Impact of khat production on household welfare in Amhara region of Ethiopia

by

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B.S., Kansas State University, 2016

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Agricultural Economics
College of Agriculture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2018

Approved by:

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Abstract

Khat, a lucrative cash crop cultivated in and near the Horn of Africa, is gaining the interest of researchers around the globe. Despite its potential to provide excess income, economic opportunity, and access to technology to those who produce it, the conflicting legal status around the globe causes policy and trade disputes between countries. Research on the impact of khat production on household welfare is sparse. To address this, the purpose of this research is to determine what factors affect the decision to grow khat and subsequently determine the impact of khat production on labor, income, education expenditure, and food security.

Data was extracted from a survey conducted in early 2017. A total of 365 households in the Amhara Region of Ethiopia were surveyed. We estimate the factors affecting the decision to grow khat by employing use of two logit models and one linear probability model to calculate marginal effects. We estimate the impact of khat production on labor, income, education expenditure, and food security through propensity score matching.

Khat production appears to be adopted by households who are educated and apt to adopt improved technologies. These households are likely to own a donkey, own irrigation, and own more plots than a non-producing household. Practicing seed saving, conservation techniques, and growing more crops decreases the likelihood of growing khat. Regarding impacts, khat production increases on-farm male (41.8%) and female (62.1%) labor and income (41.7%), but decreases education expense (-10.7%), food consumption scores (-15.9%), and number of food shortage months (-16.2%). Overall, khat production uses more labor, generates higher incomes, and decreases food shortage months, but decreases expenditure on education and dietary diversity.

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Acknowledgements

First and foremost, I'd like to thank the entire Agricultural Economics Department for making time at K-State one to remember. Specifically, thanks to Dr. Ben Schwab for taking me on as his first Master's student. I am sure the transition from working with PhD students to working with a Master's student was an interesting one for you. Thank you for your patience when I had no idea what I was doing and for your guidance when I needed direction.

The best thing that has come out of being in the Agricultural Economics M.S. program is the friendships I have developed. Paul: you have taught me so many things that have changed who I am as a person. You are the kindest soul I have ever met. Emilie: you are my go-to girl. Everything we do together involves endless amounts of fun and laughter, and you have never let me down. I will never forget either of you and am so sad we have to move away from each other. I'm not sure how I will ever function in a work environment without you.

To my crazy family: thanks for all your love, patience, and support as I attempted to carry myself through graduate school.

To my sweet husband, Brandon: thank you for taking this ride with me. You have never failed to support me and tell me how much you believe in me. Without you, I never would have finished any of this. I love you.

Chapter 1 - Introduction

Diversification into khat production, a plant with conflicting legal status across the globe, has become common for farmers in the Horn of Africa, South Africa, Madagascar, and Yemen (Expert Committee on Drug Dependence, 2006). Khat is an evergreen, perennial shrub or small tree and is consumed for recreational and medicinal purposes. The plant is chewed by laborers to increase productiveness, religious groups for prayer and worship, and by others for numerous medicinal purposes. Not only is khat used for its stimulating effects, the wood from the tree is often used for building materials and to fashion household items like utensils (Lemessa, 2001).

As a mild stimulant, khat is used similarly to chewing tobacco, chewed and then packed tightly into the cheek of the consumer, causing a surge in energy, wakefulness, and attentiveness (Lemessa, 2001). The main stimulating chemical in the plant, cathinone, is illegal in many developed countries, including the United States and many European countries (Global Legal Research Center, 2015; Valente, Pinho, Bastos, Carvalho, & Carvalho, 2014). Some research observes that khat consumption negatively impacts health by damaging the cardiovascular, gastrointestinal, and reproductive systems, and impairs neurological and cognitive functions, leading to poor judgment (Al-Motarreb, Al-Habori, & Broadley, 2010; Hoffman & Al'Absi, 2010). Despite this, khat is an important export for Ethiopia, accounting for 9% of export commodities in 2015/2016 and 17% in 2018 (IndexMundi, 2018). The reason behind this increase is unknown as are the micro- and macroeconomic impacts of khat production. This research focuses on analyzing the impact of khat production on numerous household factors, aiming to determine why households are growing the drug crop, if khat production is tied to household khat consumption, and if khat production hinders or improves household welfare.

Khat is considered both a cash crop and a type of agricultural technology. Adoption of cash crop production has been slower in developing countries because of the need for food crops. Additionally, technology adoption in developing countries is much slower due to market inefficiencies not present in developed countries (Jack, 2011). Uncertainty of being able to feed their families causes many farmers to be reluctant to switch from food crop production to cash crop production. Previous literature states that cash crops often bring more income to producers (Carrier & Klantschnig, 2016; Kuma, Dereje, Hirvonen, & Minten, 2016). With this excess income, households can purchase higher volumes of food and non-food items for their household. They can also supply higher quality inputs to their farming operation, thus increasing yields.

Despite the benefits that can be reaped by cash crop producers, there are certain risks associated with adoption. The producer is often unsure of how to successfully cultivate and market a new crop. There are also institutional risks such as government corruption and breakdown of transportation and infrastructure networks (Carrier & Klantschnig, 2016; Kuma et al., 2016). Both cash crop production and adoption of technology are often linked to higher levels of food security and household welfare, but this relationship is not always positive (Dessie, 2015). Regarding khat specifically, those who cultivate it have been found to be more food secure, own more land, and have more income (Ademe, Coates, Dalsgaard, Brimer, & Lema, 2017; Gezon, 2012a; Njiru, Muluvi, Owuor, & Langat, 2013).

Using primary data from a survey conducted in northwest Ethiopia, 365 households are analyzed to determine factors attributing to the likelihood of growing khat and the impacts of khat production on household characteristics. To do this, initial background information on the khat plant and the setting in Ethiopia is provided, including historical background, cultivation,

markets and taxes, legal status, and the Ethiopian economy and agriculture sector. To determine factors attributing to the khat growing decision, we employ use of logit and linear probability model regressions. This method finds that khat production appears to be adopted by households who have education and aptitude to adopt improved technologies. To determine the impacts of khat production on household characteristics, we employ use of propensity score matching and ordinary least squares fixed-effect regressions. Impacts of khat production on this sample include increase in on-farm labor used and household income, and decreases in education expenditure, food consumption scores, and months of food shortages.

Chapter 2 - Background: Khat in Ethiopia

Literature analyzing characteristics and social and economic aspects of khat use is abundantly available; some literature regarding the history of and traditional stories about khat was produced as early as the 11th century, while more analytical and technical work was first published beginning in the late 1700's (N. Al-Hebshi & Skaug, 2005). Because the casually termed "drug plant" is considered a controlled substance in the United States and many European countries, there is a heavy, negative cloud surrounding it (Tefera, 2009). To fully understand the impact of khat in Ethiopia, a complete analysis of the plant and setting must be conducted. Throughout Chapter 2, this highly-debated cash crop will be thoroughly explained, highlighting the historical background, plant features, cultivation and uses, health effects, and global legal status. To conclude, the overall setting in Ethiopia will be discussed.

Historical Background

Khat (*Catha edulis)* is referred to by many names depending on the country; in Ethiopia, it is called *chat*, in Yemen, *qat*, in Kenya, *mirra*, and in Somalia, *qaad* or *jaad* (Kandari, Yadav, Thakur, & Kandari, 2014). In English and Arabic, the plant is referred to as khat, which will be the term used throughout this paper (Lemessa, 2001). Traditionally, khat is thought to be of Yemen origin; Yemen legend suggests that khat was first discovered by a goat herder who noticed his animals acting strangely after consuming the plant and decided to try it himself. Following his consumption, the herder experienced a burst of energy, wakefulness, and overall sense of awareness, similar to the modern-day effects of caffeine. More recent literature suggests

that khat is actually of Ethiopian origin, specifically the Hararghe region[1] (Lemessa, 2001); according to Ethiopian history, the first khat plant was brought over to Ethiopia from Yemen by merchants on an assignment from the leaders of Harar City (Getahun & Krikorian, 1973). The merchants strategically planted the first collection of khat plants inside the city, primarily to be harvested and consumed by members of the city council to alleviate tiredness and fatigue. The plant was, and still is, considered to be "holy," to the extent that some consumers thoroughly washed their bodies and prayers were offered prior to consuming the plant from a clean cloth. Another Ethiopian legend says khat is simply a creation of God, delivered to sacred people with the intention of providing them with the energy to continue to pray (Getahun & Krikorian, 1973).

Accounts of khat's origins have been primarily passed down orally over many generations, so the true origin and history of the plant may not ever be fully and accurately exposed. Despite the conflicting accounts, Bálint (2013) agrees with Getahun and Krikorian's (1973) belief that khat originated in Ethiopia due to the high prevalence of khat production, consumption, and trade in the area.

Plant Features

Features of the khat plant are evaluated by summarizing two key areas: the botanical description, which includes the physical appearance and external structure, and the chemical composition, which outlines the substances and compounds within the plant.

[1] Ethiopia has experienced several reorganizations of regions. The (former) province of Hararghe, located in eastern Ethiopia, has since been split into two areas: East Hararghe and West Hararghe. The region encompassing East and West Hararghe is now the Oromiya region, and the Hararghe province does not exist.

Botanical Description

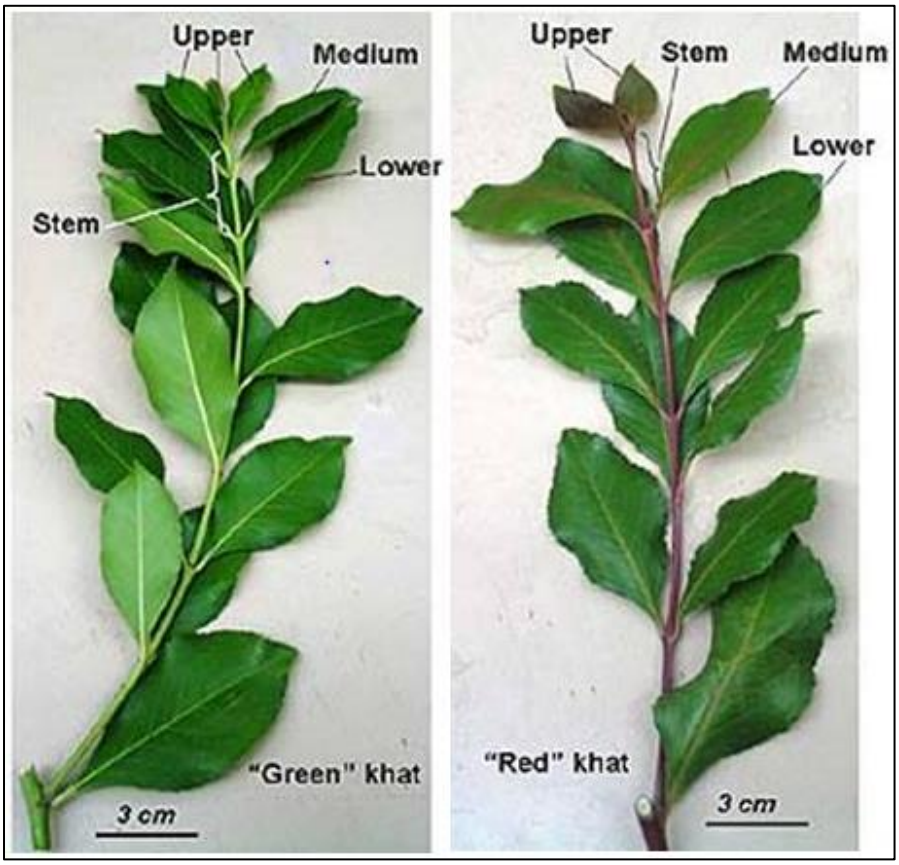
Figure 2-1 illustrates an established, flowering khat plant; the evergreen perennial shrub or small tree typically grows to around seven meters when produced as a cash crop, but can grow as tall as 15-25 meters if left untended (Lemessa, 2001).

Figure 2-1. Mature broad leaf khat tree in flower

Reproduced from: ("Bushman's Tea, Khat, Qat, Cat, Miraa, Jaad (Catha edulis)," 2012)

The stalks that grow off the main trunk are relatively straight, slim, and can come in a variety of colors, such as red or green, illustrated in Figure 2-2 (Getahun & Krikorian, 1973).

Figure 2-2. Red and green khat varieties



Reproduced from: (Vinokur, Levi, Feygenberg, & Rodov, 2008)

The leaves are elliptical and oblong with serrated edges, approximately 5-10 centimeters long and 1-4 centimeters wide, with a shiny green top and lighter-colored, fibrous bottom (Lemessa, 2001). During the flowering of the plant, flowers are rather small and white in color, which produce a fruit that eventually release small, rosy seeds once matured (Lemessa, 2001).

Chemical Composition

According to Getasetegn (2016), Flückiger and Gerock (1887) published a study concluding that caffeine was likely the ingredient in khat causing the mild stimulant effects of chewing. It was not until 1975 that scientists isolated the true stimulating ingredients. The central active substances in the khat plant that cause the feeling of euphoria and wakefulness are cathinone and cathine (Getasetegn, 2016). According to two separate studies conducted nearly 30

years apart (Krizevski, Dudai, Bar, & Lewinsohn, 2007; Szendrei, K., 1980), these compounds are similar to that of amphetamine-like compounds. Other substances found in the leaves include polyphenols and ascorbic acid (primarily Vitamin C), both of which are phytochemicals that have "health-promoting potential," carotenoids, amino acids, calcium, iron, fiber, and vitamins such as thiamin, niacin, and riboflavin (Dudai et al., 2006; Vinokur et al., 2008).

Cultivation

Khat plants begin as shoots or cuttings from an existing plant and thrive at an altitude of approximately 1500-2500 meters above sea level (masl), although it can be grown at lower altitudes if there is no tendency for frost to develop (Lemessa, 2001). The cuttings are typically planted in terraces on hillsides in rows; this allows farmers to simplify agricultural operations by intercropping with other crops such as maize, sorghum or sweet potato (Kandari et al., 2014). If the area is too sloped, farmers will typically solely devote the area to khat and plant other crops in flatter plots (Lemessa, 2001). Properly drained soil is imperative to the successful growth and cultivation of khat as it does not grow well in wet soils (Klingele, 1998).

Once planted, khat takes between 2-3 years to become established and mature enough for routine harvesting (Getasetegn, 2016). Khat can adapt to many climates, thrives in an extensive variety of soils once established, has low vulnerability to pests and diseases, and is typically grown in dryer areas with access to irrigation (Klingele, 1998). The production and management is reported as relatively easy, involving typical crop activities such as fertilizing, weeding, watering, pruning, and harvesting (Klingele, 1998; Lemessa, 2001). Both pruning and water access are key factors in producing quality khat; pruning encourages the stems to grow in a straight and uniform manner, while proper rainfall and irrigation is critical for establishment and overall growth (Lemessa, 2001). Once the plant is established, the frequency of watering is more

important than the amount of water. Even distribution of rains among the rainy and dry seasons is ideal, and farmers hand water or irrigate their khat plots several times throughout the dry season to ensure the plant is receiving an even distribution of water. The first harvest of a khat plant is not typically sold on the market, but rather consumed by the farmer as a test of quality to improve his subsequent harvests.[2] Following the initial harvest, the second and third harvests are of greater volume, higher quality, and thus sold in the marketplace (Lemessa, 2001).

Unlike seasonal agricultural crops, khat is harvested 2-3 times per year; if a farmer strategically plants his khat at different times throughout the year, he will be able to harvest and sell his crop continuously, providing a constant stream of income that would not otherwise exist (Kandari et al., 2014). To harvest the crop, the younger, softer shoots are removed by hand, while tougher shoots are cut using hand tools (Lemessa, 2001). The harvested khat, which is only of high quality and value for 2-3 days and must be marketed or sold immediately, is wrapped in plastic bags or banana leaves for freshness, illustrated in Figure 2-3 (Cassanelli, 2011). It is then either locally sold, exported or directly consumed (Lamina & Lamina, 2013).

[2] Standards upon which farmers grade their khat include "exciting rate or narcotic effect, taste, physical appearance, demand and market value" (Lemessa, 2001).

Figure 2-3. Harvested khat wrapped in banana leaves for transport

Reproduced from: (Drug Enforcement Agency, 2017)

Markets and Taxes

Typically, khat farmers in the Horn of Africa and Arabian Peninsula do not directly sell to buyers in a local market; they allow buyers (often exporters) to assess the khat and negotiate prices in the field or sell their product to brokers (called a *dalala* or *qaqabi*) in local markets (Alemu, 2015; Lamina & Lamina, 2013; Lemessa, 2001). The *dalala* do not take physical ownership of the crop, but act as an intermediary between the farmer and the local or exporting buyer (Alemu, 2015). Unless local buyers purchase khat directly from the farmer, the commodity is subject to taxation. A governmental khat taxation institution (called a *kella*) weighs the khat and assigns a unit tax depending on the commodity's destination. For local consumers who purchase khat through a *dalala*, the tax is three Ethiopian birr (ETB) per kilogram. The export tax is six ETB per kilogram. To promote export activity by removing export taxes, the Ethiopian government has closed all but two khat *kellas* in the past ten years causing a decrease in

government revenue. Khat prices have also remained low because of the influx in supply (Alemu, 2015).

Prior to 2011, khat was ranked the third most exported Ethiopian commodity by volume next to coffee and oilseeds; since 2011, khat has dropped into the fourth spot, partially attributed to the Ethiopian khat taxing system (Alemu, 2015). According to two Ethiopian news articles (Hagos, 2017; Tessema, 2016), despite the taxing system, the Ethiopian Ministry of Trade describes khat as a key agricultural export.[3] In 2015/2016, khat accounted for 9% of Ethiopian export commodities (International Trade Administration, 2017), while recent data estimated khat to be 17% of Ethiopian export commodities (IndexMundi, 2018). Khat is exported to 93 countries worldwide, including Malawi, Hong Kong, Brazil, and Norway (Hagos, 2017).

Uses

Although the khat plant is typically only viewed as a recreational drug or stimulant, it can also be used in social, recreational and work situations, medicinal practices, and as a wood material for construction and tools.

Social, Recreational and Work

The typical way to consume khat is by chewing the soft leaves and packing them into the cheek, similar to that of chewing tobacco (National Drug Intelligence Center, 2003). The leaves release the main active chemical, cathinone, once they are chewed and the consumer experiences bursts of energy, alertness, improved communication, and suppressed appetite (Kelly, Kicman, & King, 2011). Khat is consumed by a wide group of people for social, cultural, and work reasons: the religious use it in order to balance working, praying, and fasting during religious seasons;

[3] Access to Ethiopian Ministry of Trade documents is limited and was not available at the time of this publication.

farmers report using it to lower their body temperature when working outside in the heat; laborers consume khat to remain energized and complete their strenuous activities; night watchmen use it to stay awake and alert, and; students often chew khat to enhance performance on examinations (Cassanelli, 2011). Group recreation frequently involves khat chewing in northeast Africa, creating an environment of sociability and intellectually stimulating conversation due to the greater level of attentiveness experienced by the users. The social and entertainment aspects of khat consumption attract many users (Cassanelli, 2011).

Medicinal

According to a study conducted in North Yemen (Kennedy, Teague, Rokaw, & Cooney, 1982), khat chewers in the area believe that khat can alleviate the symptoms of many illnesses and bodily complaints, such as colds, fevers, arthritis, headaches and even depression. Folklore suggests that khat protects against malaria, cures coughs, asthma and stomach problems, suppresses appetites, cures genital infections, and increases libido (Cassanelli, 2011). Specifically, the leaves and roots are believed to cure the flu, coughs, some sexually transmitted infections and chest problems, the root of the plant is believed to treat stomach pains, and boils are treated by smoking the dried leaves (Lemessa, 2001).

Construction and Tools Material

Because termite infestation is not commonly found in the wood of khat plants, it is used frequently in housing structures, fencing systems, and cabinetry (Klingele, 1998; Lemessa, 2001). Many household items are fashioned from the wood, including pots, pans, forks and combs. Additionally, farmers will use the wood in order to make a variety of hand tools, such as hammers or chisels (Lemessa, 2001).

Health Effects

Despite the increase in blood sugar levels, blood circulation, and energy, there was little knowledge of the effects of khat chewing on a physiological level before the early 2000's (Tefera, Kirsten, & Perret, 2003). Scientific studies have since been published associating khat use with a plethora of negative health outcomes: cardiovascular diseases, gastrointestinal tract and liver damage, impairment of the peripheral and reproductive systems, and neurological and cognitive impairments ranging from anxiety, irritability and insomnia to schizophreniform psychotic disorder and even suicidal depression (Al-Motarreb et al., 2010; Hoffman & Al'Absi, 2010). A case-control study conducted in Ethiopia (Abebe et al., 2005) concluded that habitual khat chewers are more likely to engage in "multiple sexual practices," increasing the susceptibility of sexually transmitted infections and potentially contributing to the increased dissemination of HIV/AIDS.

Although the majority of literature associates chronic khat use with harmful health outcomes, most of this information is retrieved from small sample sizes and responses are typically anecdotal; therefore, the conclusions drawn from these studies may be implausible (N. N. Al-Hebshi, Al-Sharabi, Shuga-Aldin, Al-Haroni, & Ghandour, 2010). Positive health effects linked to khat chewing include improved periodontal health, decreased levels of triglyceride and cholesterol, and increased antioxidant levels within the human body (N. N. Al-Hebshi et al., 2010; Getasetegn, 2016).

Legal Status

The conflicting legal status of the plant across different nations can be a source of confusion and dispute. The production of khat is banned in many developed countries, including the United States and several European countries, such as France, Germany, Norway, Denmark,

Ireland, Sweden, the United Kingdom, and the Netherlands (Global Legal Research Center, 2015; Valente et al., 2014). The substances in the khat plant are regulated within the United States under the Controlled Substances Act (Drug Enforcement Agency, 2017). The primary active chemical, cathinone, falls under the category of Schedule 1, the same category that lysergic acid diethylamide (LSD), heroin, and marijuana fall into; this means khat has a "high potential for abuse," is not considered safe, and is not accepted as a medical treatment. Cathine, the secondary active compound, is a Schedule IV stimulant, considered legal but has been proven to potentially lead to some level of stimulant dependence (Drug Enforcement Agency, 2017).

Although legal in certain countries, such as Djibouti, Ethiopia, Kenya, Somalia, Yemen, Portugal, and Australia, rules regarding the use of khat continuously change and governments display attitudes ranging from simple acceptance to outright prohibitions (Cassanelli, 2011; Valente et al., 2014). Strict bans and regulations on khat within Somalia and Djibouti have come and gone since the early 1900's, but no permanent law has been able to be put into effect (Cassanelli, 2011). In Ethiopia, despite having more than five legally registered khat exporting entities, the government provides assistance to coffee producers through subsidies to encourage coffee production while offering no extension services to khat producers (Alemu, 2015). These efforts stem from the United Nations Commission on Narcotic Drugs regulations (Lamina & Lamina, 2013; Lemessa, 2001).

The Setting in Ethiopia

As one of the world's oldest countries, the oldest independent country in Africa and second most populous country in Africa, Ethiopia has a rich history and unique characteristics unlike any other nation (BBC News, 2017; Crummey, Mehretu, & Marcus, 2017).

Geography and Demographics

Located in eastern Africa, the landlocked country of Ethiopia (see Figure 2-4) has a total area of just over 1.1 million square kilometers, which is just faintly less than twice the size of Texas (Central Intelligence Agency, 2017). The country population is 105 million.

Figure 2-4. Current map of Ethiopia

Reproduced from: (Central Intelligence Agency, 2017)

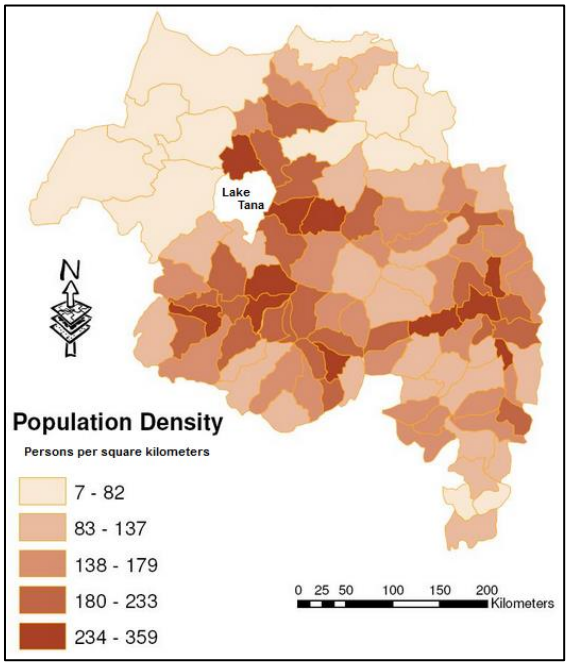
There has been incredible improvement in human development measures in the past 20 years; primary school attendance quadrupled, child mortality decreased by 50%, and the number of people with access to clean water increased by 50% (The World Bank Group, 2017b). Unfortunately, the quickly increasing population is putting a strain on available land resources, contributing to the deterioration of the environment (Central Intelligence Agency, 2017).[4] The country is highly vulnerable to natural hazards, such as earthquakes, volcanic eruptions, and

[4] Although the country has higher than average mortality rates, the high fertility rate has sustained a continually growing population.

frequent droughts, and is currently experiencing environmental complications like deforestation, overgrazing, soil erosion, desertification, and water shortages (Central Intelligence Agency, 2017).

The study region (Amhara) is in the northwestern part of Ethiopia. It is divided into 11 zones, 140 woredas, and approximately 3,429 kebeles (Adugna, 2016b). The Nile River and its source, Lake Tana, are located in this region. The eastern portion of the Amhara region is characterized by sloping escarpments with adjacent lowland plains and continually experiences droughts and pest damage to crops. The western portion, mainly characterized by flat plains, produces surpluses of agricultural products due to healthy soils and sufficient rainfall. Because of land degradation, the government has resorted to resettling several hundred Amhara farmers to other regions in the past 50 years (Adugna, 2016b). Figure 2-5 illustrates the population distribution of the Amhara region, highlighting denser populations in the central, south central, and eastern portions.

Figure 2-5. Population density of Amhara region



Reproduced from: (Adugna, 2016b)

Economy

Ethiopia is one of the poorest countries in the world but considered one of the "top performing economies in Sub-Saharan Africa" with an average growth rate of 7% from 2011-2018 (Central Intelligence Agency, 2017; FAO, 2018). From 1980 to 2005, Gross Domestic Product (GDP) fluctuated in between $7 billion to $14 billion (The World Bank Group, 2017a). Following 2005, growth of GDP has been steady, in between 8% to 12%, although forecasts predict a decrease in GDP growth to less than 8% in 2018 and 2019. GDP for 2015 was $64.5 billion and $72.4 billion for 2016 (The World Bank Group, 2017a). Agriculture is the main driving force of the economy, with over 70% of the population engaged in the agriculture sector (Central Intelligence Agency, 2017; FAO, 2018).

Agriculture Sector

With a tropical monsoon climate that varies depending on the topography of the location, the country devotes 36.3% of total land area to agriculture (Central Intelligence Agency, 2017). Within the Amhara region, nearly 50% of total land area is used for agricultural production activities (Adugna, 2016b). Land ownership and rights concerns can cause subsistence farmers to avoid producing excess food to sell in the market and has delayed commercial agriculture expansion (Crummey et al., 2017). Agriculture is a considerable portion of the country's GDP (35.8%) (IndexMundi, 2018). The most exported commodity by volume is coffee (27% of exports), followed by oilseeds (17%), khat (17%), gold (13%), cut flowers (7%), live animals (7%), hides and skins (3%) and meat products (3%) (IndexMundi, 2018). More than 85% of total crop production in the Amhara region comes from cereals like teff, barley, wheat, maize, sorghum, and millet (Adugna, 2016b).

There is anticipated growth in agro-processing, textiles, apparel, leather, cash crops, and consumer demand for eggs, meat, dairy products, cooking oil, beverages, sugar, and wheat-based products, creating a need for investments in agricultural equipment (tractors, cold storage facilities, irrigation), agro-processing equipment (millers, extruders), cotton exports, and grocery exports (U.S. Department of Commerce, 2018).

There are three main types of agricultural activity: subsistence crop farming, consisting of smallholder farms growing staple crops like teff, wheat, barley, oats, sorghum, corn, millet, root vegetables, lentils, chickpeas, and beans to consume in the household; cash crop farming, where farmers produce crops such as oilseeds, beeswax, sugarcane, khat, coffee, and some grains, grasses, and vegetables to sell for profit, and; livestock rearing, using animals for household consumption, agricultural operations, and profit generation through sales of meat, hides, skins, and milk. The majority of farmers adopt a combination of the activities (Our Africa, 2018).

Combining rain-fed and low-input agricultural operations with susceptibility to irregular precipitation, eroded soil, and low technology access results in low productivity throughout Ethiopia, although continual partnerships with non-profit organizations fight against this (FAO, 2015). Most Ethiopian farmers rely on rain-fed irrigation for their crops (Hirvonen, Taffesse, & Worku Hassen, 2016). There are two seasons of increased rain throughout the calendar year: *belg*, which occurs March through May, and *meher*, which occurs June through October and is considered the main rainy season. Agricultural production depends on the rainy seasons and occurs in seasonal cycles, causing "lean seasons," which is the time in between harvests where food is less available. For the Amhara region of Ethiopia, typical harvest months are November

(*Hidar*) and December (*Tahesas*), crop sales months are January (*Tir*) and February (*Yekatit*), and the livestock sales month is April (*Miazia*) (Hirvonen et al., 2016).

Chapter 3 - -Literature Review

Many farmers in developing countries, such as Sudan, Somalia, Ethiopia, South Africa, Madagascar, and Yemen, are diversifying into khat production. In the case of this research, khat is not only considered a cash crop, but also a type of agricultural technology. As discussed in Chapter 2, Ethiopian farmers are often subsistence, cash crop, and/or livestock farmers. Cash crop farmers specialize in the production of food and non-food crops solely to market and sell them for a profit. For farmers in developing countries, adoption of drug or cash crop production can be difficult or nearly impossible due to limited resource access. Previous research shows that successful adoption of cash crop production and other forms of agricultural technology can have a significant impact on a farmer's welfare. Less research is available studying the impact of khat on a farmer's welfare—the area of interest for this research. This chapter provides a review of past literature related to the impact of the adoption of cash crops and technology on food security and income, factors that affect the likelihood of growing khat and the impact of khat production on micro- and macroeconomic factors, and proposed theories on cash crop production, technology adoption, and food security.

Impact of Cash Crop Production and Technology Adoption

Kuma et al (2016) study the effect of a specific cash crop (coffee) on food security on small farms in Ethiopia. The authors utilize the Household Food Insecurity Scale (HFIAS) as the measure of food insecurity. Using ordinary least squares (OLS) and instrumented variable (IV) regressions, the authors found that coffee growing households with a higher percentage of household income coming from the crop reported higher food security than other households. They suggest this could be due to the steady stream of income flowing in from coffee sales, allowing producers to purchase food in the market at will (Kuma et al., 2016). Although this

study focuses on coffee, the results for other cash crops would likely be similar. Alternatively, Oumer and Neergaard (2011) concluded that higher income farmers were those who diversified their crop production by adding in root crops, legumes, and vegetables with livestock rather than specializing in cereal crops or oil crops, concluding that increased levels of diversity, not cash crop production, contributes to higher income.

Using a dataset representative of over 2000 farming households in Ethiopia, Shiferaw, Kassie, Jaleta, and Yirga (2014) aimed to determine the effect of the adoption of improved wheat varieties (a type of agricultural technology) on household food insecurity. To measure food insecurity, a perception of the household's own food insecurity was used in addition to a measure of food expenditure. By doing this, the authors were able to group the households into four levels of food security: chronic, transitory, breakeven, and none. By using the generalized propensity score (GPS) methodology, it was concluded that adoption of improved wheat varieties increases households' food security; furthermore, those households who had already adopted could benefit even further by adopting more improved varieties. The authors strongly suggest that improvement of household access to improved technologies and services is a way to alleviate food insecurity (Shiferaw et al., 2014).

