respondents, 26 individuals agreed that fruit is harder to sell than other corps, whereas 24 disagreed with that statement. Based on this distinction, a set of characteristics were identified and valued with the Mann–Whitney U test to suggest the following farmer profile. Compared to the others, farmers who did not perceive fruits as hard to sell were more likely to own larger homegardens, be located closer to the market, use extension services more frequently, and be members of farmer associations or cooperation. At the same time, this type of farmer was more dependent on rainfall for irrigation, recalled less weather and insect shocks, indicated a lower incomer per capita, and had fewer years of schooling and a lower level of education.

Table 5. Farmer's profile based on correlation between variables depending on the perception of commercializing fruits (n = 50)

Variable	Easy to sell (n = 24)		Hard to sell (n = 26)		M-W test
	Mean	SD	Mean	SD	p-value
Homegarden size (m ²)	11827	12521	5552	3960	0.007
Distance to market (km)	1.08	0.98	1.88	1.03	0.002
Irrigation (rainfed = 0, other = 1)	0.50	0.51	0.88	0.34	0.005
Weather shocks (1 = frequent)	0.13	0.34	0.50	0.51	0.005
Insect attack (1 = frequent)	0.29	0.46	0.58	0.50	0.044
Using extension service (1 = very often, 2 = often, 3 = sometimes, 4 = rarely, 5 = never)	1.65	0.75	2.21	0.83	0.020
HH income/capita (birr)	8844	7005	15395	11182	0.055
Schooling (years)	5.81	3.49	8.25	2.91	0.009
Education (level)	0.538	0.508	0.792	0.415	0.063
Membership assoc/coop (yes = 1)	0.5	0.51	0.25	0.442	0.074

6. Discussion - present

6.1. Fruits and livelihood in the study site

Most farmers show a positive attitude toward the benefits of integrating fruit trees into their homegardens. However, fruit commercialisation is perceived as challenging despite nearly all output being sold at the local market. Levels of fruit consumption are deficient, and an increase in fruit production could substantially benefit the rural economy and cover dietary needs. It is essential to document the production aspects and determine the factors that could increase the integration of fruit crops in homegardens. As recognised in several studies, cultivating fruits in homegarden brings several benefits to rural communities, leading to higher fruit consumption within households, increased income and market participation, and contributing to the ecosystem balance of farming areas (Berhanu Desalegn & Jagiso 2020; Adane et al. 2019; Jemal et al. 2018; Mathewos et al. 2018; Mossie et al. 2020).

The collected data suggest that the implemented project may increase farmers' awareness and adoption of fruit crops, one of the intended outcomes. Seven out of nine species are currently cultivated in homegardens of the studied sample. However, the average number of fruit species cultivated is relatively low. Only three species are typically cultivated. This is according to a previous study that highlighted the typically reduced diversity of fruit species in Ethiopian homegarden (Abebe et al. 2010; Mathewos et al. 2018). Exotic fruit crops are rising as they are more demanded by urban and export markets (USDA Foreign Agricultural Service 2018; Yigezu Wendimu & Wendimu 2021). Our results support that commonly produced crops are mango, banana, and avocado. Apple trees were not present in the sample, despite having a high potential for this region. The main obstacles to smallholder apple production were insect pests, poor markets, theft of fruits and low awareness (Nigussie et al. 2019). This temperate fruit species have been introduced in recent years, and as research suggests, farmers might not be well informed and perceive the crop as risky. Many farmers appointed family tradition as the source of learning about species, especially the more local species such as gishta and guava. Government extension services were more linked to exotic fruits, such as mango, avocado, and papaya, recommending better-marketed crops. After all, when

comparing the estimated harvest and the amount sold, it is evident that most produce is intended for the market. Only a few farmers store fruits at home. The same goes for processing and preserving after harvest. Fruits are highly perishable fruits that need proper storage facilities or processing units to be kept fresh and safe for consumption. Weak market linkages have been pinpointed as a significant entry barrier for smallholders into the fruit sector (Nigussie et al. 2019; Gebre et al. 2020). From the gender perspective, men tend to decide what species to grow and take care of the trees, whereas women have more decision-making in selling the fruits, which is widely accepted in rural sub-Saharan countries (Kiptot & Franzel 2012). Additionally, research shows that women are disadvantaged in decisions regarding land, trees and household, access to credit and extension visits, despite contributing more to the household labour (Kiptot & Franzel 2012). It is generally accepted that strategies to include women in agriculture production are linked to increased food and nutrition security and could have a decisive impact on production diversity (FAO 2013).