Factors Contributing to Growing Khat and the Impact of Khat

Determining the factors affecting the decision to grow khat provides insight into the overall impact of khat. Is there a fundamental difference between those households that grow khat and those that choose not to? Using panel survey data from the Oromia Region and Southern Nation in Ethiopia, Ademe, Coates, Dalsgaard, Brimer, and Lema (2017) used multilevel linear regression to examine the relationship between khat production, land used for crop production, and crop variety. In their study, nearly one-third of khat producers were also

consumers. They determined that the number of hectares used for crop production increased by 0.2 units for khat producers and that khat producers were twice as likely to grow varieties of crops than non-producers. They also found that khat producers converted their land from other crops to khat production land because of income opportunities and soil infertility. Njiru, Muluvi, Owuor, and Langat (2013) examined specific demographics of khat growing households, determining that access to extension services, agricultural land size, main occupation of the household head, household's income, and number of school-aged children improved the probability of producing khat, while distance to the main market, access to credit, and age of the household head decreased the probability. Overall, the literature indicates that khat growing households appear to be those with more land, diversified crops grown, access to extension, higher household income, and with several school-aged children.

The impact of khat on micro- and macroeconomic factors has been studied using both qualitative and quantitative research methods. Gezon (2012a, 2012b), interested in the lives of drug crop producers, conducted a series of interviews in northern Madagascar, aiming to link khat production to food security. Hypothesizing that khat was displacing vegetable production and thus increasing the prominence of food insecurity, the author interviewed individuals involved in the vegetable production supply chain, including farmers, buyers, and sellers. She found that although there was a decrease in vegetable production in the survey area, it was not due to the increase in khat production in the area; the economic market for vegetables had simply weakened, as well as the physical markets and transportation methods (Gezon, 2012a). A separate empirical paper examined how the diversification of traditional home gardens in Ethiopia impacted productivity, and found that vegetable systems diversified with khat did not negatively impact productivity, plant species richness, or food security; rather, khat-based

vegetables systems were found to be more food secure than traditional home gardens (Mellisse, Descheemaeker, Giller, Abebe, & van de Ven, 2018).

Qualitative studies also conducted by Gezon (2012b) recount interviews with civilians, describing the complications of cultivating khat; she explains the common misconception among non-khat growers that the khat plant requires no attention, and therefore requires less labor than other crops. Farmers in Madagascar strongly disagreed with this notion, speaking of the intense labor required to weed, irrigate, monitor, and harvest their khat plots. Pests also threaten the crop, and although some wealthier growers use pesticides, most growers have no access to or cannot afford them (Gezon, 2012b).

Using propensity score matching after determining the factors contributing to the likelihood of growing khat, Njiru, Muluvi, Owuor, and Langat (2013) concluded that income generation is the reason why many households diversify into khat production. Without revenue from khat sales, khat producing households have a lower household income than non-khat producing households (Njiru et al., 2013). On a micro level, Gezon (2012a) postulated that the higher income generated from those who grow khat allowed for higher levels of food security, although this hypothesis was not tested with any empirical methods.

Using secondary data sources and spatial analysis techniques, Dessie (2015) examined the broad relationships between water, khat production, income, and food security in Ethiopia. The author determined that khat production has multiple indirect impacts on food security. Khat production contests for land not only with food crops, but with other land and water uses. It changes land use dynamics and agricultural activity, shifting the focus of agricultural production from food crops to cash crops. This results in less diversification of crops grown, fewer food crops being produced and, therefore, less availability of food. However, khat production

contributes to higher farmer income, allowing khat farmers to purchase available food in the market (Dessie, 2015).

There are few quantitative studies researching the effect of khat production on micro- and macroeconomic factors. Based on this review of past literature, there is a clear need for quantitative research studying these overall impacts, which is where the contribution of this research lies.

Theory

Cash Crop and Technology Adoption

Drug crops are considered cash crops and are often attractive to farmers for several reasons. In a recent paper, Kuma, Dereje, Hirvonen, and Minten (2016) describe benefits to cash crop production for developing countries, focusing on the increase in cash income for those involved. With the excess income, households can purchase more food and non-food goods, supply quality inputs to their farms, and contribute to an overall increase in welfare and prosperity. Cash crops also benefit local labor markets due to the labor intensive nature of production (Poulton, Al-Hassan, Cadisch, Reddy, & Smith, 2011). Kuma et al (2016) describe cash crop production as a practice that "paves the way for agricultural transformation," allowing farmers to enhance their farms, increase yields, and motivate innovation. However, although cash (and drug) crops theoretically provide farmers with broader opportunities, unknown risk is involved (Carrier & Klantschnig, 2016).

Production risk is the initial risk taken on by new cash crop farmers (Fafchamps, 2003). There is a learning curve with adoption of a new practice. A farmer must start from square one, teaching himself different ways to plant, weed, and irrigate a new crop, without certainty that his methods will yield successful harvests. Even if the farmer is successful, he will then encounter

market risk, perhaps the most dangerous of all risks. He must sell in unfamiliar markets without complete understanding of prices, unsure of the revenue he will receive. If export markets are unexpectedly restricted due to a change in legal status in certain countries, prices could fall dramatically. Institutional risk of infrastructure collapse and civil unrest can potentially lead to a decline in the market for the crop. A food crop market crash has less impact as farmers can simply consume the crop. This is not the case for cash crops. According to Fafchamps (2003), a farmer will only adopt cash crop production if their food security is not affected. Otherwise, poor farmers will continue to grow subsistence crops, guaranteeing to feed their family. For farmers in developed countries, taking on these risks does not have a major effect on the livelihood of his family. For those in developing countries, production, market, financial, institutional, and personal risks can severely impact a household's survival (Kahan, 2008). Similarly, adoption of technology involves high risk.

Khat is considered a type of agricultural technology because growing the crop is not available to all due to access to irrigation, funds, knowledge, markets, and other factors. According to Jack (2011), many of the poorest people around the world are farmers. Because of market instabilities, generating revenue from bountiful harvests is often uncertain and complicated, especially in underdeveloped areas. Unlike farmers in developing nations, those in developed countries have high access to valuable technology, allowing for possible expansion of production, increase in yields, increase in revenue, and potential increase in welfare. Jack (2011) highlights seven market inefficiencies that limit farmers in developing countries from adopting advantageous technologies, summarized in Table 3-1.

Table 3-1. Barriers to technology adoption in developing countries

Externalities – Although technologies are intended to help farmers, inadvertent "spillovers" can have negative impacts. Sometimes beneficial technologies are not adopted as anticipated, and those with "spillovers" are adopted extensively.
Input and output market inefficiencies – Weak links in the supply chain can limit farmers from reaching cost-effective input and output markets.
Land market inefficiencies – Issues with land ownership and rights can cause farmers to be weary of adopting new technologies. There is risk with adopting a new technology and then having the land it is being used on taken away.
Labor market inefficiencies – Government restrictions and high costs of labor can inhibit farmers from utilizing extra labor needed to implement new technology.
Credit market inefficiencies – Countries will lower funding opportunities cannot provide credit to their farmers, which is a necessary component to technology adoption.
Risk market inefficiencies – Some farmers are unsure if the loss/risk associated with adopting technology can be counterbalanced with a gain; therefore, they do not adopt.
Informational inefficiencies – Dissemination of information inside a country with fewer forms of communication (few TV's, radios, mobile phones) is difficult. A farmer cannot adopt a technology if they have not heard about it.

Note: All information summarized from existing table in Jack's (2011) paper

Govereha and Jayne (2003) briefly discuss two opinions related to production and farmers' food security. The first opinion is that through cash crop production, households can stimulate economic and agricultural growth and use cash to purchase food without the worry of food crop production. The second opinion is that cash crop production stimulates no growth and inhibits the expansion of vegetable production in the community. Households are not growing their own food, vulnerable to the unpredictable food market, and are more susceptible to food insecurity (Govereh & Jayne, 2003). Dessie (2015) strongly emphasize the idea that although literature relating cash cropping and food security frequently portrays a positive relationship between the two, this is not always the case depending on location.

Food Security

In developing countries, food security is a key measure of household welfare and can be impacted directly (or indirectly) by several household and environmental factors. Measures of food security can indicate the current economic, agricultural, and social state of an area. In developing countries, food availability is more unpredictable due to dependence on rain-fed production and less advanced production practices (Hirvonen et al., 2016). Household diets change during the lean season, often substituting legumes and vegetables (lower in terms of energy and micronutrients) for poultry, fish, and meat. Seasonality affects non-cash crop producing households because they are dependent on the rainy seasons to grow their food, whereas cash crop producing households have cash on hand to purchase food in the market regardless of the season (Hirvonen et al., 2016).

The Economic Research Service (ERS) of the United States Department of Agriculture (2016) published a recent report studying data from Bangladesh, Ethiopia, and India, to determine whether using a measure of caloric consumption or subjective responses to a questionnaire provided more reliable results to determine the level of food insecurity. By evaluating data extracted from the Ethiopian survey, the ERS determined that the level of food insecurity calculated using caloric consumption as a measure was nearly the same as the level calculated from the subjective response questionnaire. This was due to the more detailed questions included in the Ethiopian survey, but not in the other two countries. Although the results for the food insecurity measures from the subjective response questionnaire were reliable, the results from the caloric consumption measures were more robust. Therefore, the ERS concluded both measures of food insecurity were consistent, but the caloric consumption measure could be considered the superior option.

Summary

Previous literature studying the impact of cash crop and technology adoption on household welfare is plentiful, while research examining the khat-specific impacts is often anecdotal and sparse. Past research states that khat producers are different than non-khat producers demographically and socially, and that khat increases household income, and ultimately, increases food security, which is an appropriate measure of an important dimension of household welfare in developing countries. If low-income households are food secure, it is likely due to economic, social, and/or agricultural reasons within their community. Quantitative analysis on the impact of khat production on household welfare is needed to expand the limited knowledge of this controversial plant.

Chapter 4 - Data

Data Source

Data utilized in this research was extracted from a survey conducted by two research institutions in Ethiopia (Tilahun, Tesafa, & Temesgen, 2017). The purpose of the survey was to collect baseline data regarding household demographics, food security, agricultural, and livestock operations, asset acquisitions, health practices and other elements applicable to the Appropriate Scale Mechanization Consortium (ASMC) activities and project (Tilahun et al., 2017).

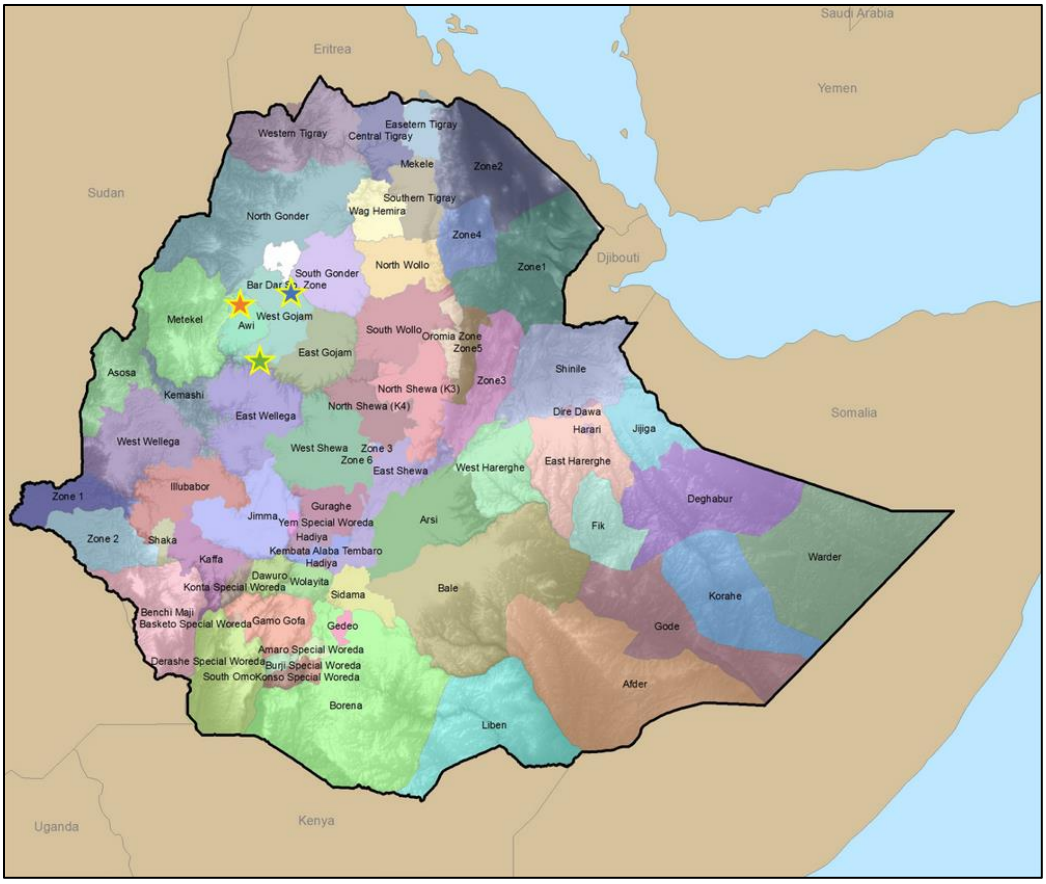
The survey was conducted by Bahir Dar University-Bahir Dar Institute of Technology (BDU-BiT) and Amhara Region Agricultural Research Institute (ARARI) in collaboration with the Feed the Future Innovation Lab for Agricultural Intensification from January 5 to March 6, 2017 (Tilahun et al., 2017). Enumerators surveyed 365 households distributed among three of the 108 districts in Amhara, commonly referred to as woredas.[5] Each woreda belongs to a zone (in this case, either West Gojam or Agew Awi), which forms a region (in this case, Amhara). The sampling design stratified the sample by woreda and used 26 kebeles (smaller, neighborhood units) as the enumeration area. One surveyed household recorded no basic household data but did record data for the rest of the modules. One surveyed household did not record a plot roster but did record data for the modules not involving plot-level data.

The information obtained from the initial survey will serve as a baseline. Each household is expected to obtain assistance from ASMC activities following completion of the survey. The

[5] The three woredas surveyed in the Amhara region are Bahir Dar Zuria, indicated by the blue star, Dangila, indicated by the orange star, and Bure, indicated by the green star in Figure 4-1.

survey will be repeated once households within the woreda have received assistance from ASMC, which will allow changes among households to be measured (Tilahun et al., 2017).

Figure 4-1. Selected survey woreda sites



Reproduced from: (Adugna, 2016a; Colorado State University, n.d.)

Those surveyed are identified by a Respondent Personal Identification Number (PID). The population-based survey instrument (see Appendix A) commences with a household roster, breaking down the number in the household, genders, ages, level of schooling, and other household demographic information. It then asks the household to provide information regarding land owned and rented, including crops produced, inputs used, irrigation resources, labor used, farm tools and machinery, and agricultural mechanization. Assets, income sources, and expenditures are itemized. Also included are sections regarding food security, dietary

consumption, hygiene, diseases, household shocks, loan and credit accessibility, decision making, and extension.

Household Descriptive Statistics

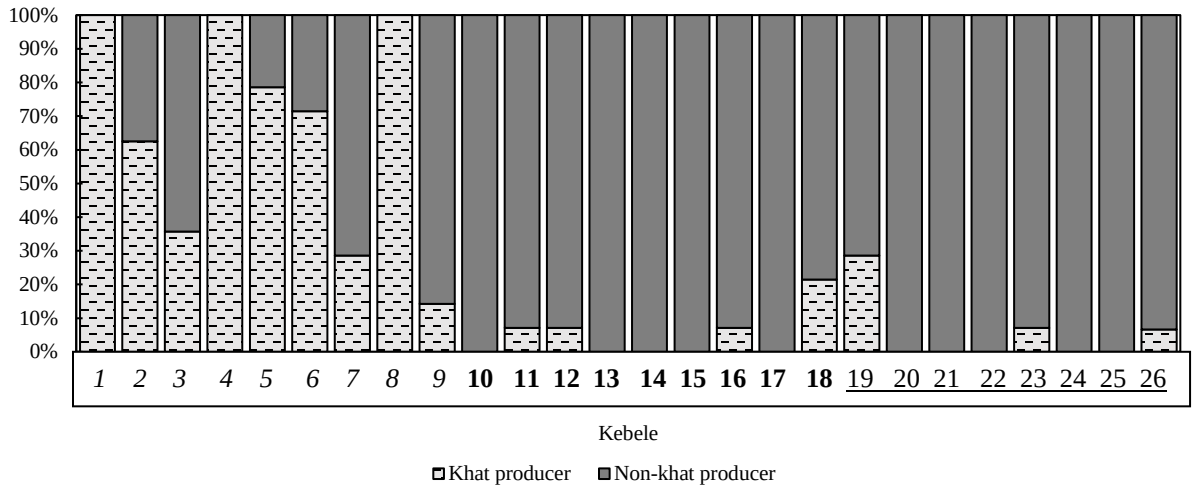
Of the 365 surveyed households, 94 are recognized and coded as khat producing households, while 271 are recognized and coded as non-khat producing households. The distribution of khat and non-khat producers in the household sample among the three woredas and among the 26 kebeles are illustrated in Figures 4-2 and 4-3.

Figure 4-2. Distribution of household sample by woreda

Source: Author's own work

The distribution of the household sample among the three woredas indicates that Bahir Dar Zuria, containing 113 households, is heavily dominated by khat producers, while Bure and Dangila, each containing 126 households, have a significantly smaller proportion of khat producers. The number of households in each kebele ranges from 14 to 16; three kebeles contain only khat producers (1, 4, 8), while ten contain only non-producers (10, 13, 14, 15, 17, 20, 21, 22, 24, 25).

Figure 4-3. Distribution of household sample by kebele



Note: Kebeles in *italics* are located in Bahir Dar Zuria, kebeles in **bold** are located in Dangila, and kebeles that are underlined are located in Bure.

There are 2,209 total members among the households, averaging approximately six people and three children per household. Table 4-1 provides summary statistics for household size, number of children in household, hectares owned, and number of plots owned for khat and non-khat growing households. Khat producing households' average number of family members is 6.4, greater than non-khat producing households' average number of family members (6.0). Additionally, khat producing households exhibit an average of 3.2 children per household, while non-khat producing households have 2.6 children per household. Khat growing households tend to own more land than non-growers (1.9 hectares compared to 1.6 hectares, respectively). They also own 1.1 more plots than non-producers on average.

Table 4-1. Household arrangement of sample

	Non-khat grower				Khat grower			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Number in household	6.0	2.0	1.0	12.0	6.4	1.9	2.0	10.0
Number of children	2.6	1.6	0.0	7.0	3.2	1.7	0.0	7.0
Number of school-aged children	2.3	1.4	0.0	6.0	2.6	1.3	0.0	5.0
Hectares owned	1.6	0.7	0.2	4.0	1.9	0.9	0.5	4.4
Number of plots owned	5.9	2.3	2.0	17.0	7.0	2.8	2.0	16.0

Table 4-2 breakdowns the demographic, credit, and technology adopting variables of the sample. The household sample includes 742 school-aged children (7 years old to 17 years old) and 1,085 adults (older than 17 years old). Of those in a khat growing household, 10.4% of children and 38.6% of adults have no education, compared to 8.3% and 37.8% for non-khat growing households. A greater proportion of children in khat households have completed primary school (79.3% compared to 70.0% of non-khat), but less have completed secondary school (9.9% compared to 20.0% of non-khat). Fewer adults in khat growing households have completed secondary school or university than those in non-khat households (21.8% and 1.9% compared to 28.3% and 3.3%, respectively), but more have finished a literacy program (12.2% compared to 7.2%, respectively). A greater percentage of both children and adults in non-growing households are literate than in khat households (7.4% more and 1.9% more, respectively).

More khat growing households reported a household member suffering from a disease in the past year (37.2%) than non-khat growing households (23.6%). Khat producing households also more frequently reported two or more household members being ill throughout the year,

although the cause of illness is unreported. Regarding access to credit, neither khat nor non-khat growing households borrow money from non-governmental organizations (NGOs) or friends and relatives; rather, their primary source of credit is Rotating Savings and Credit Associations (ROSCAs), savings groups, or credit groups. Of non-khat producers, 23.3% reported borrowing money from ROSCAs, while only 5.4% of khat producers reported the same.

One hypothesis is that khat growers may be more innovative, creative, and technologically advanced than non-khat growers. Because they have already adopted a type of agricultural technology by producing khat, it would be logical to assume that they have experience with other technology. Indications of technology adoption in the survey include the practice of seed saving, use of improved seed, use of fertilizer, and practicing conservation techniques. Although none of these practices are directly associated with cultivating the khat plant, adoption indicates that the household is more technologically advanced than average. More non-khat producers practiced seed saving (83.0%) this past year than khat growers (73.4%). This is not surprising as saving seed is a way for producers to save money rather than a direct indication of innovation. Use of improved seed and fertilizer application among the two groups is nearly equivalent. Nearly 70% of khat growers reported adopting conservation techniques, while only 55.2% of non-khat producers reported the same.

Table 4-3 provides a detailed breakdown of conservation techniques and organic input types. Among non-khat growers, contour ploughing proves to be the favored conservation technique, reported at a frequency of 37.0%. Terraces and cover cropping were reported as the second and third most used conservation technique, reported at frequencies of 14.1% and 13.7%, respectively. Khat growers reported using a wider variety of conservation techniques, not favoring one heavily over the others, indicating that khat producers are more willing to adopt

more varieties of technologies than non-producers. Organic input types do not vary across khat and non-khat producers; for both groups, mulch is the most frequently used, followed by household waste and manure.

Table 4-2. Distribution of household sample by demographic, credit, and technology adoption variables

	Frequency			%		
	Khat grower			Khat grower		
	No	Yes	Total	No	Yes	Total
Education level of children: (*n=742*)						
None	44	22	66	8.3	10.4	8.9
Primary school	371	168	539	70.0	79.3	72.6
Secondary school	106	21	127	20.0	9.9	17.1
Complete university	1	0	1	0.2	0.0	0.1
Literacy program	8	1	9	1.5	0.5	1.2
Education level of adults: (*n=1,085*)						
None	311	101	412	37.8	38.6	38.0
Primary school	193	67	260	23.5	25.6	24.0
Secondary school	233	57	290	28.3	21.8	26.7
Complete university	27	5	32	3.3	1.9	3.0
Literacy program	59	32	91	7.2	12.2	8.4
Ability to read and write						
Children (*n=742*)	477	175	652	90.0	82.6	87.9
Adults (*n=1,085*)	515	159	674	62.6	60.7	62.2
Household suffer from disease (*n=365*)	64	35	99	23.6	37.2	27.1
Multiple household members ill (*n=365*)	15	3	18	5.5	3.2	4.9
Issuance of loan from: (*n=363*)						
Non-governmental organization	2	1	3	0.7	1.1	1.0
Friends and relatives	7	2	9	2.6	2.2	2.5
Savings or credit group	63	5	68	23.3	5.4	18.7
Use of seed saving (*n=365*)	224	69	293	83.0	73.4	80.5
Use of improved seed (*n=365*)	246	87	333	91.1	92.6	91.5
Application of fertilizer (*n=365*)	267	94	361	98.9	100.0	99.2
Conservation practices used (*n=365*)	149	65	214	55.2	69.9	59.0

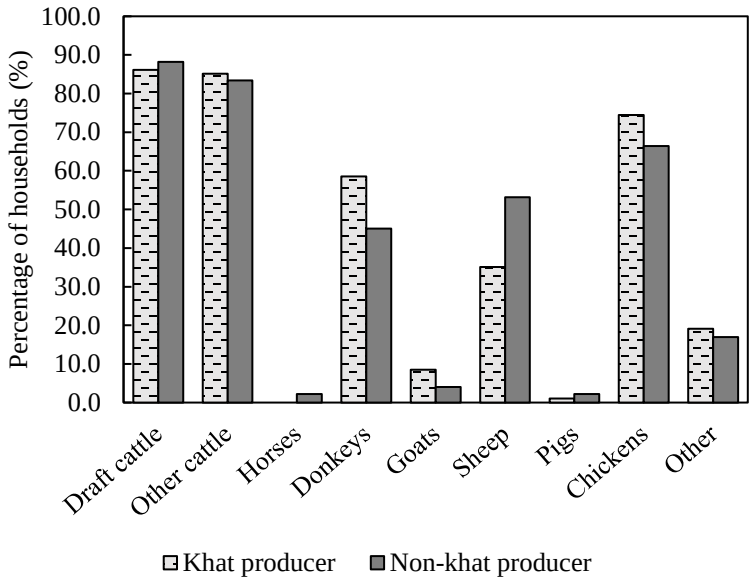
Table 4-3. Distribution of household sample by conservation practices and organic inputs

	Frequency			%		
	Khat grower			Khat grower		
	No	Yes	Total	No	Yes	Total
Main conservation type (*n=363)*						
Not applicable	66	25	91	24.4	26.9	25.1
Contour ploughing/pit planting	100	20	120	37.0	21.5	33.1
Tree/bush/shrub plant rows	22	12	34	8.2	12.9	9.4
Terraces or bunds	38	21	59	14.1	22.6	16.3
Trenches	3	2	5	1.1	2.2	1.4
Cover cropping	37	5	42	13.7	5.4	11.6
Strip cropping	2	6	8	0.7	6.5	2.2
Other	2	2	4	0.7	2.2	1.1
Main organic input type (*n=363*)						
Not applicable	6	3	9	2.2	3.2	2.5
Do not know	1	0	1	0.4	0.0	0.3
Household waste	64	21	85	23.7	22.6	23.4
Mulch	3	4	7	1.1	4.3	1.9
Compost	147	45	192	54.4	48.4	52.9
Crop residue	22	3	25	8.2	3.2	6.9
Manure	24	16	40	8.9	17.2	11.0
Green manure	3	0	3	1.1	0.0	0.8
Other	0	1	1	0.0	1.1	0.3

Although not the most important sector of agricultural activities in Ethiopia, ownership of livestock among the sample groups was common. Figure 4-4 provides the percentage of the household sample that owns certain types of livestock, including animals that are used for agricultural activities, for home consumption, and for products that can be sold for profit in the marketplace. The greatest differences reported among khat and non-khat producers regarding livestock ownership is between donkeys, sheep, and chickens. A higher frequency of khat producers reported owning donkeys and chickens than non-khat producers (58.5% versus 45.0% and 74.5% versus 66.4%, respectively) and a higher frequency of non-khat producers reported

owning sheep than khat producers (53.1% versus 35.1%, respectively). Owning draft cattle and other cattle were reported similarly among the two groups.[6]

Figure 4-4. Percentage of households that own certain livestock



Source: Author's own work

Table 4-4 provides a comparison of income variables among both groups of producers. On average, annual gross household income for khat producers is more than twice as much as non-khat producers (31,588.17 ETB compared to 15,766.01 ETB). The standard deviation for both groups of producers' mean annual gross household income is comparable at 26,006.87 ETB for khat producers and 28,201.36 ETB for non-khat producers. Khat producers' average percentage of total gross income from khat is 38.2%.

[6] Other cattle refers to bulls, fattening cattle, cows, heifers, and calves.

Table 4-4. Household income variables descriptive statistics

	Non-khat grower			Khat grower		
	Median	Mean	S.D.	Median	Mean	S.D.
Annual gross income						
Household	9,800.00	15,766.01	28,201.36	23,050.00	31,588.17	26,006.87
Per person	500.00	2,268.77	5,610.70	3,635.71	4,730.31	4,345.91
Annual gross revenue from khat						
Household	-	-	-	8,000.00	12,490.12	13,282.18
Per person	-	-	-	1,250.00	2,081.94	2,197.88
Total annual expenditure on growing khat						
Household	-	-	-	1,600.00	2,315.35	3,236.56
Per person	-	-	-	250.00	361.19	400.60
Annual net income from khat						
Household	-	-	-	6,028.00	10,700.55	12,258.58
Per person	-	-	-	1,150.00	1,802.68	2,029.20
Percent of gross income from khat						
Household	-	-	-	33.3	38.2	25.5
Per person	-	-	-	33.3	38.2	25.5

Note: All income and expenditure values are measured in Ethiopian Birr (ETB)

Food Security Descriptive Statistics

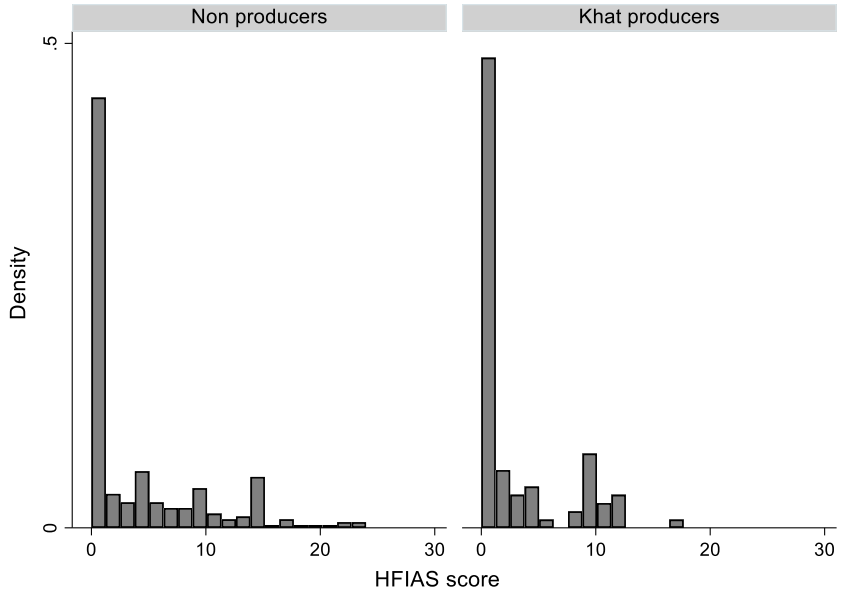
Measures of food security were calculated from the Dietary Diversity and Food Security survey modules. The Food Security module questionnaire and Household Food Insecurity Access Scale (HFIAS) scores were created using the USAID HFIAS for Measurement of Food Access Indicator Guide (Coates, Swindale, & Bilinksy, 2007). The questionnaire contains nine occurrence questions regarding the households' perceptions and behavioral responses to food insecurity, vulnerability or stress. Each household answers all nine questions, responding with one of four answers:

- 0 = Never
- 1 = Rarely (one or two times)
- 2 = Sometimes (three to 10 times)

- 3 = Often (more than 10 times)

The sum of the frequency-of-occurrence in the past month for the nine questions is summed up, creating the HFIAS score for each household. The score falls in the range of 0-27, 0 meaning the household responded "Never" to all questions and 27 meaning the household responded "Often" to all questions. The lower the score, the more food secure the household, while the higher the score, the less food secure the household (Coates et al., 2007). A histogram for HFIAS scores of each sample group in Figure 4-5 shows that a greater proportion of khat producers have extremely high access to food (HFIAS score close to zero) than non-producers. The distribution of HFIAS scores for khat producers is tighter than non-khat, displaying a smaller standard deviation and lower maximum. Overall, it appears that khat producers have a lower average HFIAS than non-khat, indicating higher food access.

Figure 4-5. Household Food Insecurity Access Scale scores histogram



Source: Author's own work

Each household in the sample was also assigned a Household Food Insecurity Access Prevalence (HFIAP) indicator, which classifies each household into one of four possible

categories of food insecurity. Following the category codes found in the HFIAS Indicator Guide (2007), a category variable for each household was calculated. The distribution of Household Food Insecurity Access Prevalence indicators among the sample is found in Table 4-5. While more than half of each group are considered "Food secure" (53.1% for non-khat producers and 57.5% for khat producers), a more significant proportion of non-khat producers (25.8%) are considered "Severely food insecure," compared to only 13.8% of khat producers. Evaluation of food shortage measures in Table 4-6 shows that non-khat growing households reported the ability to store their food longer than khat growing households in both seasons, but experienced food shortages for 0.7 months longer throughout the past year.

Table 4-5. Distribution of Household Food Insecurity Access Prevalence indicators

	Frequency			%		
	Khat grower			Khat grower		
HFIAP category (n=365)	No	Yes	Total	No	Yes	Total
Food secure	144	54	198	53.1	57.5	54.2
Mildly food insecure	18	12	30	6.6	12.8	8.2
Moderately food insecure	39	15	54	14.4	16.0	14.8
Severely food insecure	70	13	83	25.8	13.8	22.7

Table 4-6. Food shortage measures in past year

	Non-khat grower				Khat grower			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Food storage length in months (irrigated season)	2.5	1.5	0.0	8.0	2.1	1.2	0.0	5.0
Food storage length in months (*meher* season)	4.1	1.4	2.0	12.0	3.8	1.3	0.0	12.0
Months experienced food shortage	0.9	2.4	0.0	12.0	0.1	0.4	0.0	3.0

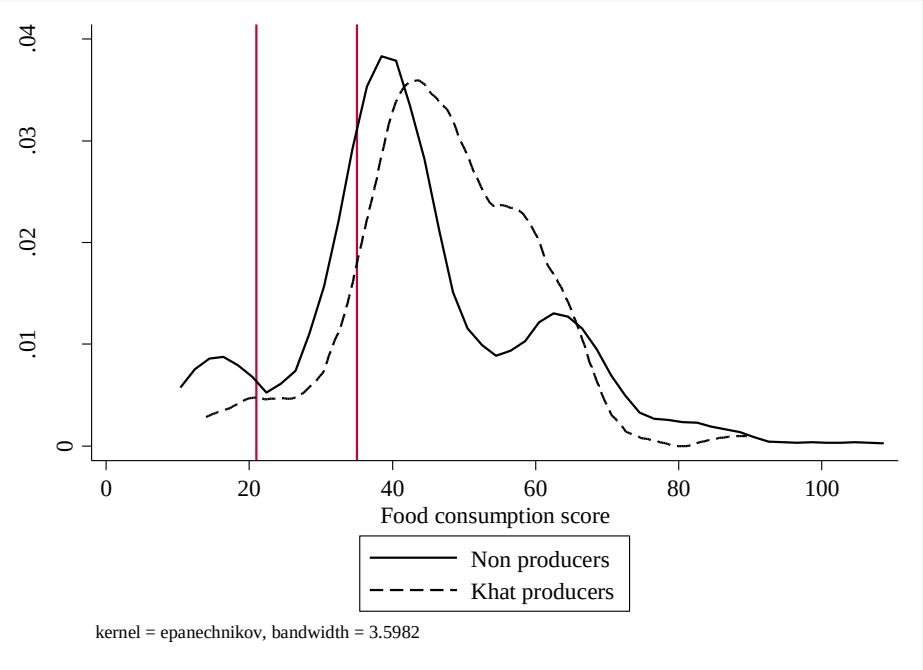
A Food Consumption Score (FCS) was calculated for each household in the sample following the guide prepared by the United Nations World Food Programme Vulnerability

Analysis and Mapping Branch (Vulnerability Analysis and Mapping Branch, 2008). Although formal reports or analyses including the FCS have been completed in many African countries, including Lesotho, Malawi, Mozambique, and Zambia, Ethiopia has no official published reports that include these measures (Vulnerability Analysis and Mapping Branch, 2008).

The score was calculated by first grouping all responses in the Dietary Diversity survey module into the nine Food Consumption Groups (FCGs): main staples, pulses, vegetables, fruit, meat and fish, milk, sugar, oil, and condiments. The frequencies of each food group are added up and coded as seven if the number is above seven. Each value is then multiplied by an assigned food group weight, and then all values are summed, creating the FCS (Vulnerability Analysis and Mapping Branch, 2008). There are three thresholds that FCSs fall into: poor food consumption (0-21), borderline food consumption (21.5-35), and acceptable food consumption (>35).

A Kernel density estimate of FCSs along with the thresholds, indicated by vertical markers, is included in Figure 4-6. Comparing the FCSs, khat producers display a more favorable average score of 46.9 with a standard deviation of 12.4, while non-khat producers demonstrate a less favorable average score of 43.4 with a standard deviation of 16.4. Additionally, the FCS thresholds show that 87.1% of khat producers have acceptable food consumption compared to 72.0% of non-khat producers, and that a higher percentage of the non-khat producing sample exhibits borderline or poor food consumption than the khat producing sample.

Figure 4-6. Kernel density estimate of food consumption scores among khat and non-khat producing households



Source: Author's own work

Land Descriptive Statistics

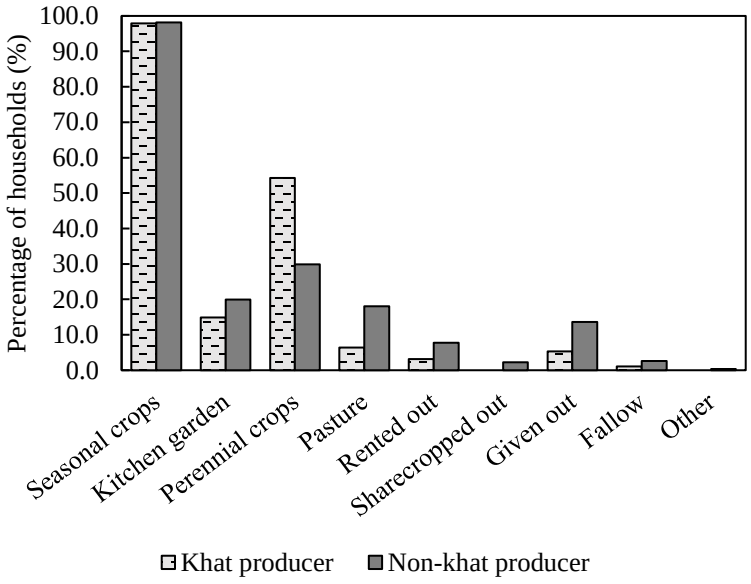
Each respondent identified the plots they owned, and data was collected on each, including use of plot, plot characteristics, irrigation methods, and inputs used. Of the 2,264 plots included in the survey, 93 plots grew khat and 2,171 grew other crops. A comparison of plot characteristics such as soil fertility, plot slope, soil type, and soil erosion among khat and non-khat plots is found in Table 4-7. A higher percentage of khat plots were reported as fertile than plots growing other crops, but interestingly, nearly all khat plots (86.0%) are planted on a flat slope. Soil types and erosion does not vary greatly among the types of plots.

Table 4-7. Distribution of land sample by plot characteristics

	Frequency			%		
	Khat plot			Khat plot		
	No	Yes	Total	No	Yes	Total
Soil fertility (*n=2,264*)						
Unsure or not applicable	12	0	12	0.6	0.0	0.5
Did not respond	53	1	54	2.4	1.1	2.4
Fertile	1,396	73	1,469	64.3	78.5	64.9
Medium fertile	618	19	637	28.5	20.4	28.1
Less fertile	92	0	92	4.2	0.0	4.1
Plot slope (*n=2,264*)						
Unsure or not applicable	6	0	6	0.3	0.0	0.3
Did not respond	53	1	54	2.4	1.1	2.4
Flat	1,718	80	1,798	79.1	86.0	79.4
Steep	376	11	387	17.3	11.8	17.1
Steeper	18	1	19	0.8	1.1	0.8
Soil type (*n=2,264*)						
Unsure or not applicable	10	10	20	0.5	0.0	0.9
Did not respond	52	53	105	2.4	1.1	4.6
Clay	213	213	426	9.8	11.8	18.8
Sandy	280	280	560	12.9	11.8	24.7
Loamy	1,605	1,605	3,210	73.9	75.3	141.8
Silt	10	10	20	0.5	0.0	0.9
Soil erosion (*n=2,264*)						
Unsure or not applicable	12	0	12	0.6	0.0	0.5
Did not respond	53	1	54	2.4	1.1	2.4
No erosion	1,198	54	1,252	55.2	58.1	55.3
Mild erosion	839	38	877	38.7	40.9	38.7
Severe erosion	69	0	69	3.2	0.0	3.0

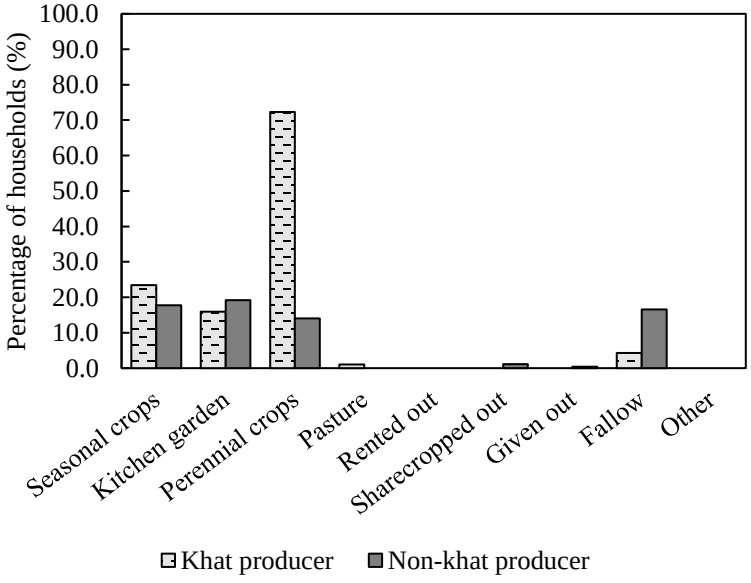
In total, 367 of the 2,264 plots in the sample were reported as irrigated. Due to enumerator confusion, some khat growers were not asked about irrigation on their khat plots. For this reason, only 67 of the 93 khat plots (72.0%) were reported as irrigated. Because of this, a different approach to measuring irrigation access was used. Each household was marked with a binary code for each type of plot use for each season. Figures 4-7 and 4-8 identify the reported usage of plots for households during each season, *meher* and irrigated.

Figure 4-7. Percentage of households using at least one plot for specified reason during the *meher* season



Source: Author's own work

Figure 4-8. Percentage of households using at least one plot for specified reason during the irrigated season



Source: Author's own work

During the *meher* season, nearly all households reported growing seasonal crops on at least one of their plots. Over half of khat producers (54.3%) grew perennial crops on at least one of their plots, while only 29.9% of non-khat producers reported the same. Using a plot for

kitchen gardens was reported by 19.9% of non-khat producers and 14.9% of khat producers. More non-khat producers also reported using at least one of their plots for pasture (18.1%), giving out temporarily to others (13.7%), and renting out (7.7%) than khat producers (6.4%, 5.3%, and 3.2%, respectively). Sharecropping during the *meher* season is not common among either types of producers.

During the irrigated season, 72.3% of khat producers reported growing perennial crops on at least one of their plots, compared to 14.0% of non-khat producers, indicating that khat producers have easier access to irrigation. Growing seasonal crops was reported by 23.4% of khat producers, and 16.0% reported using at least one of their plots as a kitchen garden, comparable to non-khat growers (17.7% and 19.2%, respectively). Letting a plot lie fallow was more popular among non-khat producers than khat producers (16.6% compared to 4.3%). Overall, non-khat producers do not use their plots during the irrigated season to the same capacity as khat producers.

Only 300 of the 2,171 non-khat plots (13.8%) were reported as irrigated, pointing to the fact that khat requires irrigation more intensively than other crops. Frequency analysis of the Irrigation survey module is included in Table 4-8, identifying sources of water, type of well, method of irrigation, method of obtaining water for irrigation, frequency of irrigation, and self-perceived water availability.

Table 4-8. Distribution of land sample by irrigation access and methods

	Frequency			%		
	Khat plot			Khat plot		
	No	Yes	Total	No	Yes	Total
Water source (*n=367*)						
Ground-water	39	22	61	13.0	32.8	16.6
Body of water (river, pond)	228	31	259	76.0	46.3	70.6
Other	33	14	47	11.0	20.9	12.8
Type of well (*n=367*)						
Not applicable	260	46	306	86.7	68.7	83.4
Drilled	0	0	0	0.0	0.0	0.0
Hand-dug	40	21	61	13.3	31.3	16.6
Irrigation method (*n=367*)						
Surface/flooding	152	34	186	50.7	50.8	50.7
Drip	11	1	12	3.7	1.5	3.3
Furrow	113	11	124	37.7	16.4	33.8
Level basin	1	0	1	0.3	0.0	0.3
Bucket/hose/watering can	16	20	36	5.3	29.9	9.8
Other	7	1	8	2.3	1.5	2.2
Water obtaining method (*n=367*)						
Unsure	11	2	13	3.7	3.0	3.5
Gravity	141	16	157	47.0	23.9	42.8
Hand/foot pump	5	0	5	1.7	0.0	1.4
Hand bucket/hose	19	14	33	6.3	20.9	9.0
Diesel pump	121	34	155	40.3	50.8	42.2
Other	3	1	4	1.0	1.5	1.1
Irrigation frequency (*n=367*)						
Unsure	39	11	50	13.0	16.4	13.6
At least once a day	47	2	49	15.7	3.0	13.4
Every other day	10	3	13	3.3	4.5	3.5
At least once a week	100	32	132	33.3	47.8	36.0
2-3 times a month	85	17	102	28.3	25.4	27.8
1 time a month	19	2	21	6.3	3.0	5.7
Water availability (*n=367*)						
Unsure	1	0	1	0.3	0.0	0.3
Did not respond	6	1	7	2.0	1.5	1.9
Always when needed	132	33	165	44.0	49.3	45.0
Usually	45	17	62	15.0	25.4	16.9
Sometimes	104	15	119	34.7	22.4	32.4
Rarely	12	1	13	4.0	1.5	3.5

According to Table 4-8, khat plots are irrigated from a wider variety of sources, including bodies of water, like rivers, ponds, and dams (46.3%), ground water (32.8%), and other (20.9%), while water for other crop plots comes from a narrower variety of sources, mainly bodies of water (76.0%). For all plots, if a well is utilized in their irrigation, all of them are hand-dug and not drilled. The main irrigation method for both khat and other crop plots is surface irrigation or flooding, but secondary irrigation methods differ. For khat plots, hand watering with a bucket, hose, or watering can is the second most favored method with a frequency of 29.9%, followed by furrow irrigation with a frequency of 16.4%. For non-khat plots, furrow is the second favored irrigation method with a 37.7% frequency. Obtaining the water for khat plots is from three primary sources: diesel pumps, gravity, and hand bucket or hose, with frequencies of 50.8%, 23.9%, and 20.9%, respectively. Other crop plots obtain water from two main sources, gravity (46.2%) and diesel pumps (39.7%). Approximately half of both groups of plots always have water available when needed, but the remainder of non-khat plots were reported as having less availability to water, with 34.7% of plots sometimes having availability and 4.0% of rarely having availability. Overall, producers who grow khat on their plots use a variety of water sources, irrigation methods, and water obtaining methods, indicating higher prevalence of experimentation, production proficiency, and willingness to adopt new technologies or production methods, while non-khat plots reported the opposite, indicating less of a tendency for experimentation or willingness to adopt new production or irrigation methods.

Tables 4-9 and 4-10 look specifically at the 67 reported irrigated khat plots, analyzing the water obtaining method and irrigation method by water source, and the irrigation frequency and water availability by irrigation method.

Table 4-9. Water obtaining method and irrigation method by water source for khat plots

	Water source			
	Ground water	Body of water	Other	Total
Water obtaining method (*n=67*)				
Unsure	0	2	0	2
Gravity	3	11	2	16
Hand bucket/hose	13	0	1	14
Diesel pump	6	18	10	34
Other	0	0	1	1
Irrigation method (*n=67*)				
Surface/flooding	7	17	10	34
Drip	0	1	0	1
Furrow	0	10	1	11
Bucket/watering can	14	3	3	20
Other	1	0	0	1

Table 4-10. Irrigation frequency and water availability by irrigation method for khat plots

	Irrigation method					
	Surface or flooding	Drip	Furrow	Bucket and hose	Other	Total
Irrigation frequency (*n=67*)						
Unsure	7	0	0	4	0	11
At least once a day	1	0	1	0	0	2
Every other day	2	0	0	1	0	3
At least once a week	17	0	2	13	0	32
2-3 times a month	7	0	7	2	1	17
1 time a month	0	1	1	0	0	2
Water availability (*n=67*)						
Did not respond	1	0	0	0	0	1
Always when needed	19	1	4	8	1	33
Usually	5	0	2	10	0	17
Sometimes	9	0	4	2	0	15
Rarely	0	0	1	0	0	1

Of the 67 reported irrigated khat plots, nearly half (46.3%) are irrigated from a body of water, while 31.3% are irrigated by ground water. Of the plots irrigated from a body of water,

58.1% obtain water using a diesel pump and 35.5% from gravity. Surface irrigation and furrow irrigation are the preferred irrigation methods when the plot is irrigated from a body of water (54.8% and 32.3%, respectively). Of the plots irrigated from ground water, 59.1% obtain water using a hand bucket or hose, while 27.3% use a diesel pump. More than half (63.6%) of plots using ground water are irrigated by using a bucket or watering can, while 31.8% are irrigated using surface or flooding irrigation.

Approximately half (50.7%) of irrigated khat plots use surface or flooding as the irrigation method, 29.9% irrigate by hand with a bucket and hose, and 16.4% use furrow irrigation. Of those using surface or flooding irrigation, half are irrigated at least once a week, and 20.6% are irrigated 2-3 times a month. Water is always available when needed for 55.9% of surface irrigated khat plots. Of those irrigated by hand, 65.0% are irrigated at least once a week and 90.0% have water available usually or always when needed.

Tables 4-11, 4-12, and 4-13 provide summary statistics for total days per year devoted to plots by family members, hired labor, and exchanged labor. For each household, total family labor days for each activity was calculated by summing up all labor days reported for males, females, and children. Total days hired labor for each activity was calculated by summing up all labor days reported by hired labor, and this process was similarly repeated to calculate total days exchanged labor.[7] The All Activities variable was calculated by summing up all labor days for each activity for the respective labor type.

[7]Exchanged labor refers to "a labor sharing group in which reciprocity to members is upon demand either within the same season or in the future." This information is included in the Hired and Exchange Labor module of the survey.

Table 4-11. Total days per year family labor used in past year agricultural activities

	Other crop plot				Khat plot			
Activity	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Land prep.	5.7	5.1	0.0	43.0	10.7	11.9	0.0	48.0
Planting	4.3	4.0	0.0	42.0	11.0	13.2	0.0	54.0
Fertilizing	2.9	3.2	0.0	26.0	2.8	4.1	0.0	18.0
Weeding	6.0	6.3	0.0	54.0	12.4	13.4	0.0	50.0
Irrigating	0.4	1.8	0.0	21.0	12.7	19.1	0.0	72.0
Harvesting	5.3	4.6	0.0	60.0	16.1	19.8	0.0	72.0
Post-harvest	4.3	4.3	0.0	70.0	3.2	4.6	0.0	24.0
Marketing	1.7	1.9	0.0	12.0	7.5	8.5	0.0	24.0
All activities	31.1	22.7	0.0	197.0	76.7	80.8	0.0	282.0

Table 4-12. Total hired labor days per year used in past year agricultural activities with wage paid

	Other crop plot				Khat plot			
Activity	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Land prep.	1.0	6.3	0.0	80.0	4.6	15.9	0.0	70.0
Planting	0.6	3.2	0.0	80.0	0.7	1.8	0.0	8.0
Fertilizing	0.2	0.8	0.0	6.0	0.4	1.2	0.0	6.0
Weeding	1.8	7.8	0.0	60.0	11.1	25.0	0.0	80.0
Irrigating	0.0	0.4	0.0	4.0	1.1	3.8	0.0	20.0
Harvesting	2.3	10.9	0.0	100.0	17.7	37.4	0.0	100.0
Post-harvest	1.5	9.5	0.0	80.0	11.0	31.4	0.0	100.0
All activities	7.5	31.7	0.0	290.0	46.5	97.8	0.0	350.0
Wage (Birr)	91.3	172.5	3.0	1680.0	223.8	442.0	20.0	1680.0

Table 4-13. Total exchanged labor days per year used in past year agricultural activities

	Other crop plot				Khat plot			
Activity	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Land prep.	0.3	1.0	0.0	10.0	0.4	1.2	0.0	4.0
Planting	0.4	1.2	0.0	14.0	0.5	1.2	0.0	4.0
Fertilizing	0.2	1.0	0.0	13.0	0.2	0.6	0.0	2.0
Weeding	0.6	1.6	0.0	13.0	0.6	1.7	0.0	7.0
Irrigating	0.3	4.1	0.0	80.0	0.4	0.8	0.0	3.0
Harvesting	1.6	3.8	0.0	60.0	0.8	1.7	0.0	6.0
Post-harvest	0.8	2.8	0.0	60.0	0.3	0.8	0.0	3.0
All activities	4.1	8.7	0.0	120.0	3.1	6.8	0.0	23.0

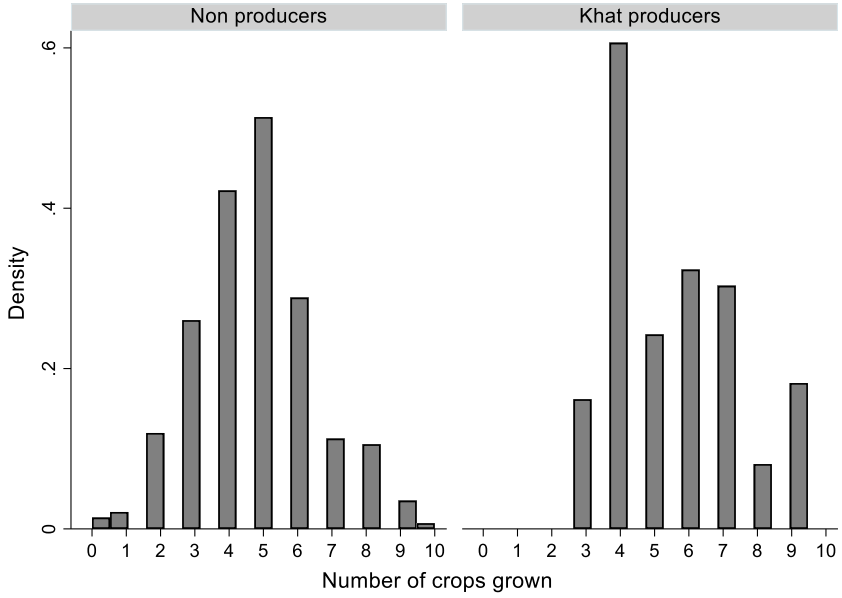
Average total family labor days for all activities on khat plots is 45.6 days more per year than on non-khat plots. Average total hired labor days for khat plots is greater than average total

hired labor days on non-khat plots for each activity, and average wage paid to hired laborers on khat plots is 132.50 ETB higher than the wage paid to laborers on non-khat plots. Regarding exchanged labor, average total days per year is comparable among khat and non-khat plots for each activity.

Crops Descriptive Statistics

Between the khat and non-khat producing households, the data indicate 2,468 crops being grown on 2,264 plots. Although most plots are dedicated to the sole production of one crop, some plots are used for multiple, seasonal crops throughout the year; therefore, the total crops grown amount is larger than the plot amount. Overall, khat producers grew 718 crops on 658 plots, while non-khat producers grew 1,688 crops on 1,606 plots. The number of crops grown by each household varies from 0-10, illustrated in Figure 4-9.

Figure 4-9. Number of crops grown per household histogram

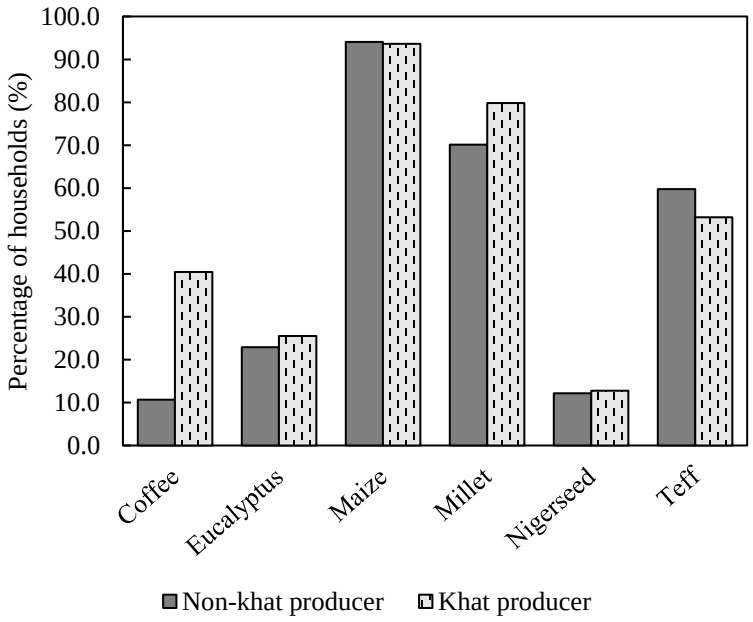


Source: Author's own work

On average, non-khat producers grow 4.8 crops on their farms and khat producers grow 5.5 crops on their farms, indicating a higher diversity of crops grown by non-producers.

Comparing which crops are being grown among the two groups is essential to understanding their differing overall farming and livelihood strategies. Figure 4-10 identifies the distribution of the household sample by most common crops grown, highlighting maize and millet as crops that over 70% of all producers grow, teff as a crop that over 50% of all producers grow, eucalyptus as a crop that over 20% of all producers grow, and coffee and nigerseed as crops that over 10% of all producers grow.[8] Figure 4-11 highlights the most similar crops grown, focusing on crops with less than a 1.0% difference in percentage of households, while Figure 4-12 highlights the most dissimilar crops grown, focusing on crops with more than a 10.0% difference in percentage of households.

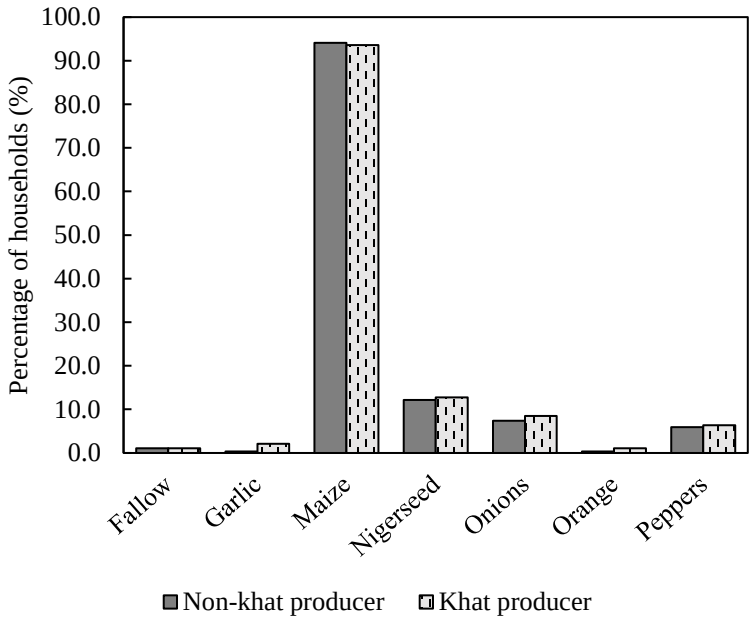
Figure 4-10. Percentage of household sample by most common crops grown



Source: Author's own work

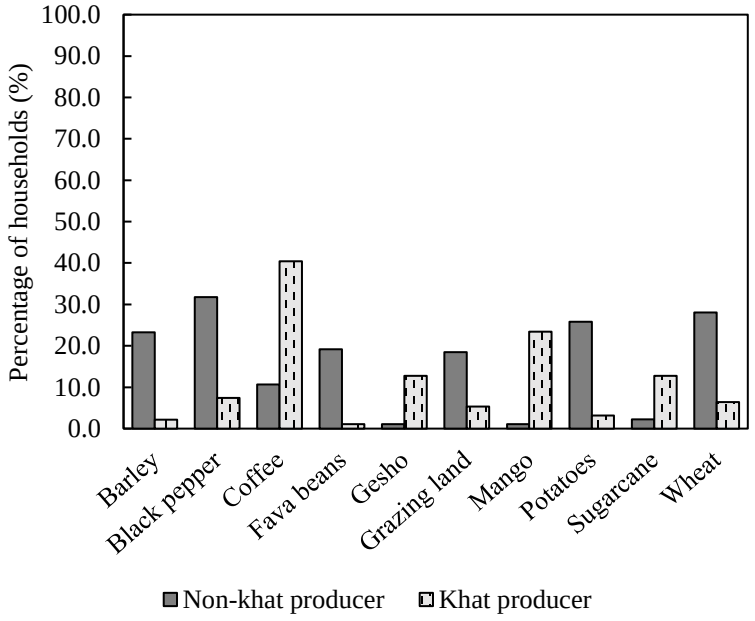
[8] The overall analysis of the percent of households growing each type of crop included in the survey can be found in Appendix B.

Figure 4-11. Percentage of household sample by similar crops grown



Source: Author's own work

Figure 4-12. Percentage of household sample by dissimilar crops grown



Source: Author's own work

Additionally, the three woredas within the sample area are affected differently by environmental, economic, and market factors, such as differing rainfall levels, access to

irrigation, cost of transportation to the market, and access to the market. Producers in certain locations may have a higher tendency to grow and sell their crops in the market rather than consume their harvest due to the above specified reasons. A comparison of total crops sold and consumed among khat and non-khat producers in each woreda is necessary.[9]

Location Separation

The survey sample is divided into three woredas: Bahir Zar Zuria (woreda 1), Dangila (woreda 2), and Bure (woreda 3). An overall comparison of the percentage of total crops sold or consumed for each woreda is included in Table 4-14.

Table 4-14. Comparison of percentage of total crops sold or consumed for each woreda

	Obs.	Sold	Consumed
Bahir Dar Zuria			
Non-khat grower	218	65.6	34.4
Khat grower	560	62.1	37.9
Dangila			
Non-khat grower	707	57.0	43.0
Khat grower	30	46.7	53.3
Bure			
Non-khat grower	647	66.2	33.8
Khat grower	67	71.6	28.4

Bahir Dar Zuria contains the highest density of khat producers, is located within the West Gojam zone of Amhara, and is the northernmost woreda of those in the survey. There are 113 surveyed households in this woreda, of which 81 are khat producing. In total, khat producing households consumed or sold 560 crops and non-khat producing households consumed or sold

[9] After comparing crops grown data with crops sold data, there were instances where a crop was listed as having been sold but not grown. It is not evident whether this is a case of crop or grain storage from the past year or an enumerator error in collecting the data. These crops were coded as being sold.

218 crops. Non-khat growers and khat growers of this woreda consume 34.4% and 37.9% of their grown crops, and sell 65.6% and 62.1% of their grown crops, respectively.

Dangila is located within the Agew Awi zone of the Amhara and is approximately 45 miles west and slightly south of woreda 1. This non-khat dominated woreda provided 126 households from the survey, of which 121 are non-khat producing. In total, non-khat producing households consumed or sold 707 crops and khat producing households consumed or sold 30 crops. According to Table 4-14, non-khat growers consume 43.0% of their grown crops, while khat growers consume over half (53.3%) in Dangila.

Bure is located within the West Gojam zone of Amhara, approximately 65 miles south and slightly west of Bahir Dar Zuria, and is the southernmost woreda included in the survey. This non-khat dominated woreda provided 126 households from the survey, of which 118 are non-khat producing. In total, non-khat producing households consumed or sold 647 crops and khat producing households consumed or sold 67 crops. According to Table 4-14, non-khat growers in Bure consume 33.8% of their grown crops, and khat growers consume 28.4%.

Tables 4-15 and 4-16 provide a condensed analysis of the percentage of each type of crop sold and consumed for non-khat and khat producers in each woreda, identifying the top three crops sold and top three crops consumed. For Bahir Dar Zuria, maize and millet are sold frequently. Instead of selling khat, non-khat producers sell nigerseed in the market. Consumption habits among these producers are vastly different; non-producers consume or use maize, eucalyptus, and teff, while khat producers consume or use khat, millet, and coffee. For Dangila, maize, millet, and teff are sold frequently and eucalyptus, millet, and teff are consumed frequently among both groups. Non-khat producers diversify their consumption crop by consuming khat. For Bure, maize is the only common crop sold among both groups; non-khat

producers sell black pepper and wheat, while khat producers sell coffee and khat. Both producers consume millet, maize, and teff; khat producers consume wheat and coffee in addition to the overlapping consumed crops.