Farmers generally perceived fruit trees in homegardens as valuable and multipurpose. For the garden, it was seen as enhancing soil quality and ecological balance. For the people, as creating an aesthetic and relaxing environment. Satisfaction and overall feeling of well-being have been linked to increased involvement in the agroforestry-based system and regeneration of trees (Weston et al. 2015). The psycho-social well-being resulted from the aesthetically pleasing and comfortable environment, leading to increased leadership, a positive attitude toward the future, and higher crop yields. The results show that the respondents enjoy their occupation and work environment. Given that, farmers might become more open to new practices and species. Farmers unanimously agreed on the importance of fruits for human consumption and health, despite 40 per cent indicating never buying fruits. Additionally, 60 per cent stated selling often. This could suggest that fruits are infrequent foods the household member eat, which echoes the low consumption of fruits attributed to the Ethiopian population (Central Statistics Agency of Ethiopia 2020). Less eager attitudes were towards prices and market competitivity. Farmers perceived fruits prices as challenging to predict and as generally harder to sell, having an extended return of investment period. Seasonal variation of prices is a critical issue in Ethiopia (Dorosh & Minten 2020). Many authors have appointed sustainable value chain development and better access to resources to

decrease this risk perception (Mossie et al. 2020; Gebre et al. 2020; Rahmann et al. 2020)
.

The typical Ethiopian rural household is male-headed and consists on average of 5.2 members, which is assimilated with our sample. Although most indicated farming as the primary source of income, the income generated from farming was around half. The agriculture sector continues to have the lowest salaries, and most households need to be involved in other activities to uphold their livelihood (Dorosh & Minten 2020). Only a few farmers reported having credit, making it harder to expand and commercialise their produce. Around one third belongs to a farmer group. However, most recalled having access to extension services at least once a month. Homegarden size and market distance matched the national average, and weather and insect shocks happened roughly twice in the past five years (Central Statistics Agency of Ethiopia 2020). Reports indicated insect pests are a significant issue every year, though our study area might be less prone due to the more humid climate (Yigezu Wendimu & Wendimu 2021). More than half had other irrigation systems, possibly due to the more accessible access to water bodies that sorrowed the region. On-farm nurseries have been linked to higher yields, but only six per cent stated having one. It could help increase farmers' know-how on crop propagation and growth to incentive the hold of nurseries. Compared with the harvest period of the selected species, the farm calendar could indicate possible seasonal challenges that interfere with the adoption of certain crops. Dorosh and Minten (2020) and Yigezu and Wendimu (2021) noted that Ethiopian smallholders typically struggle with a lack of cash, food, and water. In our case, water stress peaked in February, which is the dry season's last month, and food and cash peaked in July, shortly before the main harvest season starts.

Our findings suggest that a particular profile of farmers find fruit commercialisation easier than others. This attitude could convert into an increased engagement in fruit cultivation. The perception of easier commercialisation was linked to farmers owning a larger homegarden (Mathewos et al. 2018; Adane et al. 2019), being closer to the market, using extension services more than once a month, and being a member of a farmers association or cooperative (Parwada et al. 2010). These findings strongly suggest that they seem more commercially oriented, as they display better market connectivity and consciousness through more frequent and consistent interactions with

market agents. This is supported by research showing that farm size and market awareness positively relate to the increased commercialisation of fruits (Adane et al. 2019; Mossie et al. 2020). However, this group was more dependent on rainfall for irrigation and remembered less weather and insect shocks, pointing to a different perception of risk.

Moreover, this type of farmer had fewer years of schooling and a lower education level, indicating a possible connection to the lower risk sensibility. Our results corroborate two case studies that assessed farmers' risk perception, so the degree to which the farmer is willing to engage in certain farming activities. In Pakistan, lower risk tolerance towards weather and pests diseases was linked to the education of the households head and off-farm income (Ullah et al. 2015). In Indonesia, researchers found factors that translated into smallholder farmers' positive and negative risk tolerance. Education and farming income positively related to risk tolerance, whereas land size correlated negatively (Agussabti et al. 2020). In our case, farmers that perceived fruits as harder to sell may be less willing to take risks, as they had higher earnings and were more educated, possibly indicating more awareness of potential barriers and uncertainties. Higher incomes could also suggest more off-farm earnings, putting less effort into farming and engaging less in the fruit sector. Lastly, the lower income of the profiled farmers could also suggest a higher dependency on selling their products. Fruits have a higher value than other crops, and farmers might have a more substantial need to commercialize fruits to sustain their livelihoods.

6.2. Recommendations

The results of this study could eventually serve as baseline data for research projects aiming at smallholder fruit production, nutrition-sensitive agriculture, and agroecological based farming (Mathewos et al. 2018; Alemu et al. 2019; Ochieng Ogutu et al. 2020). The suggested farmer's profile can help target the appropriate beneficiaries to support crop production, market awareness, and nutrition training. Our approach provides insights into a relevant area for fruit production in Ethiopia and could attract agri-food businesses and benefit the local economy (Mossie et al., 2020). Lastly, the results summarise some constraints farmers currently experience, which policy actions could ease.