Table 4-15. Top three crops sold among sample groups

Non-khat producers		Khat producers	
Crop name	%	Crop name	%
Bahir Dar Zuria		**Bahir Dar Zuria**	
Maize	15.1	Maize	15.7
Millet	8.3	Millet	12.1
Nigerseed	7.3	Khat	9.8
Dangila		**Dangila**	
Maize	22.2	Maize	10.0
Millet	11.3	Teff	10.0
Teff	6.6	Millet	6.7
Bure		**Bure**	
Maize	14.5	Maize	14.9
Black pepper	12.8	Coffee	13.4
Wheat	8.0	Khat	11.9

Table 4-16. Top three crops consumed among sample groups

Non-khat producers		Khat producers	
Crop name	%	Crop name	%
Bahir Dar Zuria		**Bahir Dar Zuria**	
Maize	7.3	Khat	6.3
Eucalyptus	5.5	Millet	5.5
Teff	4.1	Coffee	4.8
Dangila		**Dangila**	
Millet	6.6	Eucalyptus	13.3
Teff	6.6	Khat	6.7
Eucalyptus	6.5	Millet, teff	6.7
Bure		**Bure**	
Millet	7.3	Teff	10.4
Maize	6.5	Wheat, millet	3.0
Teff	4.0	Maize, coffee	3.0

Khat Production and Consumption Descriptive Statistics

The Khat Production survey module questionnaire was administered to households who self-identified as khat producers. Non-producers answered an abridged version. There are 94

khat producing households within the sample; 90 of the khat producing households self-identified as khat growers within the survey, while the remaining four identified as non-khat producers. It was found while cleaning the data that although they did not self-report as being a khat producer, they reported growing or selling khat in the past year. For this reason, these four households are coded as khat producing households, although they responded to the abridged survey module questionnaire rather than the Khat Production survey module questionnaire. A similar situation occurred with non-khat producers. Therefore, only 251 non-khat producers completed the entire abridged questionnaire. Table 4-17 provides the distribution of khat plot expansion, khat selling, consumption, and ethical belief variables. while Table 4-18 illustrates the previous use of a plot prior to conversion to khat production.

Table 4-17. Distribution of khat plot expansion, khat selling, consumption, and ethical belief variables

	Frequency		%	
	Khat grower		Khat grower	
	No	Yes	No	Yes
Recently converted plots to khat production (*n=90*)	N/A	40	N/A	44.4
Purchased or rented new plots for khat production (*n=90*)	N/A	8	N/A	8.9
Plan to plant new or additional plots in next five years (*n=342*)	31	30	12.3	33.3
Repeat purchaser (*n=90*)	N/A	15	N/A	16.7
Specific agreement or contract (*n=90*)	N/A	15	N/A	16.9
Set price agreement (*n=90*)	N/A	3	N/A	3.4
Household khat consumption prior to production (*n=90*)	N/A	4	N/A	4.4
Current household khat consumption (*n=340*)	3	5	1.2	5.7
Belief of harmful health effects (*n=342*)	128	68	50.8	75.6

Table 4-18. Previous use of plot before converting to khat production

	Frequency	%
Not applicable	43	47.8
Maize	5	42.2
Vegetables	38	5.6
Other grains	3	3.3
Pasture/grazing	1	1.1

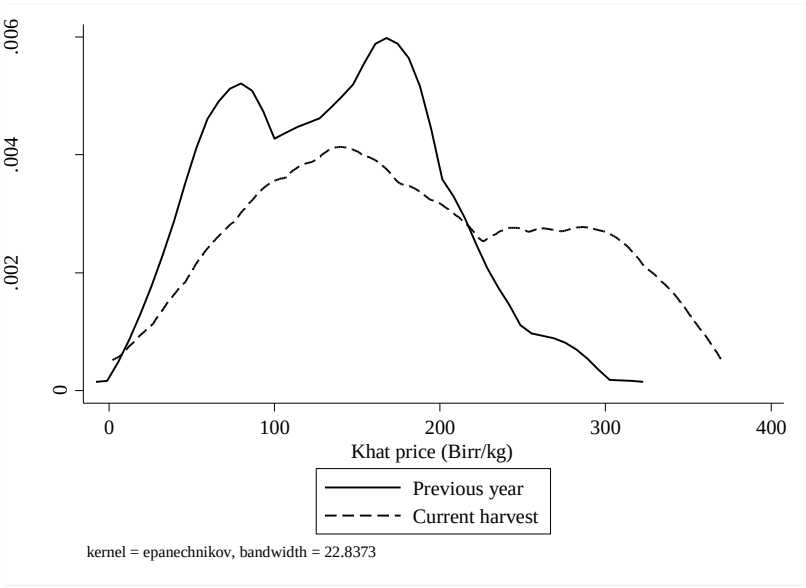
Nearly half of khat producers (44.9%) reported converting plots to khat production in the past year, and 8.9% of khat producers reported purchasing or renting new plots for khat production in the past year. Nearly half of households previously used the converted khat plot for maize production (42.2%), while 5.6% previously used the plot for vegetables, 3.3% for other grains, and 1.1% for pasture or grazing. Additionally, 33.3% of khat producers plan to plant new or additional khat plots in the next five years, while 12.3% of non-khat producers plan to begin growing khat on their farm. This gives indication that khat production has a certain type of appeal; those who have not tried it are intrigued and are interested in growing it, while for those who have tried it, one-third of them are willing to not only plant again but expand their production. Regarding khat selling, using specific contracts or set price agreements is not common. The majority of khat producing households did not consume khat prior to growing it and report not consuming it. Interestingly, more khat producers believe that khat has harmful health effects than non-khat producers (75.6% and 50.8%, respectively).

Table 4-19 provides summary statistics for khat harvesting frequency, revenue generated, and price received, and Figure 4-13 provides a Kernel density estimation for khat prices.

Table 4-19. Harvesting frequency, revenue generated, and price received from each harvest

	Median	Mean	S.D.	Min	Max
Harvest frequency of past year	20.00	26.99	33.03	2.00	220.00
Revenue generated from each harvest (Birr)	500.00	2,222.68	6,065.64	25.00	45,000.00
Most recent harvest khat price (Birr/kg)	180.00	182.98	88.53	2.00	370.00
Previous year khat price (Birr/kg)	150.00	135.43	61.26	15.00	300.00

Figure 4-13. Kernel density estimation for khat prices from previous year and current harvest



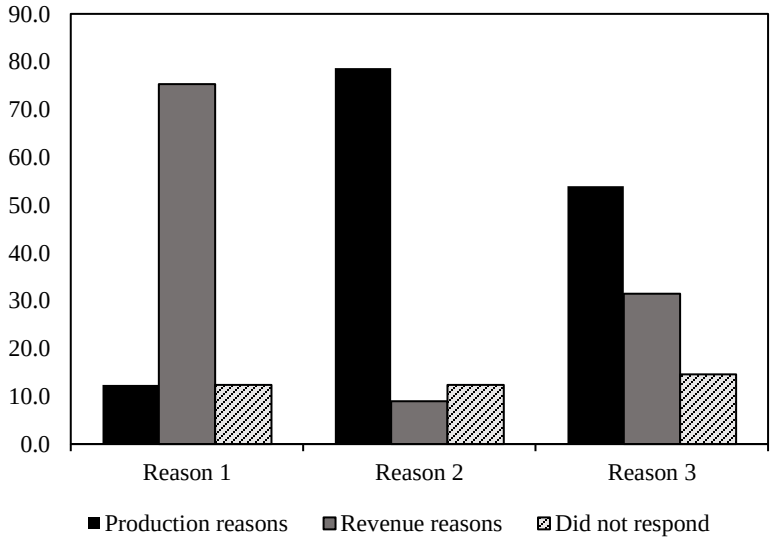
Source: Author's own work

The average number of harvests from khat plants on a khat growing farm throughout the year is 27, ranging from 2 times to over 200 times. Revenue generated from each harvest varies with a mean of 2,222.68 ETB and standard deviation of 6,065.64 ETB. The average price received from the recent khat harvest is 47.55 ETB more than the previous year (182.98 ETB versus 135.43 ETB). The Kernel density estimation indicates a bimodal distribution for the previous year harvest, and the current harvest has a more normal distribution, while still indicating bimodal tendencies. However, the estimates of khat price may not be consistent across

the sample. Khat is not always sold by measured weight; it is sometimes sold in bunches, which could (or could not) be close to the standard kilogram selling unit. Quality is also not measured. One kilogram of high-quality khat could have been sold for 200 ETB while one kilogram of low-quality khat could have been sold for 50 ETB—these are not comparable prices because they are not comparable products. The survey does not take this into account.

The main reasons for producing khat reported by khat producers is found in Figure 4-14, highlighting two main motives: production reasons and revenue reasons. Figure 4-15 displays the main reasons for not producing khat reported by non-khat producers.[10]

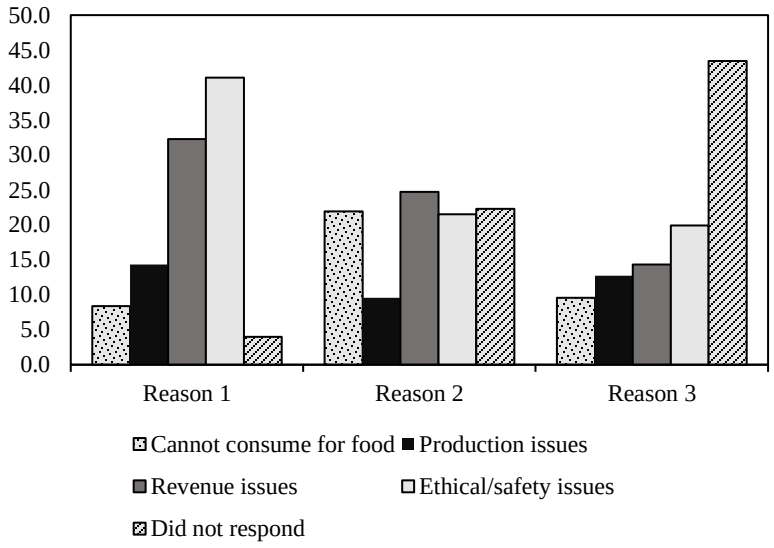
Figure 4-14. Reasons for producing khat



Source: Author's own work

[10] Coarse groups were created to create the figures.

Figure 4-15. Reasons for not producing khat



Source: Author's own work

The main reason for producing khat is revenue-related; digging further into this reveals that specifically, higher total profit is why khat producers continue production. The second reason is production-related, specifically the opportunity for multiple harvests throughout the year. The third reason (although fewer households responded to this question) is also production-related, highlighting less time needed for production. Khat producers were not asked about the ethics of khat production. For non-khat producers, the main reason for not producing is split between the belief that khat is an evil product (ethical/safety issue) and the belief that khat prices are unstable (revenue issue). The second reason for not producing is relatively equally dispersed between the belief that khat prices are unstable, khat is an evil product, and that khat cannot be consumed for food. The third reason reveals a similar pattern to the second. Overall, most non-khat producers claim to not produce because of negative ethical beliefs related to khat, surprisingly not due to issues with high initial investments, difficult production, water shortages, or land shortages.

Chapter 5 - Empirical Methods

The purpose of this research is to determine key factors affecting the decision to produce or not produce khat and successively use this information to determine the effect of khat growing on several outcome variables, including on-farm adult male labor, on-farm adult female labor, household income, expenditure on education, food consumption score, and food shortage months. Logit and linear probability models are utilized for the first stage of regression, followed by propensity score analysis for the second stage.

Stage 1: Modeling the Khat Growing Decision

Application of both logit and linear probability models was used to estimate the relationship between the binary dependent variable and socioeconomic, demographic, and institutional factors. Analysis using these models highlights factors that positively or negatively affect the probability that a surveyed farmer produces khat.

The logit model is one way to estimate the effect of multiple variables on a binary outcome variable. Logit models are a type of binary response model that assume logistic cumulative distribution and model conditional expectation (Davidson & MacKinnon, 2004). The dependent variable (D_i) can take on two values, 0 and 1; in this case, producing khat was taken as 1, while not producing was taken as 0. The size and direction of the betas (β_i) will indicate the influence a certain independent variable has on the dependent variable. The decision to be modeled is whether to produce khat or not produce khat. In linear terms:

$$D_i = \beta_0 + \beta_1 H_i + \beta_2 T_i + \beta_3 A_i + \beta_4 X_i + \varepsilon_i \quad (1)$$

$$D_i = \begin{cases} 0 \text{ if not producing} \\ 1 \text{ if khat producing} \end{cases}$$

Where, i refers to the household, D_i is the binary variable indicating production of khat, β_0 is the intercept, H_i is a vector of household demographic variables, T_i is a vector of technology adoption variables, A_i is a vector of agricultural practice variables, X_i is a vector of institutional variables, β_1, β_2, β_3, and β_4 are vectors of the respective parameter, and ε_i is the error term. Variables were selected purposefully, based on theory, and variables highly correlated with each other were excluded. Household demographic variables (H_i) include the number of children in the household, number of adults in household, sex of household head, age of household head, and household head education level. Technological adoption behavioral variables (T_i) are binary (0 = no, 1 = yes), identifying whether the household saves seed, uses improved seed, uses conservation practices, has used or hired use of a tractor this past year, owns a mobile telephone, and owns a radio. Agricultural practice decision variables (A_i) include number of plots owned, number of crops grown, ownership of donkeys or mules, access to irrigation, consumption of self-grown staple crops, sale of cash crops other than khat, and off-farm job status. Institutional variables (X_i) include access to extension workers.

Logit models transform a linear index that ranges from (-∞, ∞) to an index that ranges from [0,1] using a cumulative distribution function (Park, 2015). Following Greene (2012), the following equation is used to estimate the probability of a household producing khat:

$$\text{Prob}(D_i = 1 \mid X) = \frac{\exp(x_i'\beta)}{1 + \exp(x_i'\beta)} = \Lambda(x_i'\beta) \tag{2}$$

Where, $\Lambda(.)$ represents the logistic cumulative distribution function.

The decision to produce khat may depend on the location of the household; location can dictate access to irrigation, extension services, land, and other factors. Geographic clustering of khat growers must be accounted for when estimating the effect of household demographic,

technology adoption, agricultural practice, and institutional variables on the decision to grow khat. The first location-controlled model takes the district level (woreda) into account. Using a fixed effect to compare the three woredas, a linear representation is:

$$D_{iw} = \beta_0 + \beta_1 H_{iw} + \beta_2 T_{iw} + \beta_3 A_{iw} + \beta_4 X_{iw} + \theta_w + \varepsilon_{iw} \quad (3)$$

$$D_{iw} = \begin{cases} 0 \text{ if not producing} \\ 1 \text{ if khat producing} \end{cases}$$

Where, *w* refers to the woreda and θ_w is the woreda fixed effect. When using a fixed-effects logit model, the following equation is used to estimate the probability of a household producing khat:

$$\text{Prob}(D_i = 1 \mid X) = \frac{\exp(\sigma_i + x_i'\beta)}{1 + \exp(\sigma_i + x_i'\beta)} = \Lambda(x_i'\beta) \quad (4)$$

Where, σ_i represents a fixed parameter at the specified geographic level.

The second location-controlled model takes the village level (kebele) into account. At this level, many villages contain either all khat growers or all non-khat growers. The logit model is no longer appropriate when controlling for multiple levels of fixed effects. A linear probability model is the more suitable method to estimate the betas (β_i). Let:

$$D_{ik} = \beta_0 + \beta_1 H_{ik} + \beta_2 T_{ik} + \beta_3 A_{ik} + \beta_4 X_{ik} + \sigma_k + \varepsilon_{ik} \quad (5)$$

$$D_{ik} = \begin{cases} 0 \text{ if not producing} \\ 1 \text{ if khat producing} \end{cases}$$

Where, *k* refers to the kebele and σ_k is the kebele fixed effect. Table 5-1 provides a description of the explanatory variables with their mean values.

Table 5-1. Description and mean values of explanatory variables

Variables	Description	Mean values
Khatgrow	Household is khat producing (0 = no, 1 = yes)	-
No_kids	Number of children in household (<18 years)	2.738
No_adults	Number of adults in household (>17 years)	3.299
HHH_sex	Sex of household head (0 = female, 1 = male)	0.755
HHH_age	Age of household head	45.070
HHH_educ	Highest education achieved by household head (0 = none, 1 = primary school, 2 = secondary school, 3 = university, 4 = other)	1.211
Seedsaving	Household practices seed saving (0 = no, 1 = yes)	0.800
Improvedseed	Household uses improved seeds to grow crops (0 = no, 1 = yes)	0.918
Consvn	Household uses conservation practices (0 = no, 1 = yes)	0.586
Tractor	Household has used or hired use of a tractor this past year	0.332
Owns_mobph	Household owns a mobile telephone (0 = no, 1 = yes)	0.530
Owns_radio	Households owns a radio (0 = no, 1 = yes)	0.434
No_plots	Number of plots owned	6.180
No_cropsgrown_nokhat	Number of crops grown without khat	4.713
Owns_donkey	Ownership of donkeys (0 = no, 1 = yes)	0.482
Owns_irri	At least one owned plot is irrigated	0.482
CStaple	Household consumes self-grown staple crops	0.665
SCash	Household sells cash crops other than khat	0.642
Off_farmjob	At least one household member has an off-farm job	0.110
FM_ext	Household met with a farm mechanization extension worker this past year (0 = no, 1 = yes)	0.620
AFL_ext	Household met with an agricultural, livestock, or fishery extension worker this past year (0 = no, 1 = yes)	0.885

Stage 2: Modeling the Impact of Khat

Stage 1 provides insight into the decision to grow khat. Stage 2 determines the impact of khat growing on several outcome variables, including on-farm adult male labor, on-farm adult female labor, household income, expenditure on education, food consumption score, and food shortage months. Propensity score matching (PSM) is an appropriate method to estimate this impact. PSM is a common statistical method used to estimate treatment effects from cross-sectional data (Ridgeway, Kovalchik, Griffin, & Kabeto, 2015). Given a set of characteristics,

the propensity score estimates the likelihood that any given household would be in the treatment group, and each household is matched based on the proximity of the scores to each other; in other words, propensity score matching is an attempt at creating a control group that resembles the treated group as closely as possible (Starks & Garrido, 2004).

The propensity scores summarize the set of confounders into one, single measure, while showing differences among the groups that are otherwise undetectable when using simple regression (Starks & Garrido, 2004). PSM also allows for matching observations when there are numerous control variables. Unlike ordinary least squares (OLS), matching does not involve strong assumptions about the functional form of the model, resulting in more robust estimates (Black, 2015). However, propensity scores only adjust for measured confounders, not taking unmeasured confounders into account (Starks & Garrido, 2004).

Matching estimators identify the effect of a treatment on a certain outcome; in this case, the effect of khat production on-farm adult male labor, on-farm adult female labor, household income, expenditure on education, food consumption score, and food shortage months. To correctly estimate the treatment effects, two assumptions must hold:

1. *Unconfoundedness or conditional independence*: the treatment is independent of the outcomes and conditional on the factors that predict receiving the treatment, and
2. *Common support condition or overlap*: the probability of being assigned into a group falls in the range [0,1].

If both of these assumptions hold, the average treatment effects can be correctly identified (Grilli & Rampichini, 2011). In the case of observational studies, the assignment of a treatment variable is likely not random. In this research, growing khat in Ethiopia was not "assigned" in a random experiment; whether someone is a khat grower or not is simply a matter

of circumstance and personal decision. If the decision to grow khat is not related to on-farm adult male labor, on-farm adult female labor, household income, expenditure on education, food consumption score, and food shortage months, but conditional upon the selected covariates (household demographics, technology adoption habits, and agricultural practices), then the unconfoundedness assumption holds. Stage 1 proved that khat growing is conditional upon the selected covariates; therefore, it is assumed that unconfoundedness holds. If the selected covariates had no bearing on the decision to grow khat, the unconfoundedness assumption would not hold.

Six outcome variables were selected to determine the positive or negative impact of khat production in Ethiopia. Table 5-2 provides a summarization of the outcome variables.

Table 5-2. Description and mean values of outcome variables

Variables	Abbreviation	Description	Mean values
Malelab_dayspp	MLAB	Labor days per adult male per season	52.678
Femalelab_dayspp	FMLAB	Labor days per adult female per season	31.792
Income_pp	INC	Annual household income per household member	2,902.700
Educ_exp_pc	EDUC	Education expenditure per school-aged child in past year	498.940
FCS	FCS	Food consumption score for household	44.291
Foodshrt_mo	FDSHMO	Number of food shortage months this past year	0.674

In assessing the causal effect of khat production on the outcome variables, let Y_1 be the potential outcome of a household who grows khat and Y_0 the potential outcome of a household who does not. The participation effect of growing khat for household *i* is given as the value $Y_{i1} - Y_{i0}$; the expected participation effect on the population, termed average treatment effect (ATE),

can then be given by $E(Y_1 - Y_0)$. The average treatment effect on the treated (ATET) can be given as:

$$E(Y_{i1} - Y_{i0}|D_i = 1) \quad (6)$$

Where, Y_{i1} is the outcome variable for the i-th household when they grow khat, Y_{i0} is the outcome variable for the i-th household when they do not grow khat, and D_i refers to khat growing participation (1 = grows, 0 = does not grow).

The ATET can only be estimated if the expected value of the outcome conditional on khat production equals the expected value of the outcome conditional on non-khat production, given as:

$$E(Y_0|D_i = 1) = E(Y_0|D_i = 0) \quad (7)$$

Evidence from the Stage 1 regressions indicates that the decision to grow khat depends on household demographics, technology adoption habits, agricultural practices, and institutional access. To create the propensity score and determine the impact of khat production on the outcome, covariates must be carefully selected based on theory and previous literature, avoiding those that could be associated with the treatment but not the outcome, affected by the treatment, or predict the treatment status perfectly (Starks & Garrido, 2004). The correct number of variables to match on is dependent on the model; selection of too many variables can create a situation where matches are impossible to achieve, while matching on too few variables may not generate true, comparable matches (Grilli & Rampichini, 2011).

Balancing the data is the first goal in propensity score matching and should occur without examining the outcome results; this prevents the researcher from purposefully selecting variables

that give the desired results (Grilli & Rampichini, 2011). For this research, a logistic model is used to generate a propensity score is generated for each household. Each khat growing household is matched to a non-khat growing household with a similar propensity score, and the average difference in outcomes is calculated, effectively determining the causal effect of khat production on the selected outcome variable.

Because the sample size in this data is rather small, the same matching variables are used for each outcome due to sensitivity. The selected matching covariates include the location (woreda or kebele), household size, education level of the household head, age of the household head, owning a radio, owning a mobile phone, land size, and growing cash crops other than khat. Each of these covariates was proven to influence the decision to grow khat in Stage 1. The first Stage 2 model identifies the causal effect of khat production on the selected outcome variables while matching on woreda; let:

$$Y_{iw} = \alpha_0 + \delta D_{iw} + \alpha_1 H_{iw} + \alpha_2 T_{iw} + \alpha_3 A_{iw} + \theta_w + e_{iw} \quad (8)$$

Where, *i* refers to the household, *w* refers to the woreda, Y_{iw} refers to the outcome variable, α_0 is a constant of the outcome variable, D_{iw} is the treatment variable indicating production of khat, δ identifies the average treatment effect, H_{iw}, T_{iw}, and $A_{iw}$are vectors of covariates, indicating household demographics, technology adoption habits, and agricultural practices, respectively, α_1, α_2, and α_3 measure the influence the explanatory variables have on the outcome variable, θ_w is the woreda fixed effect, and e_{iw} is the error term. Household demographics include household size, education level of the household head, and age of the household head. Technology adoption habits include owning a radio or mobile phone, while agricultural practice covariates include land size and if the household grows cash crops other than khat.

The alternative to the above matching method is simple ordinary least squares regression where a functional form is assumed, and the covariates assume a linear relationship with the mean of the outcome variable. This should yield results similar to propensity score matching, although Black (2015) found that matching estimates are more reliable.

The second Stage 2 model specifies location at the smallest level—kebele. It identifies the causal effect of khat production on the selected outcome variables while controlling for kebele. In the case of this model, propensity score matching while using a logit model as the treatment model is not appropriate. This model contains parameters that perfectly predict the outcome, as some kebeles contain only khat producers and some contain only non-producers, yielding inaccurate estimates. For this model, using an ordinary least squares fixed effect regression is the superior choice. This regression yields estimates comparing the differences in outcomes among khat-producers and non-khat producers in the same kebele. To estimate the effect of khat production on the selected outcome variables while controlling for kebele, let:

$$Y_{ik} = \alpha_0 + \delta D_{ik} + \alpha_1 H_{ik} + \alpha_2 T_{ik} + \alpha_3 A_{ik} + \sigma_k + e_{ik} \quad (9)$$

Where, *k* refers to the kebele and σ_k is the kebele fixed effect.

Chapter 6 - Results

Khat Growing Decision Model

Regression Results

Using Stata statistical software, estimated marginal effects of household demographic, technology adoption, agricultural practice, and institutional variables on the decision to produce khat were calculated for each model: no location control, woreda fixed-effect, and kebele fixed-effect (see Table 6-1).[11] Marginal effects measure the effect that a change in the specified explanatory variable has on the predicted probability of the outcome variable, holding other covariates constant. For continuous variables, marginal effects are measured by a one-unit change in the explanatory variable; for dummy variables, the marginal effect is conveyed in comparison to the base category.[12] The OLS coefficient for the kebele fixed-effect model is equivalent to a marginal effect.

[11]Stata's *logit* command was used to estimate coefficients (see Appendix C) for the no location control and woreda fixed-effect models. The *margins* command was used to calculate the average marginal effects (see Table 6-1). Stata's *reghdfe* command was used to estimate the linear probability model (kebele fixed-effect model).

[12]The base category is x = 0. For example, the base category for education level of household head is having no education; likewise, the base category for having an off-farm job is having all family members work only on the farm.

Table 6-1. Marginal effects of explanatory variables on khat production binary variable

Variables	No location control[1]	Woreda fixed-effect	Kebele fixed-effect[2]
Number of kids	-0.008	-0.002	0.000
	(0.011)	(0.009)	(0.006)
Number of adults	-0.014	0.005	0.006
	(0.014)	(0.011)	(0.014)
Sex of household head	0.002	-0.006	-0.029
	(0.050)	(0.040)	(0.039)
Age of household head	-0.000	-0.000	-0.001
	(0.002)	(0.002)	(0.001)
Household head has no education (base)	-	-	-
	-	-	-
Household head finished primary	0.017	0.040	0.019
	(0.044)	(0.035)	(0.045)
Household head finished secondary	0.000	0.097	0.112
	(0.069)	(0.067)	(0.057)*
Household head finished university	0.000	0.000	-0.073
	(0.000)	(0.000)	(0.055)
Household head finished literacy program	0.089	0.081	0.086
	(0.056)	(0.039)**	(0.060)
Seed saves	-0.110	-0.088	-0.104
	(0.041)***	(0.037)**	(0.053)*
Uses improved seed	-0.014	0.119	0.050
	(0.076)	(0.046)***	(0.034)
Practices conservation	0.070	-0.064	-0.044
	(0.038)*	(0.038)*	(0.024)*
Used or hired use of a tractor	0.046	-0.106	-0.046
	(0.039)	(0.041)***	(0.089)
Owns mobile phone	0.122	0.039	0.010
	(0.041)***	(0.043)	(0.033)
Owns radio	0.011	0.045	0.054
	(0.036)	(0.033)	(0.033)
Number of plots	0.052	0.023	0.033
	(0.011)***	(0.009)**	(0.013)**
Number of crops grown	-0.076	-0.040	-0.032
	(0.017)***	(0.014)***	(0.016)*
Owns donkey	0.101	0.084	0.066
	(0.039)**	(0.034)**	(0.028)**
Owns irrigation	0.321	0.115	0.101
	(0.036)***	(0.033)***	(0.036)***
Consumed staple crops	-0.089	-0.026	-0.008
	(0.038)**	(0.033)	(0.044)
Sells cash crops	-0.172	-0.140	-0.047
	(0.042)***	(0.034)***	(0.035)
Off-farm job	-0.166	-0.056	0.015

	(0.083)**	(0.077)	(0.052)
Farm mechanization extension access	0.096	0.013	-0.016
	(0.040)**	(0.036)	(0.052)
Agriculture, livestock, fisheries extension access	-0.020	-0.015	0.024
	(0.066)	(0.051)	(0.064)
Bahir Dar Zuria (base)	-	-	-
	-	-	-
Dangila	-	-0.582	-
	-	(0.072)***	-
Bure	-	-0.493	-
	-	(0.093)***	-
N [3]	352	352	355
R^2	-	-	0.68
District level effect	No	Yes	No
Village level effect	No	No	Yes

** p<0.1; ** p<0.05; *** p<0.01*

Note: The dependent variable for all regressions is the binary khat production variable where 0 = does not produce khat and 1 = produces khat.

[1] Marginal effects for the no location control and woreda fixed-effect models were estimated using logit regression.

[2] Marginal effects for the kebele fixed-effect model were estimated using an ordinary least squares regression that absorbs multiple levels of fixed effects.

[3] Only three household heads reported completing university. These households were dropped from the logit regressions due to perfectly predicting the outcome.

As woreda is controlled for, it is expected that some explanatory variables will no longer be significant predictors of growing khat. This could happen if the variable was highly correlated with khat growing in one woreda but not correlated in the other two woredas. Owning a mobile phone illustrates this. This variable is a significant predictor of growing khat prior to controlling for location (12.2% more likely at the 1% significant level), but not significant after controlling for woreda. One explanation could be that most households in Bahir Dar Zuria have a mobile phone and because Bahir Dar Zuria is also dense with khat producers, there is a natural correlation between the variables. We see that this correlation does not hold for the other two woredas, indicating that owning a mobile phone is not a significant predictor of growing khat despite the correlation in Bahir Dar Zuria. This is also observed with consuming self-grown staple crops, having an off-farm job, and access to farm mechanization extension services. There may also be the case where we observe some new significant predictors that were insignificant

prior to controlling for woreda, which is the case of using improved seed. This variable is a significant predictor of growing khat despite its insignificance in the binary logit model not conditioned on location. This illustrates the importance of accounting for household location.

As location is controlled for at the smallest geographical unit (kebele), it is expected that even fewer variables are significant predictors of growing khat due to the small number of households in each kebele. The marginal effects for the kebele fixed-effect model measures the average marginal effect across the 26 kebeles.

Compared to households in woreda 1 (Bahir Dar Zuria), households in woreda 2 (Dangila) and woreda 3 (Bure) are less likely to grow khat (58.2% and 49.3%, respectively). Household size, sex of household head, and extension access do not play a key role in the decision to grow khat. Surprisingly, owning an external communication device (mobile phone or radio) does not significantly predict the decision to grow khat. Across each model, those households with a more educated household head are approximately 8% to 12% more likely to grow than those with no education. There is a strong negative relationship between growing khat and practicing seed saving (~8% to 11% less likely), practicing conservation (~4% to 7% less likely), and tractor use (~10% to 11% less likely) after inclusion of the woreda fixed-effect. Prior, the relationship between growing khat and practicing conservation and growing khat and tractor use displayed positive correlation, again highlighting the importance of conditioning the model on location. Households with more plots and who own a donkey are more likely to grow khat by ~2% to 6% and ~6% to 11%, respectively, while those who grow more crops are ~3% to 8% less likely to grow as are those who sell other cash crops (<1% to 9% less likely). Perhaps the most significant predictor observed is access to irrigation; this increases the likelihood of growing khat by ~10% to 33%.

Impact of Khat on Selected Outcomes

In this section, the impact of khat production on on-farm adult male labor, on-farm adult female labor, household income, expenditure on education, food consumption score, and food shortage months is examined. Stage 1 proved there is a difference between khat grower and non-khat growers and the decision to grow khat is impacted by household demographics, technology adoption, agricultural practices, and institutional variables. To estimate the impact of khat production on the outcome variables, propensity score matching is used to match khat growers to non-growers.

Data Balance of Propensity Scores

Prior to evaluating the impact of khat production on the outcomes, we examine how propensity score matching balances the covariates (see Table 6-2). Balance tables provide diagnostic statistics to ensure the covariates are balanced among treatment groups (StataCorp, n.d.). The selected matching covariates include the woreda code, household size, education level of the household head, age of the household head, owning a radio, owning a mobile phone, land size, and growing cash crops other than khat. The raw standardized differences and variance ratios illustrate the imbalance prior to performing matching. The matched standardized differences should be close to 0, while the matched variance ratios should be close to 1; any variation from 0 and 1 reflect non-perfectly balanced samples. Density graphs (see Figure 6-1) display the kernel density of the propensity scores, allowing for visual observation of covariate balance after estimation. One balance table and one density graph is included for each outcome due to differing observation numbers.

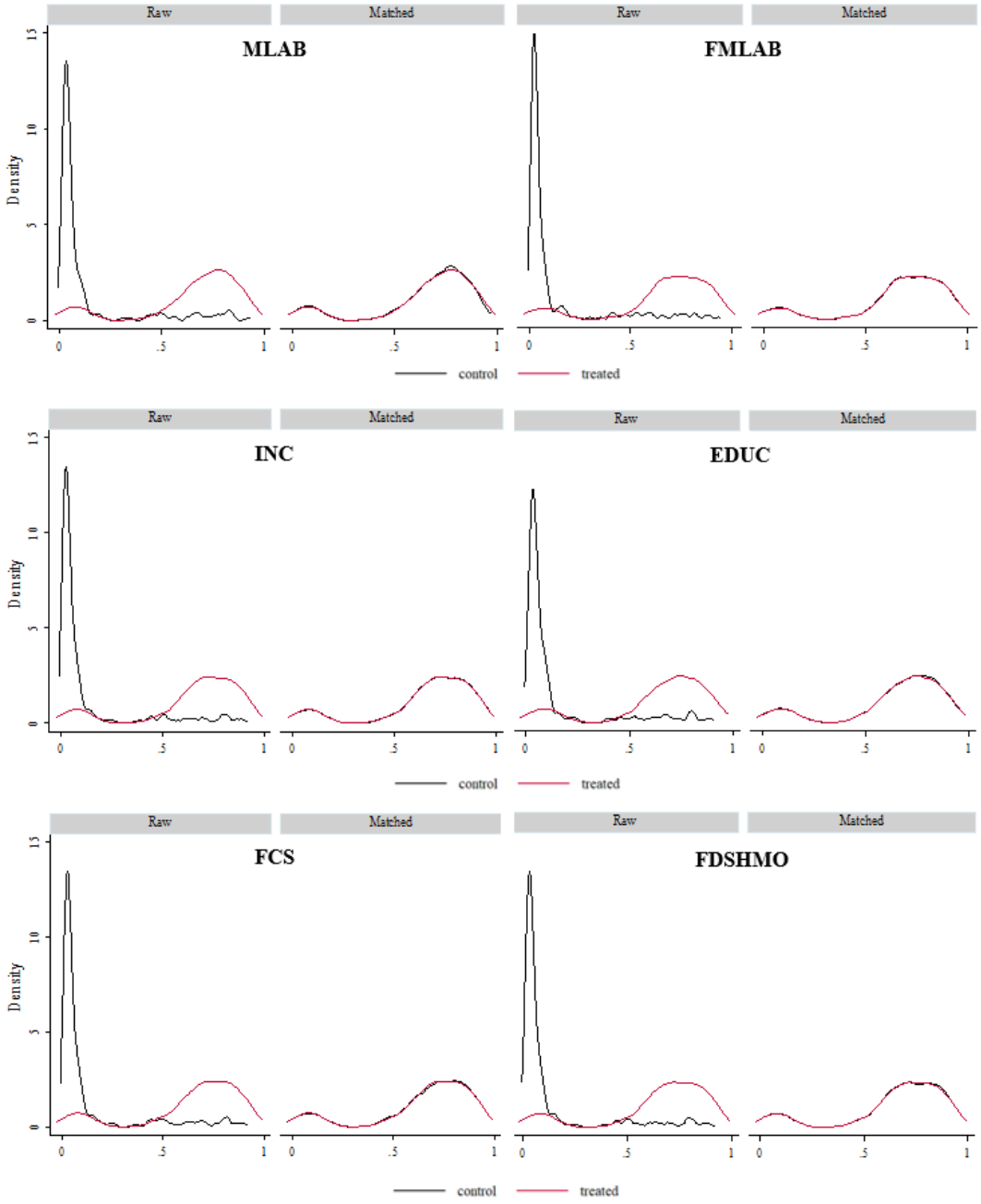
Table 6-2. Covariate balance summary statistics

	Standardized differences		Variance ratio		Standardized differences		Variance ratio	
	Raw	Matched	Raw	Matched	Raw	Matched	Raw	Matched
	MLAB				**FMLAB**			
Woreda code								
2 (Dangila)	-1.000	-0.098	0.181	0.683	-1.043	0.123	0.173	1.955
3 (Bure)	-0.914	0.090	0.301	1.366	-0.901	-0.078	0.294	0.797
Household size	0.245	-0.145	0.820	1.023	0.236	-0.168	0.906	1.108
No school	-0.259	0.075	0.877	1.071	-0.328	0.177	0.852	1.215
Primary school	0.084	0.073	1.073	1.056	0.066	-0.023	1.061	0.984
Secondary school	-0.191	0.220	0.589	2.859	-0.142	-0.078	0.683	0.797
Less than 35 yo	-0.093	0.193	0.832	1.720	-0.083	0.000	0.854	1.000
36 to 55 yo	0.354	-0.318	0.799	1.636	0.355	-0.025	0.802	1.028
Older than 55 yo	-0.277	0.159	0.602	1.584	-0.269	-0.034	0.601	0.921
Owns radio	0.127	-0.046	1.027	1.001	0.157	-0.066	1.040	1.001
Owns mobile phone	0.749	-0.058	0.667	1.093	0.740	0.052	0.707	0.936
Land size	0.421	-0.422	1.480	1.403	0.416	-0.128	1.537	1.001
Grows cash crop	-0.339	-0.295	1.547	1.426	-0.315	-0.279	1.453	1.365
N				326				348
	INC				**EDUC**			
Woreda code								
2 (Dangila)	-1.058	0.000	0.168	1.000	-1.042	-0.053	0.185	0.810
3 (Bure)	-0.863	0.000	0.322	1.000	-0.821	0.042	0.354	1.128
Household size	0.212	-0.127	0.898	1.068	0.232	-0.045	0.890	0.798
No school	-0.309	0.120	0.856	1.130	-0.294	0.246	0.870	1.324
Primary school	0.064	0.116	1.059	1.103	0.079	0.128	1.069	1.108
Secondary school	-0.100	0.126	0.772	1.545	-0.076	0.000	0.816	1.000
Less than 35 yo	-0.069	0.000	0.880	1.000	-0.107	-0.227	0.802	0.650
36 to 55 yo	0.336	0.000	0.809	1.000	0.299	0.080	0.796	0.919
Older than 55 yo	-0.263	-0.034	0.599	0.920	-0.190	0.125	0.674	1.442
Owns radio	0.158	0.064	1.036	1.006	0.165	-0.119	1.036	1.014
Owns mobile phone	0.759	-0.053	0.691	1.081	0.718	-0.182	0.715	1.338
Land size	0.375	-0.162	1.551	1.128	0.367	-0.353	1.531	0.897
Grows cash crop	-0.290	-0.143	1.420	1.153	-0.278	-0.188	1.400	1.221
N				360				321
	FCS				**FDSHMO**			
Woreda code								
2 (Dangila)	-1.050	-0.050	0.170	0.809	-1.055	0.000	0.170	1.000
3 (Bure)	-0.862	0.040	0.325	1.129	-0.858	0.000	0.326	1.000
Household size	0.208	-0.097	0.911	0.995	0.206	-0.171	0.914	0.986
No school	-0.304	0.121	0.861	1.129	-0.301	0.198	0.862	1.244
Primary school	0.073	0.216	1.065	1.228	0.044	0.023	1.043	1.018
Secondary school	-0.089	0.082	0.794	1.302	-0.099	0.082	0.774	1.302
Less than 35 yo	-0.060	-0.089	0.896	0.845	-0.068	0.064	0.883	1.153
36 to 55 yo	0.323	0.095	0.816	0.917	0.328	0.000	0.815	1.000

Older than 55 yo	-0.256	-0.098	0.608	0.798	-0.254	-0.129	0.610	0.751
Owns radio	0.160	0.065	1.033	1.004	0.141	0.087	1.034	1.011
Owns mobile phone	0.779	0.000	0.670	1.000	0.753	0.102	0.696	0.882
Land size	0.361	-0.172	1.513	0.946	0.354	-0.250	1.559	1.121
Grows cash crop	-0.292	-0.095	1.416	1.091	-0.293	-0.144	1.420	1.151
N				356				357

Note: Due to missing data, there are differing observation numbers for each outcome variable.

Figure 6-1. Covariate balance density



Source: Author's own work

Matching on propensity score proves to balance the covariates. The control group (non-khat producers, in black) was matched to the treated group (khat producers, in red); for each outcome, the matched covariates are considerably more balanced than the unmatched (raw), evident from the balance density graphs. The covariate balance is slightly different for each outcome. On-farm male labor days is the one outcome variable where the covariates are slightly unbalanced; there is a visible separation between the control and treated groups at the top of the curve in the balance density graph. The covariate causing this appears to be the secondary school covariate; the matched variance ratio is 2.859—quite far away from the target ratio of 1. However, this covariate is relatively balanced for the other outcome variables, so it is not necessary to remove it from the analysis.

Matching Results

Although khat does not require high levels of attention to produce, higher quality khat is produced when the plant is watered, pruned, and weeded consistently. Due to the labor-intensive nature of khat cultivation, the amount of labor used on the farm could be higher than other crops. Additionally, because khat is a high-value cash crop and theoretically provides a steady stream of income to those who cultivate it, it is expected that the income of khat producing households would be higher than non-producing households, holding other factors constant. It is also hypothesized that with the excess income, the household can purchase higher nutritional-quality food and dedicate more money to less frequent expenditures like education. Even if income is estimated as lower, the steady stream of income could help households combat seasonality. This could result in fewer months of food shortages throughout the year, regardless of dietary diversity. Table 6-3 provides the unmatched and matched results of the effect of khat production on the outcome variables. Full OLS results can be found in Appendix C.

Table 6-3. Unmatched OLS and matched ATET results

	MLAB	FMLAB	INC	EDUC	FCS	FDSHMO
ATET[1]	22.040	19.743	1,211.246	-53.505	-7.022	-0.109
	(9.389)**	(4.969)***	(783.670)	(63.823)	(2.598)***	(0.138)
OLS[2]	18.711	8.580	-1,067.557	-147.078	-1.653	0.017
Woreda	(8.172)**	(4.892)*	(836.780)	(209.737)	(2.348)	(0.345)
OLS[3]	0.696	2.517	19.753	-96.681	-1.754	0.086
Kebele	(6.831)	(4.599)	(495.487)	(108.215)	(2.987)	(0.191)
N[4]	326	348	360	321	356	357

** p<0.1; ** p<0.05; *** p<0.01*

[1] ATET denotes Average Treatment Effect on the Treated. This row displays the effect of khat production on the outcome variable (specified in each column) calculated using propensity score matching (matching method). Woreda is matched upon for these estimates.

[2] This row displays the effect of khat production on the outcome variable (specified in each column) calculated using ordinary least squares regression (unmatched method). Woreda is controlled for in these estimates.

[3] This row displays the effect of khat production on the outcome variable (specified in each column) calculated using ordinary least squares regression absorbing multiple fixed effects. Kebele is controlled for in these estimates.

[4] There are different observation sizes for each outcome due to missing data. 5 households had at least one of the 8 covariates omitted in the dataset. There were 34 households with insufficient male labor data, 12 with insufficient female labor data, 39 with insufficient education expenditure data, 4 with insufficient FCS data, and 3 with insufficient food shortage month data. This missing data was either due to households reporting "Not applicable" for certain questions or simply not responding to the entire questionnaire.

The results generated from the matching technique are different than those using unmatched OLS (woreda) and OLS fixed effects (kebele) regressions. Each model is consistent in reporting higher on-farm male and female labor, lower education expense, and lower FCS, although at different magnitudes. The unmatched OLS model estimates lower income and more food shortage months caused by khat, while the matched model estimates the opposite. The OLS fixed effects (kebele) model estimates no significant relationship between khat production and any outcome variable. Estimation at this geographical level is difficult because of the few number of households in each kebele. Using propensity score matching, the impact of khat production was found to be significant for on-farm male ($p<0.05$) and female ($p<0.01$) labor, and for FCS ($p<0.01$). The impact of khat production on income was nearly significant ($p=0.122$); the remaining two, although not significant ($p=0.402$ and $p=0.432$), display a reliable relationship between the outcome variable and the treatment variable. Detailed matched results follow in Table 6-4.

Table 6-4. Detailed matched ATET results

	Coef.	Robust Std. Err.	z	P>|z|	95% Conf.	Interval
MLAB	22.040	9.389	2.350	0.019	3.637	40.443
FMLAB	19.743	4.969	3.970	0.000	10.003	29.482
INC	1,211.246	783.670	1.550	0.122	-324.719	2,747.210
EDUC	-53.505	63.823	-0.840	0.402	-178.596	71.586
FCS	-7.022	2.598	-2.700	0.007	-12.113	-1.931
FDSHMO	-0.109	0.138	-0.790	0.432	-0.380	0.162

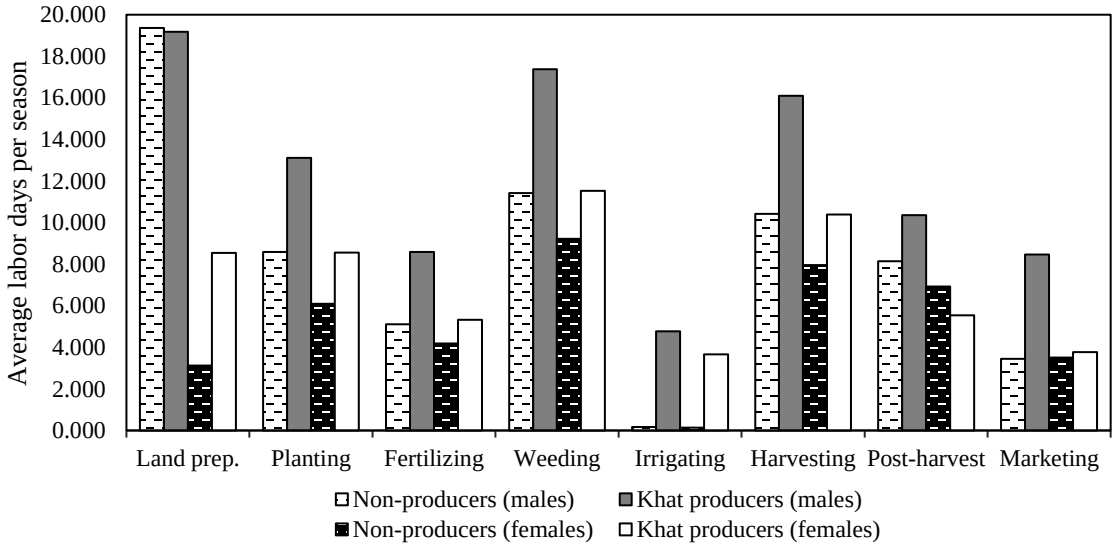
Labor Measures

Land descriptive statistics in Chapter 4 indicated that overall, khat plots require higher use of family labor (59.5% more) and hired labor (83.9% more) than other crop plots. Family labor for khat plots was found to used more extensively for each activity, except for post-harvest. The reason for this may be that children are not involved in post-harvest activities, such as selling khat in the marketplace, but are more heavily involved in pre-harvest activities. At the household level, labor days per household member include days dedicated to land preparation, planting, fertilizing, weeding, irrigating, harvest, post-harvest activities, and marketing.

Descriptive statistics specified that each male in a non-khat producing household contributes 44.9 days of labor per season, while each female contributes 27.7 days per season. Each male in a khat producing household contributes 73.9 days of labor per season, while each female contributes 43.6 days of labor per season, which is nearly as much as males in non-growing households. In relative terms, each male in a khat producing household contributes 39.2% more labor per season than those in a non-producing household; each female contributes 36.5% more labor season than their non-khat producing counterpart. After adjusting for differences in characteristics through propensity score matching, a relationship of even higher magnitude is exposed: khat production, independent of the matched variables, causes adult male labor days to be 41.8% higher ($p<0.05$) and adult female labor days to be 62.1% higher ($p<0.01$).

Further examination of the family labor module (see Figure 6-2) reveals that irrigating, marketing, and fertilizing are the main activities requiring relatively more male labor in khat producing households throughout the season (relatively 96.6%, 59.3%, and 40.4% more, respectively). Regarding female labor, irrigation and land preparation are the main activities requiring relatively more labor in khat producing households throughout the season (relatively 96.4% and 63.4% more, respectively).

Figure 6-2. Average male and female labor days per activity per season



Note: Labor days are measured per person

Income and Expenditure Measures

Table 4-4 specified that gross household income for khat growers was 50.2% higher than non-growers (31,588.17 ETB compared to 15,766.01 ETB, respectively). For comparison, summary statistics for income variables on a per household member basis were generated. The percent of gross household income generated from khat was calculated as 38.2%, giving indication that the excess income khat producers have over non-khat producers could be mainly due to revenue from khat sales. Results from propensity score matching illustrates a story analogous to the summary statistics; khat production, independent of the matched covariates,

causes gross income per household member to be 41.7% higher (1,211.25 ETB greater than the mean outcome of 2,902.70 ETB).

It was hypothesized that with the excess income generated from khat production, more income could be dedicated to less frequent expenditures such as education. Results from the propensity score matching estimated the opposite: khat production, independent of the matched covariates, causes 53.51 fewer ETB to be spent on education per school-aged child, which is 10.7% less than the mean education expenditure. This number, although negative, is not statistically significant (p=0.402). Analyzing Table 6-5 (see below) reveals that although khat growing households have more school-aged children on average, non-khat growing households spend 62.5% more on their education than khat growers.

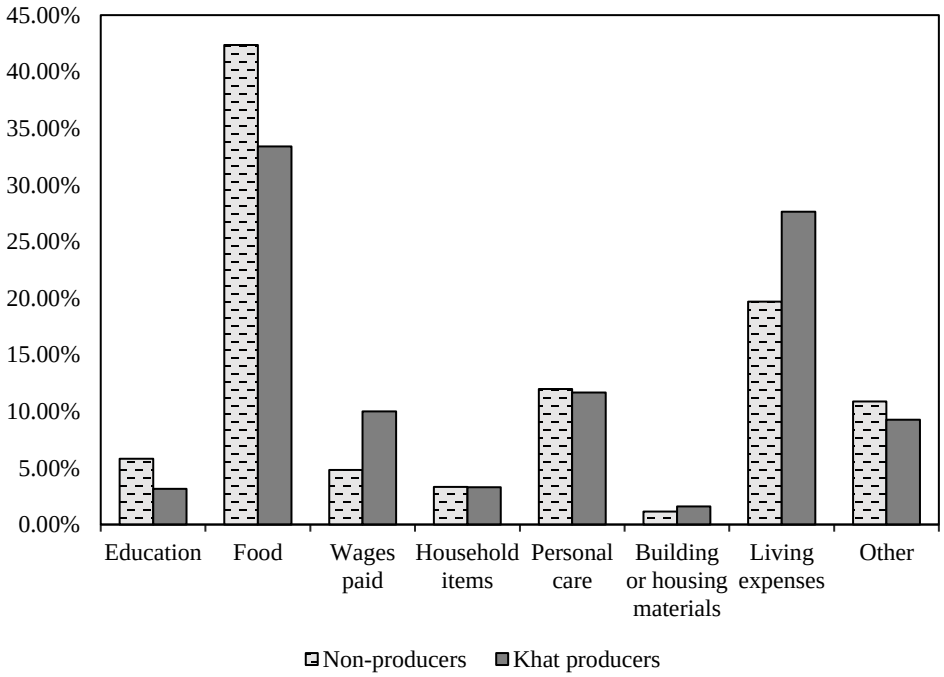
Table 6-5. Summary statistics for number of school-aged children and education expense

	Non-khat grower			Khat grower		
	Median	Mean	S.D.	Median	Mean	S.D.
Number of school-aged children	2.000	2.293	1.409	3.000	2.574	1.332
Education expense per school-aged child	200.000	596.499	1,412.625	105.000	223.477	306.233

To determine which category of expenditure is more popular among each sample group, each expenditure was calculated as a percentage of total expenditures.[13]

[13] Section O of the survey (see Appendix A) breaks down expenditures into frequent (amount spent in past 30 days) and less frequent (amount spent in past 12 months) categories. Frequent expenditure amounts were converted to yearly expenditure amounts for comparison. Wages paid includes agricultural and non-agricultural labor. Household items include kitchen equipment, linens, carpet, furniture, lamps, torches, and cleaning supplies. Personal care includes medical treatments, clothes, and personal hygiene items. Building or housing materials include materials purchased for buildings, housing improvement, or personal household item repairs. Living expenses include utilities, rent, travel, fuel, and communication. Other includes retirement, insurance, cigarettes, khat, tobacco, lotteries, and other unspecified expenses.

Figure 6-3. Individual expenditures as a percentage of total expenditures



Source: Author's own work

Percentage of expenditures spent on household items, personal care, building or housing materials, and other are relatively similar amongst khat and non-khat producers. Khat producers appear to spend less money on food and more money on wages paid to laborers and living expenses.[14] Additionally, Figure 6-3 illustrates that khat producers spend proportionally less money on education than non-producers.

Food Security Measures

Descriptive statistics in Chapter 4 illustrated that khat producers have a higher average FCS than non-producers. However, after adjusting for differences in characteristics through propensity score matching, results indicate that khat production, independent of the matched variables, causes a lower FCS. Compared to the outcome variable means, propensity score

[14] Food expenditure is not equal to the value of consumption for a household.

matching indicates that khat growing causes food consumption scores to be 15.9% lower and food shortage months to be 16.2% lower.

Although khat production is causing a lower FCS, which is a measure of dietary diversity, the descriptive statistics from the food access questionnaire module indicate that khat producers have better access to food than non-producers, shown in Table 6-6.

Table 6-6. HFIAS score descriptive statistics

	Mean	S.D.	Min	Max
Non-producer	3.934	5.711	0.000	24.000
Khat producer	2.731	4.210	0.000	17.000

Descriptive statistics (see Table 4-6) indicate that khat growing households were not able to store their food as long as non-growers in both seasons (2.1 months in irrigated season and 3.8 months in *meher* season compared to 2.5 and 4.1 months), but matching results indicate khat growers experienced shorter lengths of food shortages. Within the food shortage questionnaire, if the household reported experiencing food shortages in the past year, they were prompted to provide the primary reason for the shortage. The main cause of food shortages is summarized in Table 6-7. For those non-khat producing households experiencing food shortages, food production issues (18.0%) prove to be the main reason food shortages were experienced, followed by not having enough money (5.2%) and nature-related or weather events (4.12%).

Table 6-7. Distribution of main cause of food shortages in past year

	%	
	Non-grower	Khat grower
Causes of food shortages (*n=356*)		
Not applicable	70.4	93.3
No money	5.2	0.0
Poor health conditions	0.0	0.0
Market issues/inadequacies	1.5	0.0
Nature-related or weather	4.1	3.4
Food production issues	18.0	3.4
Other	0.8	0.0

Chapter 7 - Discussion

The Image of a Khat Growing Household

A major problem in the field of khat production research is the lack of data and overall understanding of the subject. As a result, the significant factors contributing to the likelihood of growing khat can often be difficult to unravel and directly pinpoint. Intuitively, if a household has many members, there are more available laborers to work on the farm and generate money for the family. For khat growers, this can be beneficial as the crop requires more attention to weeding, pruning, watering, and harvesting. Men are stereotypically thought of as more likely to grow drug crops than women, and younger household heads may be more in touch with newer technologies and agricultural systems. By analyzing the dynamics of khat producing households in northwest Ethiopia, it is found that most household demographics do not impact their decision to grow or not.

A khat grower does not necessarily have more or fewer people in their household, is not male or female, and is not a specific age; rather, a khat grower tends to be more educated and thus may have more ability to adopt improved technologies. They purchase and use improved seeds, own donkeys as work animals, have access to irrigation, and own more plots while growing a less expansive variety of crops. Households that sell other cash crops are less likely to engage in khat production; this could mean that if a household is already growing popular cash crops like sugarcane or coffee, they may not see any necessity to add khat to their cropping portfolio. Those households integrating conservation practices into their farming operations are less likely to grow khat, perhaps due to a widespread knowledge of the alleged negative impacts of khat production on the environment. The main conservation practice utilized by khat producers is terracing. This is not surprising as most khat plots are planted in terraces on

hillsides. Whether this is for conservation purposes or to simply maximize khat production is unclear. This does not necessarily imply that khat producers do or do not implement conservation techniques, but that they may be unaware of the ecological impacts or simply do not find environmental issues to be a priority in their household. Conservation practices (like cover cropping) may benefit future production of other crops but has no benefit to khat production. Additionally, although cash crop production methods may be introduced through agricultural, fishery, and livestock extension services, it is highly unlikely that knowledge of the benefits of khat production is distributed via official channels; therefore, it is understandable why extension access has no impact on khat production in this sample.

Behavioral Aspects of Khat Production

To fully understand a khat growing household, it is beneficial to dig deeper into the behavioral aspects of khat production. In this case, conducting two simple, supplemental regressions provides thoughtful insight into the decision-making process and strategic thinking of the sample group. The first, logit regression uses a household's beliefs about the harmfulness of khat as the binary outcome variable, khat growing as the primary independent variable of interest, and various household factors as controls to determine what influences a household's thoughts on the effects of khat consumption. Table 7-1 displays the marginal effects of the explanatory variables on the binary outcome variable.

Table 7-1. Marginal effects of household variables on household's belief about the harmfulness of khat binary variable

Variables	No controls	Controls	Controls with woreda fixed-effect	Controls with kebele fixed-effect[1]
Grows khat	0.245	0.254	0.114	0.011
	(0.059)***	(0.061)***	(0.087)	(0.147)
Number of kids	-	-0.019	-0.016	-0.007
	-	(0.016)	(0.016)	(0.015)
Sex of household head	-	0.110	0.100	0.053
	-	(0.064)*	(0.063)	(0.042)
Age of household head	-	0.004	0.004	0.001
	-	(0.002)	(0.002)*	(0.003)
No education (base)	-	0.000	0.000	-
	-	(0.000)	(0.000)	-
Primary school	-	0.161	0.147	0.184
	-	(0.066)**	(0.066)**	(0.061)***
Secondary school	-	0.170	0.212	0.212
	-	(0.093)*	(0.088)**	(0.080)**
University	-	-0.076	0.026	0.225
	-	(0.290)	(0.289)	(0.060)***
Literacy program	-	0.157	0.157	0.065
	-	(0.079)**	(0.078)**	(0.069)
Owns mobile phone	-	-0.095	-0.082	-0.024
	-	(0.056)*	(0.059)	(0.061)
Bahir Dar Zuria (base)	-	-	0.000	-
	-	-	(0.000)	-
Dangila	-	-	-0.240	-
	-	-	(0.090)***	-
Bure	-	-	-0.077	-
	-	-	(0.090)	-
N	337	333	333	332

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

[1] Standard errors adjusted for 25 kebele clusters

The second, OLS regression uses expenditure on khat, cigarettes, and tobacco per person as the outcome variable (mean=10.486), an interaction term for growing khat and a household's

beliefs about the harmfulness of khat as the primary independent variable of interest, and similar explanatory variables (see Table 7-2).[15]

Table 7-2. OLS regression results; khat expenditure

Variables	No controls	Controls	Controls with woreda control	Controls while clustering on kebele
Grows khat	-14.426	-26.602	-27.785	-50.532
	(18.149)	(22.598)	(26.347)	(37.652)
Believes khat is harmful	-9.665	-25.192	-25.989	-46.637
	(10.011)	(14.838)*	(15.157)*	(35.621)
Grows khat and khat belief interaction term	8.501	27.722	28.290	49.877
	(21.503)	(26.915)	(27.148)	(40.293)
Log of income per person	-	-7.701	-7.260	14.104
	-	(5.107)	(5.569)	(8.065)*
Log of expenditure on non-khat items per person	-	7.072	6.975	-3.542
	-	(6.657)	(6.688)	(5.823)
Number of kids	-	-8.106	-7.827	-4.208
	-	(3.697)**	(3.775)**	(3.193)
Sex of household head	-	29.755	29.200	19.218
	-	(15.988)*	(16.099)*	(14.394)
Age of household head	-	-0.546	-0.526	-0.154
	-	(0.568)	(0.573)	(0.394)
Primary school	-	-5.838	-6.641	-4.735
	-	(15.248)	(15.396)	(6.051)
Secondary school	-	40.750	41.990	49.494
	-	(20.484)**	(21.307)*	(31.373)
Literacy program	-	20.408	20.657	12.792
	-	(16.031)	(16.110)	(10.483)
Dangila	-	-	-1.788	-
	-	-	(18.537)	-
Bure	-	-	12.321	-
	-	-	(30.507)	-
Constant	19.226	50.621	47.758	-
	(7.174)***	(75.587)	(82.259)	-
N	308	224	224	223

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

[15] Unfortunately, expenditure on khat was lumped into expenditures on cigarettes and tobacco within the survey; there is no way to separate these expenditures.

Results from the logit regression demonstrate that those growing khat are more likely to say they believe khat is harmful to a person's health. Additionally, those households with an educated, male household head are more likely to find khat to be harmful. Interestingly, households with access to mobile phones are less likely to find khat to be harmful; perhaps these households have higher access to external connections and information, thus have exposure to various opinions and evidence of the impact of khat on a person's health. Those households located in Dangila are less likely to find khat to be harmful to those who consume it—a fascinating discovery considering that 96.0% of households in this woreda are non-khat producers. Combining this with the finding that khat growers are more likely to label khat as harmful leads to a puzzling situation; are khat growers able to see the harmful effects of khat because of their firsthand experience with it? Perhaps these more educated, technologically advanced khat growers fully understand the health consequences of consuming khat but are unperturbed by this knowledge because they can benefit from the lucrative aspects of khat farming, much like other drug crop farmers. Cannabis in Morocco, coca in Bolivia, and poppy opium in Burma and Afghanistan all provide "economic safety nets" for growers, and despite the associated health risks with consuming these drugs, poor farmers continue to grow them because of the market access, income generation, and credit opportunities (Buxton, 2015).

Given that we observe khat growers more likely to believe that khat is harmful to a person's health, one possibility is that this group is simply growing the crop, but not partaking in the khat chewing habit. If that were the case, we would expect to see such khat farmers spend

relatively little on khat.[16] In this instance, a likely explanation is that khat growers have more direct experience with khat than non-growers and their aversion to khat consumption follows from their greater knowledge. In that case, the term interacting khat growing and the belief about the harmfulness of khat in the regression above should be negative, indicating that, holding all factors constant, those growers who believe khat has health consequences will not consume, while those who do not grow and believe the same may or may not consume.[17] However, the interaction term combining these two factors tells a different story; with no controls, those who are growing khat and who reported believing that khat is harmful are expending 81.1% more on khat and tobacco. The introduction of controls and location fixed effects strengthens the coefficient, increasing this expenditure amount. Additionally, those households with a male household head who has completed secondary school spend considerable more amounts of money, while households with more children, understandably, expend less on khat.[18]

Ultimately, khat producers, although reporting that they believe khat impacts a person's health negatively, are both growing and expending money on khat and tobacco. The assumption that khat growers can see the harmful effects of khat and, thus, do not consume it, is not supported by the available data. A plausible explanation is that some khat producers are influenced by a negative, social stigma associated with khat in their location. As discussed in the

[16] Even those who produce khat will need to expend money on khat if they have a chewing habit. Khat only matures a few times a year and does not store well. Unless a producer has incredible amounts of trees, which is unlikely, he will not be able to sustain his habit.

[17] In theory, a producer of any good is potentially more in-touch with that good than the average consumer. If they believe that their good is harmful (or not), there is, generally, a knowledgeable reason for it. Consumers of the good may believe a certain way about a good, but their reasons for it may not stem from knowledge, and therefore, their consumption habits are not as predictable.

[18] The expenditure solely on khat cannot be separated from the expenditure on khat, cigarettes, and tobacco.

descriptive statistics, one of the main reasons why non-khat producers do not grow khat is because of a belief that khat is an evil product. If this belief is widely-held in a community, producers could have falsely reported that they believe khat is harmful due to societal expectations, while in reality, they believe the opposite and consume it. It is also possible that khat producers believe the plant to be harmful, but still enjoy khat chewing despite this, similar to a tobacco smoker in the United States. It is common knowledge that smoking is related to negative health outcomes, but despite this, many people still engage in smoking.