6.3. Suggestions for further research

It would be very suitable to explore the market drivers that challenge farmers to enter and expand fruit production (Yigezu Wendimu & Wendimu 2021). For instance, the prices of the fruit species were not included in our survey. Equally relevant is the role of women in fruit production, as they are vital players in targeting food and nutrition security (FAO 2013). Also, little importance was given to native fruit species, most of the selected crops were exotic, and there is a need to bring more light to the importance of local crops in the face of agriculture intensification (Lelamo 2021).

6.4. Limitations

Our study is not without limitations, and they may have had an impact on the results observed. First, the data collection period happened only in one part of the year, i.e., January-March. This period is characterised as the dry season, where households experience several stressors (Climate Data 2019). This could have influenced the respondent's state of mind, therefore measuring perceptions and attitudes. Secondly, data was merely collected based on farmers' estimations and not measured empirically. Individuals may under- or overestimate their output, and complementing each questionnaire with evidence could lead to a closer reflection of reality. Thirdly, the research aim is generally directed toward farmers, though the chosen sample was predominantly composed of household heads that mainly were men. Incorporating female insights would undoubtedly bring benefits, capture specific realities, and add to gender diversity in survey research (Kiptot & Franzel 2012). Nevertheless, this study's results are in accordance with similar research done in this area and topic, adding to the body of knowledge of this not sufficiently understood field.

7. Conclusions

Despite offering suitable agro-climatic conditions, fruit production and consumption in Ethiopia is suprisingly low. Rural communities could significantly benefit from expanded fruit cultivation's nutritional and economic outcomes. Therefore, this study intended to bring more light to fruit production and utilization among smallholders in Arba Minch. Key informants were interviewed to identify the most commonly promoted fruit crops in the selected study area. Afterwards, 50 households were surveyed with a semi-structured questionnaire and statistically analysed with Excel and SPSS software. Results showed that six out of the nine predefined species were currently found in the home gardens, mainly mango, banana and avocado and most of the production is sold at the local market. Farmers' perceptions and attitudes were assessed through Likert-scale questions and demonstrated a positive and conscious perspective on the effect of fruits on the agroecosystem and human health. At the same time, farmers affirmed fruits' higher labour insensitivity and riskier market conditions. Characteristics of farmers, households, homegarden, and farm calendars were analysed to find possible associations. Findings suggested that the perception of easier commercialization was linked to farmers with possible higher market interaction, lower risk perception and higher need of selling fruits to sustain livelihoods. However, research was merely based on farmers' estimations. Thus more research is needed to explore the market force's role of women and native fruit species in order to fill this gap. Recommendations go out to policymakers, project implementers and agribusinesses that may use these findings to develop appropriate approaches in the fruit sector.

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Appendices

List of the Appendices:

Appendix 1: Questionnaire

Section 1: Personal background

1.	Village name				
2.	Age (years)				
3.	Gender			**O** Female	**O** Male
4.	What is your ethnic group?			-	
5.	How many years did you go to school (years of schooling)?			-	
6.	What is your highest finished education?	**O** Primary		**O** Secondary	**O** Higher
7.	What is your highest finished education?			-	
8.	How many years have you been working in agriculture? (years)				
9.	How many years are you having fruits ? (years)				
10.	Do you belong to any farmer group, association or cooperative?			**O** Yes	**O** No
11.	Does your main source of income come from farming?			**O** Yes	**O** No

12. Do you like working in agriculture?	**O** Strongly agree	**O** Agree	**O** Neither agree, not disagree	**O** Disagree	**O** Strongly disagree
13. Do you like the environment/place of your farm (do you like this place)?	**O** Strongly agree	**O** Agree	**O** Neither agree, not disagree	**O** Disagree	**O** Strongly disagree

Section 2: Household characteristics

1.	Are you the household head?				**O** Yes	**O** No
2.	How many people live together in your household (number)?					
3.	How many between 15-60 years (number)?					
4.	Do you have credit?		**O** Yes	**O** No		
5.	Do you use extension services~~?~~	Very often (more times per month)	Often (once a month)	Sometimes (a few times per year)	Rarely (once a year)	Never
6.	What was your household cash income last year in birr?			-		
7.	How much came from farming?				birr	%
8.	How much came from fruit trees?				birr	%
9.	How much came from other activities?				birr	%

10. How often do you sell fruits?	**O** Very often (more times per month)	**O** Often (once a month)	**O** Sometimes (a few times per year)	**O** Rarely (once a year)	**O** Never	
11. How often do you purchase fruits?	**O** Very often (more times per month)	**O** Often (once a month)	**O** Sometimes (a few times per year)	**O** Rarely (once a year)	**O** Never	

12.	Do you store fruits at home?	**O** Yes	**O** No
13.	Do you preserve / process fruits?	**O** Yes	**O** No
14.	What is the average expenditure on food per month?	birr	
15.	What is the % of fruits?		