The Greater Implications of Khat Production

The primary goal of this research is to broaden the knowledge of the implications of khat production by analyzing data from a specific geographic location. Whether khat production is considered harmful or beneficial depends on numerous factors. Theoretically, the amplified revenue generated from khat sales can be recycled back into local economies by means of increased consumption of local products and foods, increased expenditure on higher value assets like tractors and stoves, and investments in infrastructure like more efficient transportation systems and quality housing or building materials. Some have even argued that the increased alertness and energy from consumption can stimulate laborers, fueling production of crops and livestock.

However, regardless of the revenue generated from khat sales, the cultivation and consumption of khat is controversial for ethical, economic, and ecological reasons. Ethically, khat is thought of by some as a “drug plant” that can cloud the mind of the consumer and lead to an increase in health problems. Economically, many khat consumers spend higher percentages of their income on their habit or similar vices, potentially at the expense of their family members’ education, nutrition, and safety. Ecologically, khat production has been suggested to contribute

to the decrease in local water supply due to the necessity of irrigation. Results from this research indicate that khat production can both aid and damage those who produce it.

Implications derived from analysis

Khat producing households use more adult male and female labor, mainly for land preparation, irrigation, harvesting, and marketing, aligning with Gezon's (2012b) qualitative findings after interviewing khat producers in Madagascar. Site selection in preparation for planting of khat plots is integral to the success of its cultivation, much more so than other crops; khat cannot be planted on a poorly drained or rocky piece of land. Irrigating and harvesting khat plants is much more strenuous and intensive than other, more manageable crops as khat needs evenly distributed irrigation and requires frequent harvests. Marketing is primarily done by the males in the household, and the data indicates that the majority of khat sales occur on the farm or in the district market rather than a village or khat market. This provides insight into the role of women in khat producing households, signifying that although female labor is maximized more than in non-producing households, women are typically more involved with the private cultivation of the crop than with the public and potentially risky aspect of taking it to the market or negotiating price with a *dalala*. Furthermore, not only do khat producing households utilize more family labor than non-producers, they also utilize more paid agricultural labor, potentially stimulating labor markets in khat-producing locations.

Matching analysis confirms that khat production generates higher levels of income for growing households than their non-growing counterparts, but not quite to the magnitude calculated by summary statistics. Indeed, khat producers make more money than non-khat, but whether the excess income is coming solely from khat sales or other income sources is unclear. The results indicate that khat producing households have approximately 45.0% to 55.0% higher

gross household income than non-producing, but only 35.0% to 45.0% of that is coming from khat production. It is not clear what is driving the difference in these estimates. Khat producers could be strategically selecting crops that maximize their profit while not concerning themselves with diversifying their crop production portfolio. In this sample, most khat plots were previously maize plots, indicating that khat producers are substituting khat in for staple crops. One-third of all current producers plan to expand their khat production capacity in the next five years, and the main reason is due to revenue reasons, including the ability to obtain a higher profit, low initial investment costs, stable market prices, and low production costs.

In general, it appears that even after removing khat revenue out of total revenue, khat producers are still richer than non-producers. The excess revenue could be originating from sales of other crops that non-khat producers are not growing, or perhaps from off-farm employment or livestock sales, but the data does not provide a clear answer for this. Of note, non-khat producers own a much higher percentage of sheep than khat-producers, indicating that rather than diversifying into khat or cash crop production, some households are shifting to livestock production to increase income.

Regardless of where the excess income is coming from, khat producers are not spending it on investments in childhood education; it is being paid towards laborers on their farms and living expenses such as utilities, rent, travel, fuel, and communications. There is a strong link between the intensive nature of khat production and expenditure on laborers and living expenses. Khat production requires more family and external labor to successfully cultivate, travel and fuel to transport the frequent harvests to the market multiples times a year, and communication to be connected to the traders, brokers, and trends in the market. Although khat producers are not spending more money on building or housing materials, utilities and rent are reported as higher

for them; even though they are not expending more to improve their existing dwellings, perhaps they are residing in more valuable and quality houses and have better access to electricity and water.

Although income for khat producers is proven to be higher, they are not expending this money on more food than non-producers; in fact, khat producers are expending approximately 9.0% less on food, aligning with Fafchamps' (2003) theory that high-income farmers spend proportionally less money on food than low-income. After comparing khat producers to similar non-khat producers based on household demographics, khat production causes households to have a lower FCS, meaning that a khat growing household with six people, owns a mobile phone, and owns four plots feeds their household with less diverse foods than a non-growing household with the same demographics. They are either not purchasing diverse foods in the market or not growing diverse foods in a kitchen garden; yet, these households did not report having low access to food or feeling stressed about food. Khat producing households may be richer and able to feed their family sufficiently but may be feeding them more vegetables, fruits, and staples as opposed to meats and dairy products. Whether this means a khat producing household is more (or less) food secure than a non-producing household is a matter of opinion.

Regarding seasonality, khat can be harvested year-round unlike other crops, which provides a constant stream of income throughout the year and could alleviate seasonal food insecurity. Although non-growers reported storing their food longer, the amount of food they stored may have not been enough to provide proper sustenance to their family throughout the duration of the year. Food production issues are the main cause of food shortages for these households, meaning that the households had too little land or lack of farm inputs, both of which could be originating from an overall lack of money. Combining the higher, steady income with

shorter lengths of food shortages gives rise to the idea that khat growing households are less affected by seasonality than non-producers. Overall, although khat production causes households to have lower dietary diversity, this is not necessarily an indication that khat production causes food insecurity. Khat producing households still have ample access to food, experience fewer food shortage months, and generate more income to purchase higher quantities of food than their non-producing counterparts.

Policy Implications

The current legal status of khat around the globe contributes to a puzzling dilemma for Ethiopian policymakers. When the United Kingdom banned khat in 2014, effectively decreasing Ethiopian government revenue, Ethiopian legislators responded by increasing the domestic tax to compensate for the revenue loss (Dessie, 2015). By doing this, the government indirectly harmed khat producers by discouraging individuals to consume khat. As khat is banned in other countries, policymakers will have to develop new strategies to continually generate revenue. The Ethiopian government has attempted to control khat production by imposing domestic and export taxes on khat as well as providing subsidies and extension services to other cash crop producers in attempts to entice producers to switch from growing khat to other crops. The export tax on khat is currently higher than the domestic tax (6 ETB compared to 3 ETB), which could be inhibiting export activity for the country. If the export tax was lowered or even removed, khat producers could be motivated to produce and sell more of their crop, and Ethiopia could benefit economically from an increase in export activity and, ultimately, growth in GDP.

Despite the government interventions, Ethiopian farmers are drawn to khat production likely due to market forces such as significantly higher profits (Belwal & Teshome, 2011) and unstable coffee prices (Gemech & Struthers, 2007). This is evident in the expansion of land used

for khat production; in the Amhara region, there has been a 252% increase in land used for khat production from 2003/2004 to 2014/2015 (Cochrane & O'Regan, 2016). The Ethiopian government benefits greatly from the tax revenue generated by khat; in 2010, khat taxes contributed an estimated US$289 million to government revenue (Dessie, 2015). The local labor economy also benefits from khat production with over one thousand Ethiopian citizens employed through khat *kellas* and even more employed on khat farms (Belwal & Teshome, 2011). In general, the evidence suggests that khat is sufficiently more valuable relative to other crops that Ethiopian farmers grow. Negative consequences associated with khat, such as adverse health effects or changes in societal behavior, would have to be extremely large to justify discouraging or banning consumption or production of khat.

Chapter 8 - Summary and Concluding Remarks

Khat growing households in Ethiopia appear to be different than non-growing households. They are more educated, apt to adopt agricultural technologies, own different livestock, have access to irrigation, and own more plots. Although these households have more household members and children, this does not affect their decision to grow khat. Many households decide to grow khat because of its profitability and opportunity for multiple harvests throughout the year, unlike other field crops. A societal belief that khat is an evil product or causes harm to the user weighs heavily upon both khat growing households and non-growing households. Most non-growing households do not grow the drug crop because of this negative overtone, but surprisingly, more khat growing households believe khat is harmful than non-growers. It is unclear why khat producers continue to grow a crop they reportedly believe is harmful, and uncertain why they expend more money on khat and tobacco despite this belief. Regardless of the behavioral and ethical aspects of khat production and consumption, khat is an integral cash crop in Ethiopia and households are planning on expanding production.

Khat requires 41.8% more male labor and 62,1% more female labor from household members to irrigate, harvest, and market than a typical field crop, but the generated cash from khat sales is well worth the required intensive labor. With this increased income (41.7% more), households can invest in technologies, land, and expansion of khat production, and potentially provide their families with higher-quality homes and ample access to water and electricity. Although khat producing households are not spending their excess income on education (10.7% less) or diverse foods for their family (15.9% lower FCS scores), their food security is not suffering due to khat production. In fact, these households appear to be less affected by seasonal

hunger because of the steady stream of income provided by frequent khat plant harvests and sales, experiencing 16.2% fewer food shortage months.

Limitations

Diving deeper into the locational elements of this research by controlling for kebele is important to determine if there is some unobserved variable impacting households in a certain location. We can examine the difference among households in each kebele—a much smaller and more precise geographical unit than woreda. Because many kebeles contain either all khat or all non-khat producers, some kebeles were automatically dropped from the analysis. On a kebele level, the impact of khat production on labor, income, and food consumption score is underestimated, while the impact on education is overestimated.

The sampling strategy was not explicitly designed to stratify woredas or kebeles based on khat production. The survey was also not designed to determine factors contributing to the decision to produce khat, so the variation in khat production covaried with the variation in location. There is great difficulty in trying to disentangle the khat growing effect from the kebele fixed effect; it is uncertain whether impacts on this level are due to a household growing khat or the location of a household. There is likely some unobserved kebele level variable explaining the outcome variables that was not measured in the data and is not captured in this model. For this reason, although the kebele level analysis is not incorrect, the woreda fixed effect model provides the most reliable results and elements for discussion.

Another main limitation of this research is missing and/or miscoded data. It is unclear whether the discrepancies in the data are due to misunderstandings from the interviewed household, recording errors by the enumerator, or simply input or merging errors by the data

company. In all instances, the best judgment was used to recode and interpret the data; regardless, some errors could still be present.

Previous research points out that subjective measures like the FCS and HFIAS are not as robust of a food security measure as a caloric consumption measure because FCS and HFIAS are subjective measures while caloric consumption is an objective measure. A household could consume limited amounts of meats and dairy products or eat less preferred foods while still meeting their daily nutritional needs. The survey was also administered shortly after the main harvest, so levels of food security could be higher than if measured during the lean season. A more thorough and detailed questionnaire including objective measures of food security could provide valuable insight otherwise missed in this survey. Future research in the impact of khat production should also explicitly design the survey to evenly disperse khat growing households across locations.

Suggestions for Further Research

This research was not initially set out to examine the behavioral aspects of khat production and consumption, but found that the social aspects, expectations, and connotations related to khat are related to production. Because we are unsure if respondents responded truthfully with regards to their ethical beliefs of khat, employment of the list-experiment technique could reduce the errors and bias that result from social influence. This technique is often successful when used in the context of controversial or sensitive topics ("List-Experiment Technique," 2008). Stratifying khat producers among the sample would be key to measuring the opinion on the social aspects of khat.

It was surprising that khat producers are not expending more of their income on education for children considering that khat producers have higher income and are more likely to

be educated. However, perhaps if farming is more profitable, these households see less of a need for education to transition their children out of farming. Administering a "dedicated" survey would more precisely measure education expenditure (Tiyab & Ndabananiye, 2013). This type of survey focuses on a specific aspect of a topic (education expenditure rather than household expenditure). Instead of asking the households to recount all household expenditures, the household provides specific estimates for each aspect of education expenses, such as registration fees, uniforms, mandatory textbooks, private classes, and boarding fees for each school-going child (Tiyab & Ndabananiye, 2013). This is a more accurate and thorough representation of education expenditure. Again, stratifying khat producers among the sample is necessary.

Surveying other drug crop producers (cannabis, coca, opium poppy) could verify the robustness of the results of this research. It would be interesting to determine if drug crop producers in other developing countries are similar to khat producers in Ethiopia. Administering a survey similar to the one used in this research could determine the factors behind the decision to grow other drug crops and the impacts of production. These results could determine if khat is a drug crop that provides greater or less opportunity than other drug crops.

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Appendix A - Survey

Bahir Dar University Study on Mechanization in Agriculture: Ethiopia Household Questionnaire

Introductory Statement and Informed Consent (to be read to the respondent):

"We are coming from Bahir Dar University and the Amhara Regional Agricultural Research Institute (ARARI) in association with the Feed the Future Innovation Lab for Agricultural Intensification to talk to you about agricultural practices, household food consumption, and other livelihood activities. We will be asking questions about agricultural activities, livestock activities, and diet over the last 12 months of the farming year, that is, the last full Meher/Kirempt and the last full Belg/Bega. We will also ask questions about your household's diet, asset purchases, and health practices. The survey is expected to take approximately 2-4 hours to complete. If you agree to participate, the information you provide will be used for research purposes only. Your answers will not affect any benefits or subsidies you may receive now or in the future. Your responses to these questions will remain strictly confidential. Your survey responses will be identified through code numbers, and your name will not appear in any data that is made publicly available. However, we would like to write down your contact information in case some issues in the questionnaire are unclear and we need to follow up with you for more information or clarification. After we have finalized the entry of all the information, we will throw away any documents with your name. Do you consent to provide information for this study? You may withdraw from the study at any time and if there are questions that you would prefer not to answer then we respect your right not to answer them.

Has consent been given for the interview by the respondent? *(01=Yes, 00=No)* [__ __]

UNIVERSAL SURVEY CODES	-99 = Not applicable
	-88 = Don't know
	-77 = Refuse to answer

A1: REGION		A2: ZONE		A3: WOREDA		A4: KEBELE		A5: HOUSEHOLD NUMBER	

REGION CODE:	ZONE CODE	WOREDA CODE	KEBELE CODE
1 Amhara	1		
2 Oromia	2		
3 SNNPR	3		
	4		
	5		

GPS coordinates			**Degree**	**Minute**	**Second**
A6	GPS Latitude	N			
A7	GPS Longitude	E			
A8	Elevation (in meters)				

ENUMERATOR NAME:				Code				
DATE OF INTERVIEW (FIRST VISIT): *USE EUROPEAN CALENDAR*				DATE OF INTERVIEW (SECOND VISIT): *USE EUROPEAN CALENDAR*				
	DD	MM	YY		DD	MM	YY	
INTERVIEW STARTING TIME (FIRST VISIT)				INTERVIEW STARTING TIME (SECOND VISIT):				
	HOUR	MIN			HOUR	MIN		

Supervisor code		Inspection date by supervisor			Verifier code		Verification date		
		DD	MM	YY			DD	MM	YY

Household information		
A9	Name of head of household	
A10	Name of respondent (if not head)	
A11	Respondent relationship to head (if not head)	
A12	Was translator used? 1. Yes 2. No	
A13	Phone numbers (if available)	
A14	Religion of the head 1 Christian 2 Muslim Other (specify)	
A15	Ethnicity of the head 1 Amhara 2 Gurage 3 Oromo 4 Tigray 5 Hadia Other (specify)	

Codes for the Household Module

Code (1) Relationship to head

1 Head
2 Wife/husband
3 Child
4 Adopted child
5 Grandchild
6 Niece/nephew
7 Father/mother
8 Sister/brother
9 Uncle/aunt
10 Son/daughter-in-law
11 Brother/sister-in law
12 Grandfather/mother
13 Father/mother-in-law
14 Other relative
15 Servant (farm worker, herder, maid, etc) or servant's relative
16 Other unrelated person

Code (2): Marital Status

1 Currently married, one spouse
2 Never married
3 Divorced
4 Separated
5 Widow or widower
6 Married, more than one spouse

Code (3): Residence Status

1 Present at home most of the time
2 Traveling
3 Working within the country
4 Working outside the country
5 Studying/training outside the village
6 Other, specify

Code (4) Labor Capacity

1 young child (too young to work)
2 working child (herding livestock; domestic chores; childcare; hired)
3 adult (able to do full adult workload)
4 working elderly / partially disabled (able to do light work only)
5 permanently unable to work (disabled, or non working elderly)
6 chronically ill (unable to work in the production seasons)

Code (5) Occupation

1 Farmer or family farm worker
2 Domestic Work (incl. housewife)
3 Manual worker
4 Tailor
5 Weaver/thatcher
6 Craftsworker/Potter
7 Blacksmith/mason
8 Foodseller
9 Driver/Mechanic
10 Skilled factory worker
11 Teacher
12 Health worker
13 Part Official/Administrator/Clerical
14 Soldier
15 Trader
16 Unable to work (or not in labor force)
17 Student
18 Unemployed/Looking for work
19 Other (specify)

Code (6): Schooling

0 Did not complete any schooling
1 1st grade
2 2nd grade
3 3rd grade
4 4th grade
5 5th grade
6 6th grade
7 7th grade
8 8th grade
9 9th grade
10 10th grade
11 11th grade, vocational (TVT)
12 11th grade, preparatory
12 12th grade, vocational (TVT)
14 12th grade, preparatory
15 Incomplete university education
16 Completed university education
17 Adult literacy program participation
18 Other literacy program
19 Some Church/Mosque School

Code (7): Self-rated Health

1 Poor
2 Fair
3 Good
4 Very good
5 Excellent

PID of Respondent_____

Module A: Household Roster: *Household members=Persons who live together and eat together from the same pot (share food) for at least half of the past 12 months, including hired labour, students and spouse living and working in another location but excluding visitors)*

PID NUMBER	1 List names of household members	2 Sex 1 Male 2 Female	3 How old is [NAME]? **Years if 5 years or older** **Years and months if less than 5 years**		4 Relations-hip to head	5 What is the present marital status of [NAME]? **Write -99 if age <10**	6 Current status of member?	7 Is [NAME] able to work or currently working? **If child too young to work, fill in code=1 and >>next line**	8 Main Occupation	9 Was there a time where you were unable to find work for more than one week in the last year? 1=yes 2=no **Write -99 if the person is unable to work during the year or permanently disabled.**	10 Can he/she read and write? 1=yes 2=no	11 Highest grade of schooling obtained
	NAME	**CODE**	**Years**	**Months**	**CODE 1**	**CODE 2**	**CODE 3**	**CODE 4**	**CODE 5**	**CODE**	**CODE**	**CODE 6**
01												
02												
03												
04												
05												
06												
07												
08												
09												
10												
11												
12												
13												
14												

CODE (1): Use of land
1 Cultivated field with seasonal crops
2 Kitchen garden
3 Cultivated with perennial crops
4 Grazing/pasture land
5 Rented out
6 Sharecropped out
7 temporarily given out to others
8 Left fallow
9 Not a Meher/Irrigation Season field
10 Not rented this season
11 Other purpose, specify

CODE (2): Soil fertility
1 Lem (fertile)
2 lem-teuf (medium fertile)
3 teuf (less fertile)

CODE (3): Slope
1 meda (flat)
2 dagetama (steep)
3 gedel (steeper)

CODE (4): Land acquisition
1 Allocated
2 Purchased
3 Inherited/parents' gift
4 Rented-in
5 Sharecropped in
6 Borrowed free
Other, specify

CODE (5): Who makes decisions?
1 Head
2 Spouse
3 Head and spouse jointly
4 Adult children
5 Head and adult children
6 Spouse and adult children
7 Whole family
8 Head and parent
9 Head and brothers
10 PA (peasant association)
11 Original landholder
12 Head and tenant

Module B: Land

Ask the farmer about all lands rented, owned, sharecropped, and cultivated. A parcel refers to a piece of continuous land used by a farmer, and individual plots fall within the parcel. A plot is defined as a piece of land within a given parcel that is either not continuous across the entire parcel, and thus is broken up spatially, or it is broken up due to its use by different crops

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Parcel number **Repeat parcel number if there are multiple plots on the parcel**	Plot number **Given each parcel an individual number**	How was the plot used during Meher 2016?	How was the plot used during Irrigation Season 2016?	How large is this plot?	Distance from home	Soil fertility	Slope	Soil type 1 Clay 2 Sandy 3 Loamy 4 Silt	Soil erosion 1 No erosion 2 Mild erosion 3 Severe erosion	How did you acquire the plot?	Who makes the majority of decisions regarding this plot?	Is the plot registered? 1 Yes 2 No >> 13 -7 Don't know	Whose name is on the land registration certificate?	If land was rented in for cash payment, how much did you pay?	If land was share-cropped in, what was the division of production (1/4, 1/2, etc)
		Code 1	**Code 1**	**# Hectares**	**Minutes**	**Code 2**	**Code 3**	**Code**	**Code**	**Code 4**	**Code 5**	**Code**	**Code 5**	**Birr**	**#**

	Code (1) for Crops	Code (1) for Crops (cont.)		Code (1) for Crops (cont.)		Code (2) Current yield compared to normal year	
	GRAINS/GRASSES		**LEGUMES**	**ROOTS/TUBERS/VEGETABLES**		1	Much higher
1	MAIZE	19	HORSE BEANS/FABA BEANS	37	SWEET POTATOES	2	Little higher
2	WHITE TEFF	20	FIELD PEAS	38	CARROT	3	Roughly the same
3	BLACK TEFF	21	PIGEON PEA	39	CABBAGE	4	Little lower
4	MIXED TEFF	22	HARICOT BEAN	40	PUMPKIN	5	Much lower
5	WHEAT	23	LINSEED	41	PAWPAW	-88	Don't know
6	BARLEY	24	VETCH	42	POTATOES	**Code (3) Adverse production conditions**	
7	MILLET	25	ROUGH PEA	43	GARLIC	1	Late rains
8	SORGHUM	26	GROUNDNUT	44	ONIONS	2	Insufficient rains during growing season
9	RICE	27	BLACK PEPPER	45	TOMATO	3	Too much rain during growing season
10	OATS	28	LENTILS	46	LETTUCE	4	Rains during harvest time
11	NAPIER GRASS	29	CHICK PEA	47	SASULA	5	Plant disease during season
12	EMMA WHEAT	30	COW PEA (Ater)	48	PEPPERS	6	Weed damage
	FODDER LEGUMES	**OIL CROPS**			**PERRENIAL CROPS**	7	Insect damage
13	LABLAB	31	NIGERSEED (NUG)	49	CHAT	8	Wind/storm
14	CLOVER	32	SUNFLOWER	50	SUGARCANE	9	Flooding
15	ALFALFA	33	SESAME	51	COFFEE	10	Low temperatures
16	SESBANIA	34	LINSEED	52	TOBACCO	11	Animal/bird damage (eating or trampling crops)
17	GRAZING LAND	35	RAPESEED (GOMENZER)	53	ENSET	12	Post-harvest spoilage
18	FALLOW	36	LUPIN	54	BANANA	13	Other, specify
				55	PINEAPPLE		
				56	AVOCADO		
				57	ORANGE		
				58	MANGO		
				59	EUCALYPTUS		
				60	OTHER CROP, SPECIFY		

Module C. CROP PRODUCTION

ENUMERATOR: FIRST ASK WHICH CROPS WERE GROWN BY THE HOUSEHOLD ON EACH PARCEL, EACH PLOT, AND EACH SEASON (columns 1 to 3 for each season). THEN ASK columns 4 to 8. NOTE THAT THE INFORMATION TO BE COLLECTED IN THIS MODULE IS AT THE PLOT-SEASON LEVEL. Copy parcel id number from module "land", repeat parcel number if there are multiple plots on the parcel. For Plot number, repeat plot number if there are multiple crops on the plot. Complete Meher season details on this page, and Irrigation Season on the next.

		1	2	3	4	5	6	7
Season		Parcel Number [Copy parcel id # from module "Land", repeat parcel # if there are multiple plots on the parcel]	Plot Number [Repeat plot number if there are multiple crops on the plot]	What crop was planted on this plot during [SEASON]?	What was the area planted with [CROP] on this plot during [SEASON]?	What was the distance of space between rows of [CROP] during [SEASON] ? *If the plot is inter-cropped, provide distance of space to the nearest row, even if it is a different crop*	How much [CROP] was harvested from this [PLOT] during the **" …" season**?	Do you usually practice crop rotation on this [PLOT]?
				CODE 1	**# HECTARES**	**CMs** [write -9 if crop not planted in rows]	**# KGS**	1 Yes 2 No
Meher								

Irrigation Season

		1	2	3	4	5
		Parcel Number [Copy parcel id # from module "Land", repeat parcel # if there are multiple plots on the parcel]	Plot Number [Repeat plot number if there are multiple crops on the plot]	What crop was planted on this plot during [SEASON]?	What was the area planted with [CROP] on this plot during [SEASON]?	How much [CROP] was harvested from this [PLOT] during the **" …" season**?
				CODE 1	**# HECTARES**	**# KGS**
Irrigation Season						

SECTION D: CROP INPUTS

Enumerator: Copy parcel number, plot numbers, and crop codes from module "Crop Production". Complete the chart for all crops cultivated in the last Meher on this page, and the last Irrigation Season on the following page. Ask farmers to estimate how many of local units are in a KG to estimate quantities. Make sure farmers are referring to the inputs used for the crop HARVESTED in the most recent harvest.

Crop Season		Parcel number	Plot number	Crop codes	For the [CROP] grown in this [PLOT], how much [INPUT TYPE] did this household use during [SEASON] IN KGs?				Total cost of pesticides and herbicides [Write 0 if none, and -7 if value is not known]	Total cost of other non-labor expenses (e.g. crop residues, off-farm manure, animal or equipment rental cost)	Which two types of fertilizers did you use? 1. Urea 2. DAP 3. No fertilizer used Other, specify						
					INPUT TYPE												
					Seed saved from the previous harvest [*Write -7 if value is not known*]	Seed obtained for free or in barter/exchange [*0 if no free/barter seed, -7 if value not known*]	Traditional seed that was purchased [*0 if no traditional seed purchased*]	Improved seed that was purchased [*Write 0 if no improved seed purchased*]			1st Type	QTY	Total cost spent on this type of fertilizer	2nd	QTY	Total cost spent on this type of fertilizer	
				CODE	**# KGs**	**# KGs**	**Birr**	**Birr**	**Birr**	**Birr**	**CODE**	**# KGs**	**Birr**	**CODE**		**# KGs**	**Birr**
Meher	**1**																
	1																
	1																
	1																
	1																
	1																
	1																
	1																
	1																
	1																
	1																
	1																
	1																

Crop Season		Parcel number	Plot number	Crop codes	For the [CROP] grown in this [PLOT], how much [INPUT TYPE] did this household use during [SEASON] IN KGs?				Total cost of pesticides and herbicides [Write 0 if none, and -7 if value is not known]	Total cost of other non-labor expenses (e.g. crop residues, off-farm manure, animal or equipment rental cost)	Total cost of hired labor expenses (do not include family labor expenses)	Which two types of fertilizers did you use? 1. Urea 2. DAP 3. No fertilizer used Other, specify					
					INPUT TYPE												
					Seed saved from the previous harvest [*Write -7 if value is not known*]	Seed obtained for free or in barter/exchange [*0 if no free/barter seed, -7 if value not known*]	Traditional seed that was purchased [*0 if no traditional seed purchased*]	Improved seed that was purchased [*Write 0 if no improved seed purchased*]				1st Type	QTY	Total cost spent on this type of fertilizer	2nd	QTY	Total cost spent on this type of fertilizer
				CODE	**# KGs**	**# KGs**	**# KGs**	**# KGs**	**Birr**	**Birr**		**CODE**	**# KGs**	**Birr**	**CODE**	**# KGs**	**Birr**
Irrigation Season	2																
	2																
	2																
	2																
	2																
	2																
	2																

Module E: Irrigation

Do you Irrigate any plots during the main season?

1 Yes 2 No >> skip to Next Page Irrigation Season.

Section E1: Access and method of Irrigation

				1	2	3	4	5	6	7		8
Season		Parcel number **[COPY FROM MODULE "LAND"]**	Plot number **[COPY FROM MODULE "LAND"]]**	Is the plot irrigated ? 1 Yes 2 No **(If "No," >> Next Plot)**	If plot is irrigated, source of water for irrigation? 1 River 2 Lake 3 Dam 4 Pond 5 Ground-water 6 Harvested water 7 Other (specify -88 Don't know	If plot is irrigated using groundwater was well drilled or hand-dug? **(If not ground-water, SKIP to>>5)** 1 Drilled 2 Hand-dug -88 Don't know	If plot is irrigated using groundwater what is the depth of the water? **(If not ground-water, SKIP to>>5)** 1 < 7 meters 2 8- 50 meters 3 >50 meters -88 Don't know	Type of irrigation method 1 Surface/ Flooding 2 Sprinkler 3 Drip 4 Furrow 5 Level basin 6 Bay/border strip 7 Bucket/ hose/watering can 8 Other (specify)	What is the method of obtaining water? 1 Gravity 2 Hand/foot pump 3 Hand Bucket/hose 4 Diesel pump 5 Electric pump 6 Tractor pump 7 Other (specify)	How often do you irrigate? (# of times per CODE) 1 Day 2 Week 3 Two weeks 3 Month 4 Season 5 Year 6 Planting 7 Other, specify -88 Don't know		How well is this plot irrigated? **Water is available:** 1 Always when needed 2 Usually 3 Sometimes 4 Rarely 5 Never
				CODE	**CODE**	**CODE**	**CODE**	**CODE**	**CODE**	**#**	**CODE**	**CODE**
Meher	**1**											
	1											
	1											
	1											
	1											
	1											
	1											
	1											
	1											
	1											

				1	2	3	4	5	6	7		8
Season		Parcel number **[COPY FROM MODULE "LAND"]**	Plot number **[COPY FROM MODULE "LAND"]]**	Is the plot irrigated? 1 Yes 2 No **(If "No," >> Next Plot)**	If plot is irrigated, source of water for irrigation? 1 River 2 Lake 3 Dam 4 Pond 5 Ground-water 6 Harvested water 7 Other (specify -88 Don't know	If plot is irrigated using groundwater was well drilled or hand-dug? **(If not ground-water, SKIP to>>5)** 1 Drilled 2 Hand-dug -88 Don't know	If plot is irrigated using groundwater what is the depth of the water? **(If not ground-water, SKIP to>>5)** 1 < 7 meters 2 8- 50 meters 3 >50 meters -88 Don't know	Type of irrigation method 1 Surface/ Flooding 2 Sprinkler 3 Drip 4 Furrow 5 Level basin 6 Bay/border strip 7 Bucket/ hose/watering can 8 Other (specify)	What is the method of obtaining water? 1 Gravity 2 Hand/foot pump 3 Hand Bucket/hose 4 Diesel pump 5 Electric pump 6 Tractor pump 7 Other (specify)	How often do you irrigate? (# of times per CODE) 1 Day 2 Week 3 Two weeks 3 Month 4 Season 5 Year 6 Planting 7 Other, specify -88 Don't know		How well is this plot irrigated? **Water is available:** 1 Always when needed 2 Usually 3 Sometimes 4 Rarely 5 Never
				CODE	**CODE**	**CODE**	**CODE**	**CODE**	**CODE**	**#**	**CODE**	**CODE**
Irrigation Season	**2**											
	2											
	2											
	2											
	2											
	2											
	2											
	2											
	2											
	2											
	2											
	2											
	2											
	2											

Section E2 : Irrigation Pumps

Skip to next module if answer is "No" for first question. If farmers do not know the cost of fuel/electricity, ask them the average monthly cost and multiply by the number of seasons it is used. Write -7 if respondents don't know and -99 if not-applicable.

1. Do you use a pump for irrigation purposes? [FILL IN CODE] _____

1 Yes

2 No >> skip to Module E3 (Conservation).

	1	2	3	4	5	6		7		8		9	10	
Pump	Type 1 Hand/foot pump 2 Diesel pump 3 Electric pump 4 Solar pump 5 Kerosene pump 6 Tractor pump 7 Other (specify)	What plot is this pump used on? [COPY PLOT NUMBER from Section C; IF MULTIPLE, SEPARATE WITH COMMAS]	Who owns the pump? 1 Household has ownership 2 Jointly owned with other households/farm entities 3 Farmer association 4 Water user association 5 Private company 6 Other farmer 7 Other (specify) IF RESPONSE WAS 3-6, >> 6	Year pump was purchased (if you own it) (Ethiopian Calendar)	What was the price of the pump when purchased?	Cost of fuel or electricity per production season paid by farmer		Repair cost per production season paid by farmer		Flow rate or horse power of the pump [ENTER EITHER FLOW RATE OR HORSE POWER, IF KNOWN]		Do you pay to use the pump? 2 No>> next pump	If yes for question (9), how much per production season?	
						(ETB)		(ETB)					(ETB)	
	CODE	PLOT NUMBER	CODE	YEAR	(ETB)	Last Meher season	Last Irrigation Season	Last Meher season	Last Irrigation Season	Liter/ Second	Horse power	CODE	Last Meher season	Last Irrigation Season
Pump 1														
Pump 2														

E3. Conservation techniques: Ask about this past meher season

What type of organic inputs do you use? (Code 1 [*list up to 2*]: _____ _____

Did you practice soil and water conservation in 2016? 1 Yes 2 No _____ (if No>>Next section)

Which soil and water practices did you use? **[Record up to 3 practices per plot]** _____ _____ _____

Code 1

1 Household waste
2 Mulch
3 Compost
4 Crop residue
5 Manure
6 Green manure
7 None
8 Other, specify

Code 2

1 Contour ploughing/pit planting
2 Tree/bush/shrub plant rows
3 Terraces or bunds
4 Trenches
5 Cover cropping
6 Strip Cropping
7 Other (specify)

Module F: Farm Tools and Mechanization

Section 1: Farm Tools and Machinery for Land Preparation (Main Season)												
Crop season	Parcel numbe **[COPY FROM MODULE "LAND"]**	Plot number **[COPY FROM MODULE "LAND"]**	Crop codes **[COPY FROM MODULE "LAND"]**	Land Preparation (including harrowing & ridging)								
				Draft animal used in land preparation			Tools/machinery used for Land Preparation					
				How many oxen were used to prepare your land?	How did you acquire the oxen?	Total Rental Cost	What was the primary tool or machine you used for this activity?	Rental Cost	Fuel Cost for operation	What other tool was used for this activity?	Rental Cost	
				Write 0 if no oxen used and →		*Write -9 if oxen owned by respondent. If rental paid in-kind, estimate in-kind value.*		*Write -9 if tool or machine is owned by respondent. If rental paid in-kind, estimate in-kind value.*	*Write –9 if fuel cost is included in rental cost. Write 0 if no fuel cost.*		*Write -9 if tool or machine is owned by respondent. If rental paid in-kind, estimate in-kind value.*	
				Total oxen days	**Code 1**	**Birr**	**Code 2**	**Birr**	**Birr**	**Code 3**	**Birr**	
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
1												
1												
1												
1												
1												
1												
1												
1												

	Code (1) Equipment
1	Double axel tractor (i.e. Four wheel tractor
2	Single axel tractor (i.e. Two wheel tractor)/ Power Tiller
3	Traditional Plough
4	Improved/Modern Plough

	Code (2) Acquisition
1	Own
2	Rented and operated by farmer
3	Hired both equipment and operator (i.e. custom hire)

	Code (3) All Equipment
1	Double axel tractor (i.e. Four wheel tractor
2	Single axel tractor (i.e. Two wheel tractor)/ Power Tiller
3	Sickle (maetsid)—Imported (Albin)
4	Sickle (maetsid)—Local (Bahlawi)
5	Pick ax (doma)
6	Axe (metrebia)
7	Pruning/Cutting shears (megrezia)
8	Malakino
9	Hoe (mekotkocha) (Chikuaro/Afkuta)
10	Spade or shovel (Megafia)
11	Leather strap (Miran/Metsian)
12	Other Hand Tool (imported)
13	Other Hand Tool (local)
14	Manual (hand pump) sprayer
15	Motorized sprayer
16	Horse/ox cart (cart only)
17	cart attachment to tractor or motor vehicle
18	Other animal-drawn implement
19	Other tractor-drawn implement
20	Threshing machinery
21	Bubble dryer
22	Other drying machinery
23	Drying mat
24	Bicycle
25	Motorcycle
26	Truck or car

Section 2 : Farm Tools and Machinery for Agricultural activities (Main Season)

Crop season	Parcel numbe	Plot number	Crop codes	Seeding				Planting		Weeding		Fertilizing		Applying pesticide/ herbicide		Harvesting			
				Primary tool or machine you used for this activity?	Rental Cost	Other tool used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Other tool or machine you used for this activity?	Rental Cost
					Note 1		*Note 1*		*Note 1*		*Note 1*		*Note 1*		*Note 1*		*Note 1*		*Note 1*
				Code 1	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
1																			
1																			
1																			
1																			
1																			
1																			
1																			

Section 3 : Farm Tools and Machinery for Post-Harvest activities (Main Season)

Crop season	Crop codes **[COPY FROM MODULE "LAND"]**	Threshing/Winnowing				Drying		Selling/Marketing	
		Primary tool or machine you used for this activity?	Rental Cost	Other tool used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost
			Note 1		*Note 1*		*Note 1*		*Note 1*
		Code 1	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1									
1									
1									
1									
1									
1									
1									
1									

Note 1: *Write -9 if tool or machine is owned by respondent. If rental paid in-kind, estimate in-kind value.*

	Code (1) All Equipment
1	Double axel tractor (i.e. Four wheel tractor
2	Single axel tractor (i.e. Two wheel tractor)/ Power Tiller
3	Sickle (maetsid)—Imported (Albin)
4	Sickle (maetsid)—Local (Bahlawi)
5	Pick ax (doma)
6	Axe (metrebia)
7	Pruning/Cutting shears (megrezia)
8	Malakino
9	Hoe (mekotkocha) (Chikuaro/Afkuta)
10	Spade or shovel (Megafia)
11	Leather strap (Miran/Metsian)
12	Other Hand Tool (imported)
13	Other Hand Tool (local)
14	Manual (hand pump) sprayer
15	Motorized sprayer
16	Horse/ox cart (cart only)
17	cart attachment to tractor or motor vehicle
18	Other animal-drawn implement
19	Other tractor-drawn implement
20	Threshing machinery
21	Bubble dryer
22	Other drying machinery
23	Drying mat
24	Bicycle
25	Motorcycle
26	Truck or car

Section 4: Farm Tools and Machinery for Land Preparation (Irrigation Season)												
Crop season	Parcel numbe **[COPY FROM MODULE "LAND"]**	Plot number **[COPY FROM MODULE "LAND"]**	Crop codes **[COPY FROM MODULE "LAND"]**	Land Preparation (including harrowing & ridging)								
				Draft animal used in land preparation			Tools/machinery used for Land Preparation					
				How many oxen were used to prepare your land?	How did you acquire the oxen?	Total Rental Cost	What was the primary tool or machine you used for this activity?	Rental Cost	Fuel Cost for operation	What other tool was used for this activity?	Rental Cost	
				Write 0 if no oxen used and →		*Write -9 if oxen owned by respondent. If rental paid in-kind, estimate in-kind value.*		*Write -9 if tool or machine is owned by respondent. If rental paid in-kind, estimate in-kind value.*	*Write –9 if fuel cost is included in rental cost. Write 0 if no fuel cost.*		*Write -9 if tool or machine is owned by respondent. If rental paid in-kind, estimate in-kind value.*	
				Total oxen days	**Code 1**	**Birr**	**Code 2**	**Birr**	**Birr**	**Code 3**	**Birr**	
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
2												
2												
2												
2												
2												
2												
2												
2												

	Code (1) Equipment
1	Double axel tractor (i.e. Four wheel tractor
2	Single axel tractor (i.e. Two wheel tractor)/ Power Tiller
3	Traditional Plough
4	Improved/Modern Plough

	Code (2) Acquisition
1	Own
2	Rented and operated by farmer
3	Hired both equipment and operator (i.e. custom hire)

	Code (3) All Equipment
1	Double axel tractor (i.e. Four wheel tractor
2	Single axel tractor (i.e. Two wheel tractor)/ Power Tiller
3	Sickle (maetsid)—Imported (Albin)
4	Sickle (maetsid)—Local (Bahlawi)
5	Pick ax (doma)
6	Axe (metrebia)
7	Pruning/Cutting shears (megrezia)
8	Malakino
9	Hoe (mekotkocha) (Chikuaro/Afkuta)
10	Spade or shovel (Megafia)
11	Leather strap (Miran/Metsian)
12	Other Hand Tool (imported)
13	Other Hand Tool (local)
14	Manual (hand pump) sprayer
15	Motorized sprayer
16	Horse/ox cart (cart only)
17	cart attachment to tractor or motor vehicle
18	Other animal-drawn implement
19	Other tractor-drawn implement
20	Threshing machinery
21	Bubble dryer
22	Other drying machinery
23	Drying mat
24	Bicycle
25	Motorcycle
26	Truck or car

Section 5: Farm Tools and Machinery for Agricultural activities (Irrigation Season)

Crop season	Parcel numbe	Plot number	Crop codes	Seeding				Planting		Weeding		Fertilizing		Applying pesticide/ herbicide		Harvesting			
				Primary tool or machine you used for this activity?	Rental Cost	Other tool used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Other tool or machine you used for this activity?	Rental Cost
					Note 1		*Note 1*		*Note 1*		*Note 1*		*Note 1*		*Note 1*		*Note 1*		*Note 1*
				Code 1	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
2																			
2																			
2																			
2																			
2																			
2																			
2																			
2																			

Section 6: Farm Tools and Machinery for Post-Harvest activities

Crop season	Crop codes **[COPY FROM MODULE "LAND"]**	Threshing/Winnowing				Drying		Selling/Marketing	
		Primary tool or machine you used for this activity?	Rental Cost	Other tool used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost	Primary tool or machine you used for this activity?	Rental Cost
			Note 1		*Note 1*		*Note 1*		*Note 1*
		Code 1	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**	**Code 1**	**Birr**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2									
2									
2									
2									
2									
2									
2									

Note 1: *Write -9 if tool or machine is owned by respondent. If rental paid in-kind, estimate in-kind value.*

	Code (1) All Equipment
1	Double axel tractor (i.e. Four wheel tractor
2	Single axel tractor (i.e. Two wheel tractor)/ Power Tiller
3	Sickle (maetsid)—Imported (Albin)
4	Sickle (maetsid)—Local (Bahlawi)
5	Pick ax (doma)
6	Axe (metrebia)
7	Pruning/Cutting shears (megrezia)
8	Malakino
9	Hoe (mekotkocha) (Chikuaro/Afkuta)
10	Spade or shovel (Megafia)
11	Leather strap (Miran/Metsian)
12	Other Hand Tool (imported)
13	Other Hand Tool (local)
14	Manual (hand pump) sprayer
15	Motorized sprayer
16	Horse/ox cart (cart only)
17	cart attachment to tractor or motor vehicle
18	Other animal-drawn implement
19	Other tractor-drawn implement
20	Threshing machinery
21	Bubble dryer
22	Other drying machinery
23	Drying mat
24	Bicycle
25	Motorcycle
26	Truck or car

Module F6: Willingness to Pay

I'm now going to ask you some questions about how much you would be willing to pay for someone to perform various services on all your plots during the *meher* season.

Enumerator: When asking about threshing, ask respondent to specify the most important staple crop (e.g. maize, tef, wheat, etc…). Ask only about that crop

Service	*Crop*	*a. Starting Price (Birr)*	b. Would you be willing to pay __(a)__ for this service? *If Yes → d* *If No → e*	*c. Increment (Birr)*	d. (*Enumerator: add column a and c)* Would you be willing to pay (a)+(c) for this service? *→ f*	e. (*Enumerator: subtract column c from column a)* Would you be willing to pay (a)-(c) for this service?	f. What is the maximum you would be willing to pay for this service? *Enumerator: Write 0 if respondent unwilling to pay at any price.*
Ploughing (animal)		*150 per Timad*		*75*			
Ploughing (tractor)		*150 per Timad*		*75*			
Weeding by hand		*50 per Timad*		*30*			
Weeding by machine		*50 per Timad*		30			
Threshing/Shelling by hand (Wheat or Tef/Maize)		*20 per quintal*		*10*			
Threshing/Shelling by machine (Wheat or Tef/Maize)		*20 per quintal*		*10*			
Drying		*20 per quintal*		*10*			

Module F7: Knowledge of and Experience with Mechanization

I'm now going to ask you some questions about your experience with various agricultural machines

	1	2	3	4	5	6	7	8	9
Machine	Have you ever used or hired a _____?	Have you ever seen a _____?	Have you ever heard about _____?	Do you know any other farmers that have used ____?	For what activities do you think this machine would be most useful? (List up to three)	How does the quality of ploughing using a _____ compare to animal power?	Do you consider yourself to be knowledgeable about the use of a _____?	Would you be willing to hire a [tractor] service for ploughing if it was available in your area?	What is main reason you would not hire this service?
	1 Used myself 2 Hired 3 No	1 Yes 2 No	1 Yes 2 No	1 Yes 2 No	**Code (1)**	1 Same 2 Animal is better 3 Machine is better 4 Don't know	1 Yes 2 No	1 Yes 2 No 3 Not sure	**Code (2)**
	If 1 or 2→Q4	If Yes→Q4						If Yes>>Next row	
Two-Wheeled Tractor									
Four Wheeled Tractor									

	Code (1) Activities		**Code (2) Reasons for Not Hiring**
1	Ploughing/ tillage	1	Cost will be too high
2	Seeding	2	Machines not suited to soil
3	Planting	3	Machines not reliable
4	Weeding	4	Do not know how to operate
5	Fertilizing	5	Quality of work would be bad
6	Harvesting	6	Timeliness of service
7	Threshing/ Winnowing	7	Damage the land
8	Drying	8	Other_____
9	Selling/ marketing		
10	General Transportation		
11	Other _____		

Module F8: Support service delivering institutions for agricultural mechanization

1. Sources of major farm implements and repair & maintenance (R&M) service delivering institutions

Major farm implements	**Shortcomings of the implements**	**Source of farm implements (see code)**	**Who delivered R&M services (see code)**	**Ability of agent to address R&M issue (see code)**

Code for <u>Source of farm implements</u> as well as <u>who delivered repair & maintenance service</u>:
1= Farmers 2=Artisan 3=Local workshop 4=Agricultural office 5=NGO 6=Others _____
Code for <u>Ability of agent to address R&M issue</u>: 1=Weak 2=Moderate 3=Strong

2. Did you get extension services in any of farm mechanization activities so far? 1=Yes 2=No

3. If your answer for **Q.44 is** Yes, would you please tell me the information in the Table below

Mechanization activities to which you got extension services so far	**Who delivered the extension service (see code)**	**Ability of extension agent to address the issue (see code)**
1. Land preparation & tillage		
2. Planting/sowing		
3. Fertilizer applications		
4. Crop protection (weeding & chemical applications)		
5. Crop harvesting & threshing		
6. Crop processing (drying, post-harvest loss reduction)		
7. Irrigation practices (surface, drip, sprinkler)		
8. Milk collection & processing		

Code for <u>Who delivered the extension service</u>: 1=Agricultural offices 2=NGOs 3=Others _____
Code for <u>Ability of extension agent to address the issue</u>: 1=Weak 2=Moderate 3=Strong

Module G: CROP SALES: (ENUMERATOR) This chart is at the crop level, not plot level, for **each season**.

G1. Main season

				SECTION G: CROP SALES: ENUMERATOR: This chart is at the crop level, not plot level, for each season.											
Crop Season			1	2	3	4	5	6	7	**7a**	**7b**	8	9	10	11
		Crops grown during 2016? [Copy crop codes from module "Crop Production "	How much was saved for seed? [0 IF SEED NOT SAVED]	How much was used for gifts and exchange (except own consumption and sales)?	How much of the harvest was used for own consumption? [0 IF NO OWN CONSUMPTION]	What was the total share of crop residue removed from the field for [CROP], (by animals, humans, etc)?	How much of this harvest was sold? [IF NO SALE, WRITE 0 AND >>10]	How much of this harvest was used for other purposes*? [0 IF NO OTHER USES]	What was the main place where it was sold? 1 On farm/at home 2 Village market 3 District market 4 Regulated market 5 Roadside 6 Cooperative 7 Processor 8 Other, specify [IF 1>>9]	What was the method of transport? 1 Animal with cart 2 Animal (no cart) 3 Handcart 4 Walking 5 Bicycle 6 Motorbike / Bajaj 7 Car 8 Truck 9 Tractor	What was the cost to transport this crop?	Distance to the place where crop was sold [0 IF ANSWERED 1 TO G9]	Unit price when selling this crop?	Who was the main buyer of [CROP]? 1 Farmer/ consumer 2 Trader 3 Processor 4 Cooperative 5 Government 6 Other, specify	Who makes sales-related decisions on this crop? 1 Head 2 Spouse of head 3 Both head and spouse 4 Whole households 5 Other, specify
		Code	**# KGs**	**# KGs**	**# KGs**	**Percent**	**# KGs**	**# KGs**	**CODE**	**CODE**	**Birr**	**[Minutes one way, usual transport]**	**Birr/Kg**	**CODE**	**CODE**
Meher	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														

G2. Crop sales during irrigation season

				SECTION G: CROP SALES: ENUMERATOR: This chart is at the crop level, not plot level, for each season.											
Crop Season			1	2	3	4	5	6	7	**7a**	**7b**	8	9	10	11
		Crops grown during 2016? [Copy crop codes from module "Crop Production "	How much was saved for seed? [0 IF SEED NOT SAVED]	How much was used for gifts and exchange (except own consumption and sales)?	How much of the harvest was used for own consumption? [0 IF NO OWN CONSUMPTION]	What was the total share of crop residue removed from the field for [CROP], (by animals, humans, etc)?	How much of this harvest was sold? [IF NO SALE, WRITE 0 AND >>10]	How much of this harvest was used for other purposes*? [0 IF NO OTHER USES]	What was the main place where it was sold? 1 On farm/at home 2 Village market 3 District market 4 Regulated market 5 Roadside 6 Cooperative 7 Processor 8 Other, specify [IF 1>>9]	What was the method of transport? 1 Animal with cart 2 Animal (no cart) 3 Handcart 4 Walking 5 Bicycle 6 Motorbike / Bajaj 7 Car 8 Truck 9 Tractor	What was the cost to transport this crop?	Distance to the place where crop was sold [0 IF ANSWERED 1 TO G9]	Unit price when selling this crop?	Who was the main buyer of [CROP]? 1 Farmer/ consumer 2 Trader 3 Processor 4 Cooperative 5 Government 6 Other, specify	Who makes sales-related decisions on this crop? 1 Head 2 Spouse of head 3 Both head and spouse 4 Whole households 5 Other, specify
		Code	**# KGs**	**# KGs**	**# KGs**	**Percent**	**# KGs**	**# KGs**	**CODE**	**CODE**	**Birr**	**[Minutes one way, usual transport]**	**Birr/Kg**	**CODE**	**CODE**
Meher	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														
	1														

Section G2: Chat Production

Enumerator: Ask Section 1 *to households that reported growing chat this year. Ask Section 2 to those who do not grow chat.*

Section 1: Chat Production

1. What year did you first begin to cultivate chat? [year]
2. Since 2012, have you purchased or rented new plots for the purpose of cultivating chat? 1. Yes 2. No
3. Since 2012, have you converted plots from another use for the purpose of cultivating chat? 1. Yes 2. No If NO→Q5
4. What was the previous usage of the plot you converted to chat production (*ask only about largest converted plot if more than one plot was converted)*?
   1. Vegetables 2. Maize 3. Other grains (e.g. teff, wheat, barley, etc…) 4. Pasture/grazing 5. Cultivated with perennial crops 5. Fallow 6. Sharecropped out 7. Rented out 8 Temporarily given out to others

5. Of the following options, what are the most important reasons you switched to growing chat (list up to three)? 1. _____ 2. _____ 3. _____

   a. Higher total profit b. Multiple harvests during the year c. Production take less time d. Production is easier e. Problems transporting other crops to market f. Initial investment is low g. Price is stable h. low costs i. Other (specify)

6. Copy down the parcels and plots from the previous section for which the farmer grew chat

		1	2	3
Parcel number **Repeat parcel number if there are multiple plots on the parcel**	Plot number **Given each parcel an individual number**	Age of the chat plants on this parcel *If multiple plant ages on the parcels, ask for age of most common*	In the past full calendar year, how many times did you harvest chat from these plants?	On average what was the revenue generated from each harvest?
		years	**[0-12]**	

7. What was the price you received during your most recent harvest (*specify the unit)*?
8. What was the price you received for your harvest one year ago (*specify the unit)*?

9. During your most recent harvest, where did you sell your chat?
   1 On farm/at home 2 Village market 3 District market 4 Chat market 5 Roadside 6 Distributor 8 Other, specify_____

10. During your most recent harvest, did the person who purchased your chat purchase it from you previously? 1. Yes 2. No

11. During your most recent harvest, did you have an agreement to sell your chat to a specific person? 1. Yes 2. No if No→Q12

12. Does your agreement specify the price beforehand? 1. Yes 2. No

13. In the past year, what was the total revenue you received from chat? _____

14. In the past year, what was the total expenditure on growing chat (i.e. labor, fertilizer, irrigation, etc…)? _____

15. In a typical month, how many total hours do you and your family spend cultivating chat? _____

16. Do you plan to plant additional (new) chat plants in the next five years? 1. Yes 2. No

17. Does any person in the household consume chat now? 1. Yes 2. No

18. Did any person in the household consume chat before you first planted chat? 1. Yes 2. No

19. Do you think chat is harmful to a person's health? 1. Yes 2. No

Section 2: Those Not Growing Chat

1. Of the following options, what are the three most important reasons you have not switched to growing chat ? 1. _____
   2. _____ 3. _____

   a. Higher total profit b. Single harvest c. Production takes too much time d. Production is too difficult e. Problems transporting chat to market f. Initial investment is too high g. Price is unstable h. Cannot consume for food i. Chat is an evil product j. Safety/security k. Water shortage l. Other (specify)

2. Do you plan to plant chat plants in the next five years? 1. Yes 2. No

3. Does any person in the household consume chat now? 1. Yes 2. No

4. Do you think chat is harmful to a person's health? 1. Yes 2. No

Module H. Family LABOR

How many hours do you consider to be in a full workday? _______________ hours

ENUMERATOR: COMPLETE FOR EACH CULTIVATED CROP IN EACH PLOT IN EACH PARCEL. Base person-days off of the definition of a workday defined above. WRITE 0 IF NO LABOR IS USED FOR [ACTIVITY] FOR [CROP]. This section is only for family members. So, please do not include hired and exchange labor, which will be filled in the next module. Make sure you multiply the number of persons from the specific labor type (adult male, female, child) by the number of days they work to arrive at the person days for the activity. "DAYS" Refers to person says spent on each activity per season.

Crop season		Parcel numbe [COPY FROM MODULE	Plot number [COPY FROM MODULE	Crop codes [COPY FROM MODULE	2			3			4			5			6			7			8			9		
					For the [CROP] grown in [SEASON], how many person-days of FAMILY LABOR were used on [ACTIVITY]																							
					Activity																							
					land preparation (including harrowing & ridging)			planting			fertilizing			weeding			Irrigating			harvesting			post-harvest activities			marketing		
					male	female	Child	male	female	Child	male	female	Child	male	female	Child	male	female	Child	male	female	Child	male	female	Child	male	female	Child
					days	days	days	days	days	days	days	days	days	days	days	days	days	days	days	days	days	days	days	days	days	days	days	days
Meher	1																											
	1																											
	1																											
	1																											
	1																											
	1																											
	1																											
	1																											
	1																											
	1																											
	1																											
	1																											
	1																											

For the <u>all</u> crops grown in the irrigation season, estimate how many person-days of FAMILY LABOR were used for all activities?

Male		Female		Child	

Module I. Hired and Exchange Labor

Complete the questions below, and if applicable, proceed to the chart. Categorize all persons under 15 as "child" workdays. For hired and exchange labor, you don't need to differentiate between male, female, or child. WRITE 0 IF NO LABOR IS USED FOR [ACTIVITY] FOR [CROP].

1. Have you used hired labor in either Meher or Irrigation Season of 2014 for any agriculture related activity such as land preparation, planting, weeding, irrigating, or harvesting? _____ 1 Yes 2 No

2. Have you used exchange labor such as 'debo' or 'wonfel' in either Meher or Irrigation Season of 2014 for any agriculture related activity such as land preparation, planting, weeding, irrigating, or harvesting? _____ 1 Yes 2 No

3. Have you or other household members offered your labor to work on another farm in either Meher or Irrigation Season of 2014? _____ 1 Yes 2 No

>> If the respondent said NO to BOTH questions (1) and (2), please skip to the next (Livestock) module. Otherwise, please fill in the following table.

Crop season		Parcel number **[COPY PARCEL NO. FROM MODULE "LAND"]**	Plot number **[COPY PLOT NO. FROM MODULE "LAND"]**	Crop codes **[COPY CROP CODES FROM MODULE "LAND"]**	**4** For the [CROP] grown in [SEASON], how many person-days of HIRED AND EXCHANGE LABOR were used on [ACTIVITY] — Activity: land preparation (including harrowing & ridging)		**5** planting		**6** fertilizing		**7** weeding		**8** Irrigating		**9** harvesting		**10** post-harvest activities		**11** Average daily wage paid to the hired laborers? WRITE ESTIMATED VALUE IF IN-KIND	**12** What is the most common type of labor sharing? 1. Debo* 2. Wonfel*
					Hired	Exchange	Hired	Exchange	Hired	Exchange	Hired	Exchange	Hired	Exchange	Hired	Exchange	Hired	Exchange	Birr per day per worker	Code
					person days	person days	person days	person days	person days	person days	person days	person days	person days	person days	person days	person days	person days	person days		
Meher	1																			
	1																			
	1																			
	1																			
	1																			
	1																			
	1																			
	1																			
	1																			
	1																			

*Wonfel refers to labor sharing group that works in rotation for each group member and reciprocity is within the same season while debo refers to a labor sharing group in which reciprocity to members is upon demand either within the same season or in the future. Please use this definition if the name of the labor sharing is different from debo/wonfel in the study site.

SECTION J. LIVESTOCK OWNERSHIP

ASK THE HOUSEHOLD HEAD OR OTHER KNOWLEDGEABLE MEMBER

Code	1	2	4	5	6
	Animal type	In the past 12 months, have members of your household raised or produced [ANIMAL TYPE]? 1. Yes 2. No ►NEXT LINE	Which household member/s PRIMARILY takes care of [ANIMAL TYPE]? 1 Head 2 Spouse 3 Both head and spouse 4 Children 5 Other household member 6 Non household member	Which household member/s makes the decision to sell [ANIMAL TYPE] and/or by-products? 1 Head 2 Spouse 3 Both head and spouse 4 Children 5 Whole family 6 Other household member 7 Non household member	How many [ANIMAL TYPE] does your household currently own?
ID	**ANIMAL TYPE**	**CODE**	**CODE**	**CODE**	**Number**
100	Draught cattle/Oxen				
101	Bulls				
102	Fattening cattle				
103	Cows				
104	Heifers				
105	Calves				
106	Horse				
107	Donkey or Mule				
108	Goats				
109	Sheep				
110	Pigs				
111	Chickens-				
112	Other livestock				
113	Honey bees-				# Hives

SECTION K: LIVESTOCK FEED AND PRODUCTS

ASK THE HOUSEHOLD HEAD OR OTHER KNOWLEDGEABLE MEMBER

Code	Animal type	DO NOT READ. Copy the response from the Livestock ownership module and ask the questions to only those animal types that the household reported to ow/raise 1. Yes 2. No ►NEXT LINE	How do you feed [ANIMAL TYPE]? 1.Grazing only 2. Mainly grazing with some stall feeding 3. Stall feeding only 4. Mainly stall feeding with some grazing 5. Other (specify)	...which of the following feed for [ANIMAL Type] have you used? [LIST UP TO THREE SOURCES] READ: 1. Green forages (legumes, grasses, and fodder trees/shrubs) 2. Pastures (grazing) 3. Crop residue (legumes and cereals) 4. Irrigated fodder (legumes and grasses) 5. Purchased fodder 6. Concentrate feeds 7. Other (specify)			How much did you pay for feed for [ANIMAL Type] over the past 12 months? [WRITE 0 IF THERE WAS NO PURCHASE OF FEED]
				1st	**2nd**	**3rd**	**Birr**
ID		**1**	**2**	**3a**	**3b**	**3c**	**4**
1	Large ruminants (cattle; *100-105 on previous page)*						
2	Equines (e.g. horses, donkeys, and mules; *106-107 on previous page)*						
3	Small ruminants (sheep, goats*; 108-109 on previous page*)						
4	Monogastrics (e.g. chickens, porks, poultry; *110-112 on previous page)*						

ID	**Over the past 12 months, how much have you earned in total from the following activities...?**								
	ANIMAL TYPE	*COPY RESPONSES FROM QUESTION K1 ABOVE.: IF NOT OWNED, >>NEXT LINE*	Rental/cart from [ANIMAL Type]?	Hides/skin/wool from [ANIMAL Type]?	Meat products from [ANIMAL Type]?	Dairy products from [ANIMAL Type]?	Manure sales from [ANIMAL Type]?	Egg sales from [ANIMAL Type]?	Honey sales from [ANIMAL Type]?
		CODE	**Birr**	**Birr**	**Birr**	**Birr**	**Birr**	**Birr**	**Birr**
		11	**12**	**13**	**14**	**15**	**16**	**17**	**18**
5	Large ruminants (cattle)								
6	Equines (e.g. horses, donkeys, and mules)								
7	Small ruminants (sheep, goats)								
8	Monogastrics (e.g. chickens, porks, poultry)								
9	Honey bees								

Section L: Income from Employment: DO NOT include self-employment and family businesses, which are included in the next module. Repeat PID if more than 2 jobs per season.

PID of employed family member	Time spent and income generated from farm and non-farm employment															
	Season 1: Meher (Sanni 1, 2005 to Tarr 30, 2006)								Season 2: Belg (Yekatit 1, 2006 to Genbot 30, 2006)							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Job 1	Time spent	Number of weeks	Income from job 1	Job 2	Time spent	Number of weeks	Income from job 2	Job 1	Time spent	Number of weeks	Income from job 1	Job 2	Time spent	Number of weeks	Income from job 2
	Code 1	Days/ week	Weeks	Birr/day	Code 1	Days/ week	Weeks	Birr/day	Code 1	Days/ week	Weeks	Birr/day	Code 1	Days/ week	Weeks	Birr/day

CODE 1: Job types

1. Agricultural laborer
2. Livestock laborer
3. Mixed agricultural and livestock laborer
4. Agriculture (farm) laborer
5. Livestock Herder
6. Office worker
7. Civil Servant
8. Teacher
9. Health worker
10. Trader
11. Artisan
12. Driver/Mechanic
13. Skilled Factory Worker
14. House help
15. Business/store employee
16. Contract/piece work
17. Other (specify_____)

Section M: Other Income

1 What is the total GROSS household income in a normal year? _____ETB

Source No.	2 Source	3 Did your household receive any amount (cash and cash equivalency of in-kinds) during the last year from [source]? 1 Yes 2 No >> Next source	4 What was the frequency of receipts? 1 Monthly 2 Yearly >>Q8.4.5	5 For how many months, did your household receive any amount during the last year from [source]?	6 Total Amount
		CODE	**CODE**	**NUMBER**	**Birr**
1	Family business/self-employment				
2	Rent				
3	Remittances from a household member who migrated				
4	Other Gifts/ assistance from family or friend				
5	Rent from equipment/tools/vehicle				
6	Rent from animals leased out				
7	Pension				
8	Sale of farm assets				
9	Sale of non-farm assets				
10	Other (specify): _____				

Section N: Social Protection and Development Programs

1 Has your household received food or other aid or participated in any government or NGO programs in the past 3 years? _____ 1 Yes, 2 No

IF "NO", >>NEXT MODULE

2	3	4	5	
Type of aid/program	Did you participate in this program in the last 12 months? 1 Yes 2 No *If No>>Next program*	Which agency or organization implemented the program? 1 Federal government 2 Regional government 3 NGO 4 Private company 5 Research organization Other, specify	How much income or in-kind payment did you receive in the last 12 months from the program?	
			Cash	Value of in-kind
CODE	**CODE**	**CODE**	**Birr**	**Birr**
Cash for work				
Food for work				
Emergency relief				
Income generating scheme				
Direct transfer program				
Farm support program				
Nutrition program				
Health program				
Feed the Future				
Africa Rising				
LIVES				
Other (specify)_____				

Section O: Expenditures:

If payment was in kind, have the respondent give an estimate of the value.