Section 3: Fruit species (knowledge/awareness and practice)

1. Select which statements apply and fill in the data accordingly for each fruit species:

Fruit	Banana	Avocado	Annona/Gishta	Mango	Guava	Orange	Papaya	Apple	Lime
I know									
I have, if yes how many trees									
I do not have, but I would like to have (yes/no)									
Estimated annual harvest (kg)									
Out of harvest, I sell (kg)									
If I sell (where and price/unit): 1 Farmgate 2 Neighbours 3 Local market 4 Middlemen Other, specify	O 1, ……… O 2, ……… O 3, ……… O 4, ……… O 5, ………	O 1, ……… O 2, ……… O 3, ……… O 4, ……… O 5, ………	O 1, ……… O 2, ……… O 3, ……… O 4, ……… O 5, ………	O 1, ……… O 2, ……… O 3, ……… O 4, ……… O 5, ………	O 1, ……… O 2, ……… O 3, ……… O 4, ……… O 5, ………	O 1, ……… O 2, ……… O 3, ……… O 4, ……… O 5, ………	O 1, ……… O 2, ……… O 3, ……… O 4, ……… O 5, ………	O 1, ……… O 2, ……… O 3, ……… O 4, ……… O 5, ………	O 1, ……… O 2, ……… O 3, ……… O 4, ……… O 5, ………
Who decided to grow?	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both
Who takes care of trees	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both
Who decides to sell	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both	O Man O Woman O Both
Important food for the household	O very important O rather yes O rather no O not at all	O very important O rather yes O rather no O not at all	O very important O rather yes O rather no O not at all	O very important O rather yes O rather no O not at all	O very important O rather yes O rather no O not at all	O very important O rather yes O rather no O not at all	O very important O rather yes O rather no O not at all	O very important O rather yes O rather no O not at all	O very important O rather yes O rather no O not at all
From whom did you learn about fruit trees species?	O family tradition O neighbours & friends O gov't, extension O cooperative O NGO/project O private company O Other	O family tradition O neighbours & friends O gov't, extension O cooperative O NGO/project O private company O Other	O family tradition O neighbours & friends O gov't, extension O cooperative O NGO/project O private company O Other	O family tradition O neighbours & friends O gov't, extension O cooperative O NGO/project O private company O Other	O family tradition O neighbours & friends O gov't, extension O cooperative O NGO/project O private company O Other	O family tradition O neighbours & friends O gov't, extension O cooperative O NGO/project O private company O Other	O family tradition O neighbours & friends O gov't, extension O cooperative O NGO/project O private company O Other	O family tradition O neighbours & friends O gov't, extension O cooperative O NGO/project O private company O Other	O family tradition O neighbours & friends O gov't, extension O cooperative O NGO/project O private company O Other

Section 4: Homegarden characteristics

1. What is the size in m^2 ?	-				
2. What is the ownership?	**O** Own – paper	**O** Own – customary	**O** Rented	**O** Common/Wild/ unclear ownership	**O** Other, specify:
3. How is the terrain?	**O** Flat	**O** Slope			
4. What is the soil quality?		**O** Excellent	**O** Rather good	**O** Rather bad	**O** Very poor
5. What is the ownership?	**O** Own – paper	**O** Own – customary			
6. What is the distance to the market:		km		Hours	
7. Do you have a nursery?		**O** Yes	**O** No		
8. Type of irrigation		**O** Rain	**O** Other		
9. In the last 5 years, how many weather shocks did you have that ruined your crops?		**O** None	**O** 1-2	**O** 3-4	**O** More than 5
10. In the last 5 years, how many insect pests have ruined your crops?		**O** None	**O** 1-2	**O** 3-4	**O** More than 5

Section 5: Farm Calendar

Event/Situation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lack of food												
Lack of cash												
Lack of water for irrigation												
Harvest of major crops												

Section 6: Perception/Attitudes

1. To what extent do you agree with the following statements:				
Fruit trees require a lot of maintenance.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruits are harder to sell than grains.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruits are harder to sell than vegetables.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruits are harder to sell than pulses.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruit trees are important for nature.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruits are important for your health (vitamins).	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruit trees take too long to get profit.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruit trees create a nice place to relax.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruit trees are good for livestock (shade, fodder).	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruit trees make the garden look more beautiful.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruit trees improve soil quality.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruit market prices are difficult to predict.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree
Fruits are an important component of the human diet.	**O** Strongly agree	**O** Agree	**O** Disagree	**O** Strongly disagree