Frequent Expenditures

	Item name	1 Amount spent on [item] in the **last 30 days**? **Birr**
1	Food (grocery or prepared)	
2	Fuel (firewood, charcoal, kerosene, gas)	
3	Expenses on travel (using own or available transport, within or outside village)	
4	Communication (cell phone, calling cards, phone, postage, internet, faxes)	
5	Expenses on utilities and maintenance (electricity, water, maintenance of house, furniture, vehicle)	
6	Wages to permanent non-agricultural labor	
7	House Rent (imputed rent if own house)	
8	Cigarettes/tobacco/chat	
9	Alcoholic beverages (local or commercial)	
10	Personal care products (soap, shampoo, toothpaste etc.)	
11	Household cleaning products (dish soap, toilet cleansers, etc.)	
12	Lotteries and raffles	
13	Other frequent expenditure, specify	

Less Frequent Expenditures

Item ID	Item name	1 In the last 12 months, amount spent on [item]? **Birr**
200	Clothes, shoes, and fabric	
201	Wages to permanent agricultural labor	
202	Kitchen equipment (cooking pots, etc.)	
203	Linens (sheets, towels, blankets)	
204	Carpet, rugs, drapes, curtains	
205	Furniture/mattress	
206	Lamp/torch	
208	Building materials (cement, bricks, timber, iron sheets, tools)	
209	Housing improvement or repair (latrine, new roof, new room, kitchen, etc)	
210	Wedding	
211	Contributions to IDDIR	
212	Funeral cost (other than IDDIR fees)	
213	Donations to the church/mosque	
214	Tezkar	
215	Religious ceremonies/holidays	
216	Modern medical treatment and medicines	
217	Traditional medicine and healers	
218	Education (school fees, school supplies, books, school uniform)	
219	Taxes and contributions	
221	Purchase or repair of vehicles, bicycles	
222	Repair of household and personal items (radios, appliances, watches, etc)	
223	Fines or legal fees	
224	Other less frequent expenditure, specify	

Section P: Assets

Item ID		1. How many of this [ITEM] does your household own? IF NONE RECORD 0
1	Kerosene stove	
2	Butane Gas or Electric stove	
3	Electric stove	
4	Blanket/Gabi	
5	Mattress and/or Bed	
6	Mobile Telephone	
7	Radio/ tape recorder	
8	Television	
9	Satellite Dish	
10	Sofa set	
11	Bicycle	
12	Motor cycle	
13	Cart (Hand pushed)	
14	Cart (animal drawn)- for transporting people and goods	
15	Sewing machine or Weaving Equipment	
16	Mitad-Electric	
17	Refrigerator	
18	Private car	

Item ID		1. How many of this [ITEM] does your household own? IF NONE RECORD 0
19	Biogas stove (pit)	
20	Water storage pit	
21	Mofer and Kember	
22	Sickle (Machid)	
23	Axe (Gejera)	
24	Pick Axe (Geso)	
25	Plough (Traditional)	
26	Plough (Modern)	
27	Two Wheeled Tractor	
28	Four Wheeled Tractor	
29	Hoe (mekotkocha) (Chikuaro/Afkuta)	
30	Spade or shovel (Megafia)	
31	Leather strap (Miran/Metsian)	
32	Pruning/Cutting shears (megrezia)	
33	Other Hand Tool (imported)	
34	Other Hand Tool (local)	
35	Manual (hand pump) sprayer	
36	Motorized sprayer	

Module Q: Dietary Diversity

	FOOD /	Description/ማግለጫ	In the past 7 days (not including today), how many days has anyone in the household consumed ____?
1	CEREALS/የአገዳ እህሎች	Teff, corn/maize, rice, barley, oats, wheat, sorghum, finger millet or any other grains or foods made from these (e.g. Ambasha, injera, bread, biscuits, noodles, "Qitta", porridge, "Atimit" or other grain products)	
2	ORANGE FRUITS, VEGETABLES AND TUBERS /በቫይታሚን ኤ የበለፀጉ አትክልቶችና ሥራሥሮች	Pumpkin, carrots, squash, or yellow/orange flesh sweet potatoes, Ripe mangoes, cantaloupe, apricots (fresh or dried), ripe papaya, dried peaches or *other locally available vitamin-A rich vegetables or fruits (e.g. red sweet pepper)*	
3	WHITE TUBERS AND ROOTS/ ነጣ ያሉ ሥራሥሮች	White potatoes, white yams, white cassava, or other foods made from roots	
4	DARK GREEN LEAFY VEGETABLES/ ጠቆር ያለ አረንጉዴ ቅጠል ያላቸው አትክልቶች	Dark green/leafy vegetables, including wild ones + *locally available vitamin-A rich leaves such as amaranth,Cassava leaves, Kale, Spinach etc.*	
5	OTHER VEGETABLES ሌሎች አተክልቶች	other vegetables (e.g. tomato, onion, eggplant) , including wild vegetables	
6	OTHER FRUITS ሌሎች ፍራፍሬዎች	other fruits, including wild fruits (e.g., Qulqual),	
7	ORGAN MEAT /(IRON RICH)/በብረት ማዕድን በለፀጉ የሆድ ዕቃዎች	Liver, Kidney, Heart or other organ meats or blood-based foods (e.g., "Dulet")	
8	FLESH MEATS/ሥጋ	beef, pork, lamb, goat, wild game, chicken, "koke, zhigra", or other birds	
9	EGGS/ዕንቁላል	chicken, duck, guinea hen or any other egg	
10	FISH/አሣ	fresh or dried fish or shellfish	
11	LEGUMES, NUTS AND SEEDS/ጥራጥሬዎች	beans, peas, lentils, nuts, seeds or foods made from these ("Shiro")	
12	MILK AND MILK PRODUCTS/ወተትና የወተት ውጤቶች	Milk, cheese, yogurt or other milk products	
13	OILS AND FATS ዘይትና ቅባት ያላቸው ምግቦች	oil, fats or butter added to food or used for cooking, oil seeds and foods made from oil seeds e.g "suf fitfit" –traditional food from safflower /sun flower	
14	SWEETS/ጣፋጮች	sugar, honey, sweetened soda or sugary foods such as chocolates, candies, cookies and cakes	
15	SPICES, CONDIMENTS, BEVERAGES/ ቅመማቅመም፤ቡናና ሻይ	spices(black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea,	

Module R: Food Security

ENUMERATOR: ASK THE PERSON RESPONSIBLE FOR HOUSEHOLD FOOD PREPARATION

HOUSEHOLD FOOD INSECURITY ACCESS SCALE (HFIAS)

PART A: FOR EACH OF THE FOLLOWING QUESTIONS, PLEASE CONSIDER WHAT HAS HAPPENED IN THE PAST 30 DAYS

1. During the last 30 days, did you worry that your household would not have enough food?

0 = Never
1 = Rarely (one or two times)
2 = Sometimes (3 to 10 times)
3 = Often (more than 10 times)

2. Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?

0 = Never
1 = Rarely (one or two times)
2 = Sometimes (3 to 10 times)
3 = Often (more than 10 times)

3. Did you or any household member eat just a few kinds of food day after day due to a lack of resources?

0 = Never
1 = Rarely (one or two times)
2 = Sometimes (3 to 10 times)
3 = Often (more than 10 times)

4. Did you or any household member eat food that you preferred not to eat because of a lack of resources to obtain other types of food?

0 = Never
1 = Rarely (one or two times)
2 = Sometimes (3 to 10 times)
3 = Often (more than 10 times)

5 Did you or any household member eat a smaller meal than you felt you needed because there was not enough food?

0 = Never
1 = Rarely (one or two times)
2 = Sometimes (3 to 10 times)
3 = Often (more than 10 times)

6. Did you or any other household member eat fewer meals in a day because there was not enough food?

0 = Never
1 = Rarely (one or two times)
2 = Sometimes (3 to 10 times)
3 = Often (more than 10 times)

7. Was there ever no food at all in your household because there were no resources to get more?

0 = Never
1 = Rarely (one or two times)
2 = Sometimes (3 to 10 times)
3 = Often (more than 10 times)

8. Did you or any household member go to sleep at night hungry because there was not enough food?

0 = Never
1 = Rarely (one or two times)
2 = Sometimes (3 to 10 times)
3 = Often (more than 10 times)

9. Did you or any household member go a whole day without eating anything because there was not enough food?

0 = Never
1 = Rarely (one or two times)
2 = Sometimes (3 to 10 times)
3 = Often (more than 10 times)

How many meals, including breakfast are taken per day? NUMBER	
…in the household?	…among children (6-59 months)? **LEAVE BLANK IF NO CHILDREN**
10	**11**

12	**13**	**14**												**15**		
How long does your food store usually last after the Irrigation Season harvest?	How long does your food store usually last after the Meher harvest?	Did you experience shortage of food in [MONTH] of 2016? 1 Yes 2 No												What were the main causes of food shortages? [LIST UP TO 3 IN OR DER OF IMPORTANCE]		
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	1st	2nd	3rd
Code 1	**Code 1**													**Code 2**	**Code 2**	**Code 2**

CODE 1
1 Less than two months
2 Two to four months
3 Five to eight months
4 Nine to twelve months
5 Do not partake in this harvest

CODE 2
1 Inadequate household stocks due to drought/poor rains
2 Inadequate household food stocks due to crop pest damage
3 Inadequate household food stocks due to small land size
4 Inadequate household food stocks due to lack of farm inputs
5 Food in the market was very expensive
6 Not able to reach the market due to high transportation costs
7 No food in the market
8 Floods/water logging/hailstorm
9 No money
10 Poor health conditions
11 Theft
12 Fire
13 Other, specify

Module S: Water Supply, Sanitation and Hygiene

ENUMERATOR: Ask the primary or secondary respondent, whoever is most knowledgeable

1. How would you describe the availability of water for domestic use in the rainy season?_____ 1: abundant, 2: sufficient, 3: inadequate
2. How would you describe the availability of water for domestic use in the dry season?_____ 1: abundant, 2: sufficient, 3: inadequate

Domestic Water Use

Season	Source	**3**	**4**	**5**	**6**	**7**	**8**
		Source of domestic water	Is this the same source of water mainly used for irrigation? 1. Yes 2. No	How long does it take to go there, get water, and come back?	Number of trips per week (all household members)	Main person fetching water	Treatment before drinking (multi)
		Code 1		**Minutes**	**Number**	**Code 2**	**Code 3**
Rainy	Source 1						
	Source 2						
Dry	Source 1						
	Source 2						

Sanitation	
9	**10**
What kind of toilet facility do members of your household usually use?	What is the main destination for household waste in this household?
Code 4	**Code 5**

Code 1: Source of water	Code 2: Person	Code 3: treatment	Code 4: Toilet type	Code 5: Waste destination
1 Piped into dwelling	1 Adult woman	1 No treatment	1 Flush or pour flush toilet	1 Buried
2 Piped into plot/yard	2 Adult male	2 Boil	2 Flush to piped sewer system	2 Collected by private establishment
3 Public tap / standpipe	3 Child girl	3 Water filter (ceramic, sand, composite, etc.)	3 Flush to septic tank	3 Dumped in street / open space
4 Tubewell/borehole	4 Child boy	4 Add bleach/chlorine/ waha agar	4 Flush to pit latrine	4 Disposed in the compound
5 Protected dug well	5 Other (specify)	5 Let it stand and settle	5 Flush to somewhere else	5 Dumped in river
7 Protected spring		6 Solar disinfectant 7 Strain it through a cloth 8 Other, specify	6 Flush, don't know where	6 Burned
8 Unprotected spring			7 Pit latrine	7 Other (specify)
10 River/ponds/stream			8 Ventilated improved pit latrine	
11 Tanker-truck/vendor			9 Pit latrine with slab	
12 Irrigation channel			10 Pit latrine without slab / open pit	
13 Bottled water			11 Composting toilet	
14 Other, specify			12 Bucket toilet	
			13 Hanging toilet / hanging latrine	
			14 No facility / bush/ field	

Module T: Household Diseases

Do not include the common cold under "flu". Prompt the respondent with specific diseases from the list.

Has any family member age suffered from a disease during the last 6 months days? (e.g. diarrhea, flu, malaria, etc.)_____

1	2	3	4	6
HH member (**Repeat PID if member has fallen sick more than once**)	Disease 1 Malaria 2 TB 3 Diarrhea 4 Flu 5 HIV/AIDS 6 Schistosomiasis 7 Diabetes 8 Intestinal parasites 9 Malnutrition 10 River blindness 11 Other (specify)	Treatment obtained? 1 Yes 2 No	From where? (Leave BLANK if no treatment obtained) 1 Government health post 2 Government health center 3 Private clinic 4 Individual private practice 5 Traditional healer 6 Other (specify)	How many days was [MEMBER] unable to work or go to school?
PID			**Code 1**	**Days**

1 Yes, 2 No

Code 1
Govt. hospital.....1
Govt. health centre.....2
Govt. health post.....3
Village health worker.....4
Mobile/outreach clinic.....5
Other public (*specify*)_____ 6
Private hospital/clinic.....7
Private physician.....8
Private pharmacy 9
Other private medical (*specify*)____ 10
Other source relative or friend.....11
Shop 12
Traditional practitioner 13
Other (*specify*)_____ 14

Module U: Shocks

		1. How many of your household members suffered from illness/injury during the *meher* season of [year]?	**2. Please list *all* agricultural activities that your household had difficulties with due to illness/injury of your household members.**	**3. Did any of your plots experience bad weather events, pest or disease that lowered yields during the *meher* season of [year]?**	**4. Please list *all* bad weather events, pest or disease.**	**5. In general, how was your crop production in the *meher* season of [year]?**	**6. Please list the causes of bad crop production in order of importance.**
Crop Year	**National/Local Public Event (enumerators fill this section and read to respondents)**	(Number of household members. If the answer is zero -> Q3, if the answer is greater than 0 -> Q2)	(code a)	(yes/no. If yes -> Q4, if no -> Q5)	(code b)	*Read all option aloud* Code (c)	*If farmer did not attempt to farm at all, put code 1* (code d)
2016							
2015							
2014							
2013							
2012							
2011							
2010							
2009							
2008							
2007							
2006							
2005							

Code a. Activity

1. Ploughing/Tillage
2. Seeding
3. Planting
4. Weeding
5. Fertilizing
6. Harvesting/Threshing/Windowing
7. Drying
8. Selling/Marketing
9. All Activities

Code b. Bad Crop Event

1. Drought
2. Flood
3. Untimely Rain (Monsoon)
4. Pest
5. Disease

Code c. Growing season outcome

1. Very good
2. Good
3. Fair
4. Bad
5. Very bad

Code d. Cause

1. Did not attempt any farming activity
2. Failure to complete Ploughing/Tillage
3. Failure to complete Seeding or planting
4. Failure to complete Weeding
5. Failure to complete Fertilizing
6. Failure to complete Harvesting/Threshing/Windowing
7. Failure to complete Drying
8. Failure to complete Selling/Marketing
9. Drought
10. Flood
11. Untimely Rain
12. Pest
13. Disease

Confidential: To be used only for research purposes

Module WE: Women's Empowerment in Agriculture (WEAI) Index (Male and Female)

INSTRUCTIONS ON ADMINISTRATION:

Enumerator: This questionnaire should be administered to individuals identified in the household roster (Section WE2) of the household level questionnaire as the primary and secondary respondents. You should complete this coversheet for each individual identified in the "selection section" even if the individual is not available to be interviewed for reporting purposes. Please double check to ensure:

- You have completed the household questionnaire, at least the first 2 modules;
- You have identified the correct individual;
- You have noted the household ID and individual ID correctly for the person you are about to interview;
- You have gained informed consent for the individual in the household questionnaire;
- You have sought to interview the individual in private or where other members of the household cannot overhear or contribute answers.

Module WA: Individual Identification (Male and Female)

Household Identification	Code		Interview details	Code
WA01. Household Identification:	☐☐☐		WA07. Start time of interview (hh:mm=> write in 24 hr time format)	☐☐:☐☐
WA02. Census number:	☐☐☐		WA08. End time of interview (hh:mm=> write in 24 hr time format)	☐☐:☐☐
WA03. Name of primary respondent (code from roster in Section B): Last, First:	☐☐		WA09. Name/code of enumerator:	☐☐
WA04. Name of respondent (code from roster in Section B): Last, First:	☐☐		WA10. Sex of enumerator: Male ..... 1 Female 2	☐
WA05. Sex of respondent: Male 1	☐		WA11. Outcome of interview (enter code from Code 2↓):	☐☐
WA06. Type of household (enter code from Code 1↓):	☐		WA12. Ability to be interviewed alone (enter code from Code 3↓):	☐

Code list for Module WA:

Code 1 (WA06) : Type of Household:	Code2 (WA11): Outcome of interview	Code 3 (WA12): Ability to be interviewed alone
	Completed 1	Alone 1
Male and Female adult 1	Incomplete 2	With other adult females present 2
Female, no Male adult 2	Absent 3	With other adult males present 3
Male, no Female adult 3	Refused 4	With other adults mixed sex present 4
No adult 4	Could not locate 5	With children present 5

MODULE WE2: (Dimension 1): Role in household decision-making around production and income generation (Male and Female)

Enumerator: The purpose of this module is to get an idea about men's and women's relative roles in decision making around income-generating activities. Do not attempt to ensure that responses are the same between the male and female respondent. It is okay for them to be different.

Code 1: Input into decision making

No input/ Input into very few decisions1
Input into some decisions 2
Input into most decisions/ Input into all decisions.....3
Decision not made/not applicable.....4

Activity		Did you (singular) participate in [ACTIVITY] in the past 12 months? Yes ..... 1 No .....2 >> next activity	How much input did you have in making decisions about [ACTIVITY]? **CODE 1↑**	How much input did you have in decisions on the use of income generated from [ACTIVITY] **CODE 1↑**
Activity Code	Activity Description	**WE201**	**WE202**	**WE203**
1	Food crop farming: crops that are grown primarily for household food consumption			
2	Cash crop farming: crops that are grown primary for sale in the market			
3	Livestock raising:			
4	Non-farm economic activities: small business, self-employment, buy-and-sell			
5	Wage and salary employment: in-kind or monetary work both agriculture and other			

MODULE WE3B: Agricultural Extension (Female)

Q. No.	Question	Response	Response options
WE3B_07	Where do you typically get information on farming or livestock related topics such as new seeds, technology, crop rotation or animal health?		Government agency or outlet .....1 NGO or NGO outlet.....2 Private shop/suppliers.....3 Community members or cooperative .....4 Family member.....5 Media (radio/TV/newspaper) .....6 Not applicable/do not get advice.....7
WE3B_08	Have you (yourself) ever met with an agricultural extension worker or livestock/fisheries extension worker in the past 12 months?		Yes.....1 No .....2 >> Next section
WE3B_09	How many times did you meet with the agricultural extension worker or livestock/fisheries worker in the past 12 months?		[Enter number of visits]
WE3B_10	The last time you met with an extension worker, were they a male or female?		Male.....1 Female .....2 Both male and female 3

MODULE WE3D: Access to loans (Male and Female)

Now I will ask you about any loans taken for the household in the last 12 months.

Lending sources		Has anyone in your household taken any loans or borrowed cash/in-kind from [SOURCE] in the past 12 months? Yes, cash .....1 Yes, in-kind .....2 Yes, cash and in-kind .....3 No..... 4 >> next source Don't know..... 97 >> next source	Who made the decision to borrow from [SOURCE]? Self .....1 Spouse .....2 Other household member .....3 Other member outside the household .....4 Not applicable .....98 For joint decisions, multiple responses are possible			Who makes the decision about what to do with the money/ item borrow from [SOURCE]? Self .....1 Spouse .....2 Other household member .....3 Other member outside the household .....4 Not applicable.....98 For joint decisions, multiple responses are possible1		
	Lending source names	WE3d_17	WE3d _18a	WE3d _18b	WE3d _18c	WE3d _19a	WE3d _19b	WE3d _19c
A	Non-governmental organization (NGO)							
B	Informal lender							
C	Formal lender (bank/financial institution)							
D	Friends or relatives							
E	ROSCA (savings/credit group)							

MODULE WE5a: Decision making (Male and Female)

I will now ask you some questions about decision making pertaining to the household

Enumerator: The purpose of this module is to get additional information about decision making within households.

Again, do not attempt to ensure that responses are the same between the male and female respondent. It is okay for them to be different.

Serial no		When decisions are made regarding the following aspects of household life, who is it that normally takes the decision? Self..... ..... 1>>skip to the next activity Husband/ wife .....2 Someone else in the household .....3 Someone outside the household/other ...4 Not applicable ..... 98>> skip to the next activity In case of joint decisions, there could be multiple responses			To what extent do you feel you can make your own personal decisions regarding these aspects of household life if you want(ed) to? Not at all .....1 Small extent .....2 Medium extent .....3 To a high extent 4
		WE5a_01a	WE5a_01b	WE5a_01c	WE5a_02
A	What inputs to buy for agricultural production?				
B	What types of crops to grow for agricultural production?				
C	When or who would take crops to the market?				
D	Livestock raising?				
E	Your own wage or salary employment?				
F	Major household expenditures?				
G	Minor household expenditures?				

MODULE WE6a: Time allocation (Male and Female)

Enumerator: The purpose of this module is to get an idea about men's and women's time spent in both work and leisure activities and their satisfaction with their time use.

WE6.01a: Please record a log of the activities for the individual in the last complete 24 hours (starting yesterday morning at 4 am, finishing 3 am of the current day). The time intervals are marked in 15 min intervals. Now we will ask you how you spent the last 24 hours. We will start from yesterday morning. This is an account of the entire time period. We are interested in knowing about all your activities (such as resting, eating, personal care, house and outside house work, child care, cooking, shopping, socializing, etc.), even those activities which do not take up a lot of time.

		Night								Morning																				Day																			
	Activity↓	4				5				6				7				8				9				10				11				12				13				14				15			
A	Sleeping and resting																																																
B	Eating and drinking																																																
C	Personal care																																																
D	School (also homework)																																																
E	Work as employed																																																
F	Own business work																																																
G	Farming																																																
H	Construction																																																
I	Fishing																																																
J	Shopping/getting service																																																
K	Weaving, sewing, textile care																																																
L	Cooking																																																
M	Domestic work																																																
N	Care for children/adults/elderly																																																
O	Commuting																																																
P	Travelling																																																
Q	Watching TV/listening to radio																																																
R	Reading																																																
S	Sitting with family																																																
T	Exercising																																																
U	Social activities																																																

V	Practicing hobbies																																												
W	Religious activities																																												
X	Other, specify…																																											

WE6a: Continued

	If simultaneous: Primary.... 1 Secondary 2	Activity↓	Day								Evening				Night																															
			16				17				18				19				20				21				22				23				24				1				2				3			
A		Sleeping and resting																																														
B		Eating and drinking																																														
C		Personal care																																														
D		School (also homework)																																														
E		Work as employed																																														
F		Own business work																																														
G		Farming																																														
H		Construction																																														
I		Fishing																																														
J		Shopping/getting service																																														
K		Weaving, sewing, textile care																																													
L		Cooking																																														
M		Domestic work																																														
N		Care for children/adults/elderly																																														
O		Commuting																																														
P		Travelling																																														
Q		Watching TV/listening to radio																																														
R		Reading																																														
S		Sitting with family																																														
T		Exercising																																														
U		Social activities																																														
V		Practicing hobbies																																														
W		Religious activities																																														
X		Other, specify…																																														

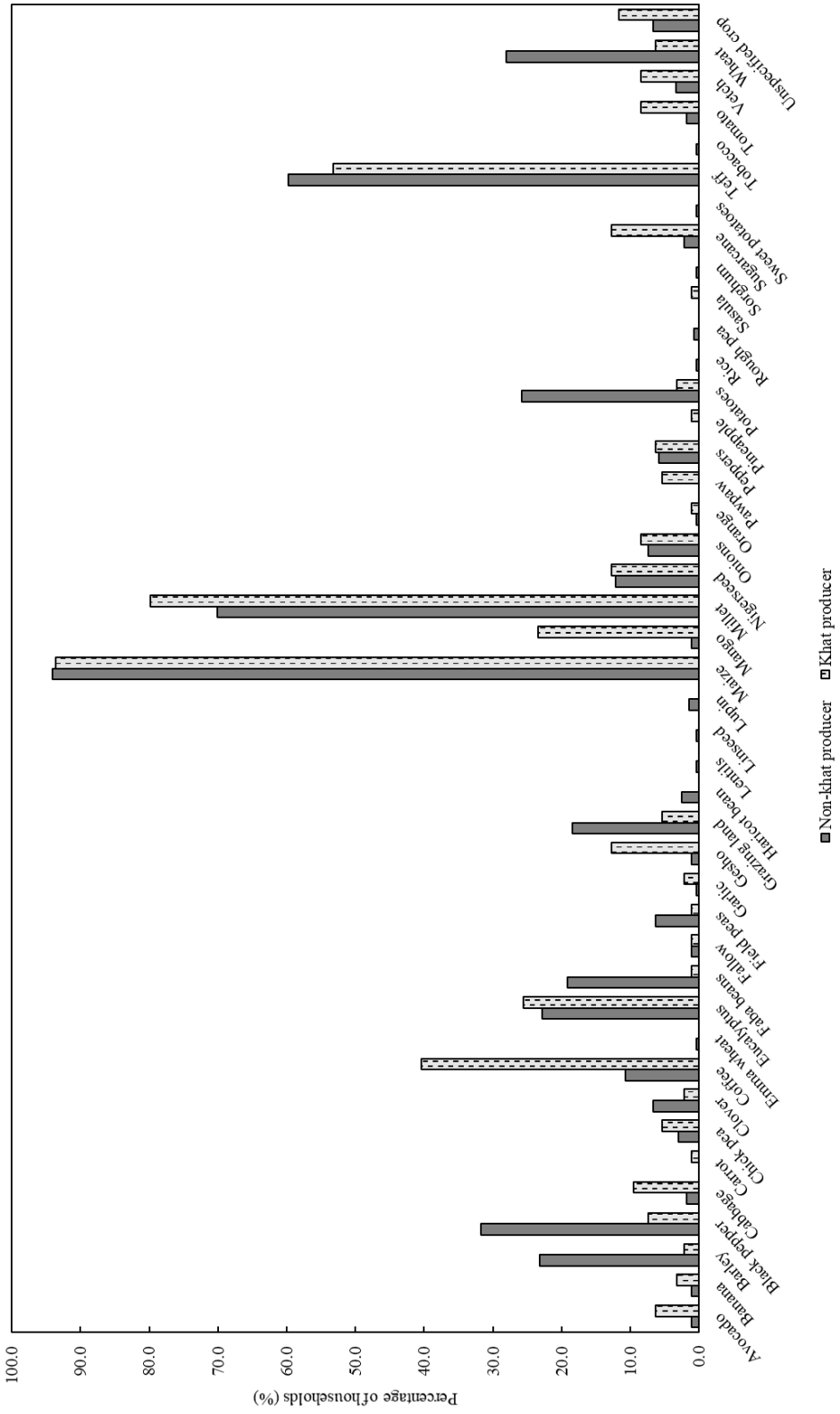
MODULE WE6b: Satisfaction with Time Allocation (Female)

Q. NO.	QUESTION	RESPONSE	RESPONSE CODE
WE6.01b	In the last 24 hours, did you work (at home or outside of the home)		More than usual ..... 1 About the same as usual ..... 2 Less than usual 3

Q. No.	Question	Response	Response options/Instructions
WE6_02	Was yesterday a holiday or nonworking day?		Yes ..... 1 No 2
WE6_03	Regarding the amount of sleep you got last night, was that [READ RESPONSES]::		Less than average ..... 1 Average ..... 2 More than average 3
WE6_04	*READ:* I am going to ask you a series of questions and I want you to tell me how would you rate your satisfaction on a scale of 1 to 10, where 1 means you are not satisfied and 10 means you are very satisfied. If you are neither satisfied or dissatisfied this would be in the middle or 5 on the scale. How would you rate your satisfaction with:		
WE6_04A	The distribution of work duties within your household?		**Please mark on a scale from 1 – 10** Not satisfied ☹ ..... 1 ⇩ Neither satisfied nor dissatisfied 😐 ..... 5 ⇩ Very satisfied ☺ 10
WE6_04B	Your available time for leisure activities like watching TV, listening to radio, seeing movies or doing sports?		
WE6_04C	Your contacts with friends or relatives?		
WE6_04D	Your possibilities of going to other places outside your village?		
WE6_04E	Your power to make important decisions that change the course of your life?		
WE6_04F	Your satisfaction with your life overall?		

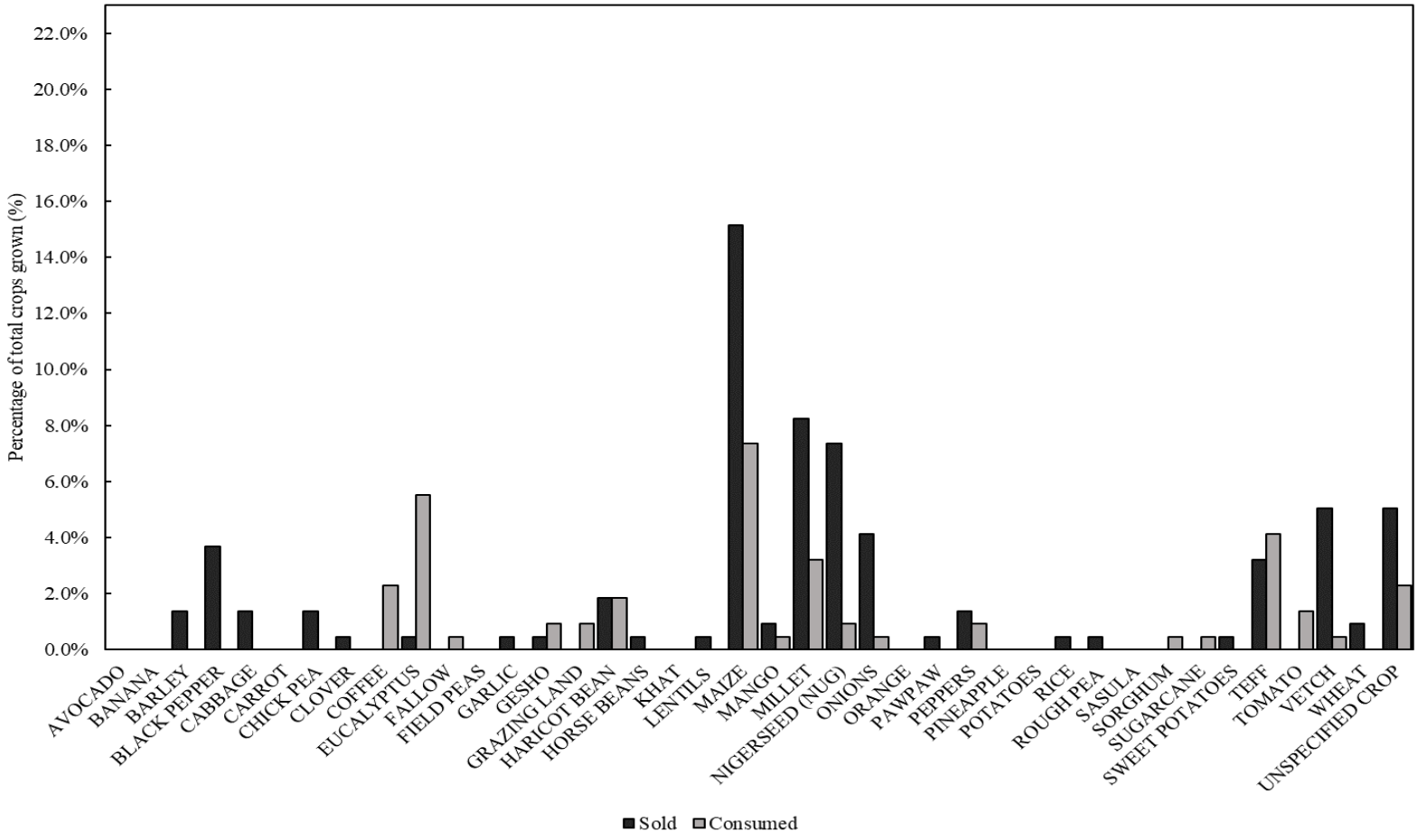
Appendix B - Supplemental Descriptive Statistics

Figure B-1. Percentage of households that grow specified crop



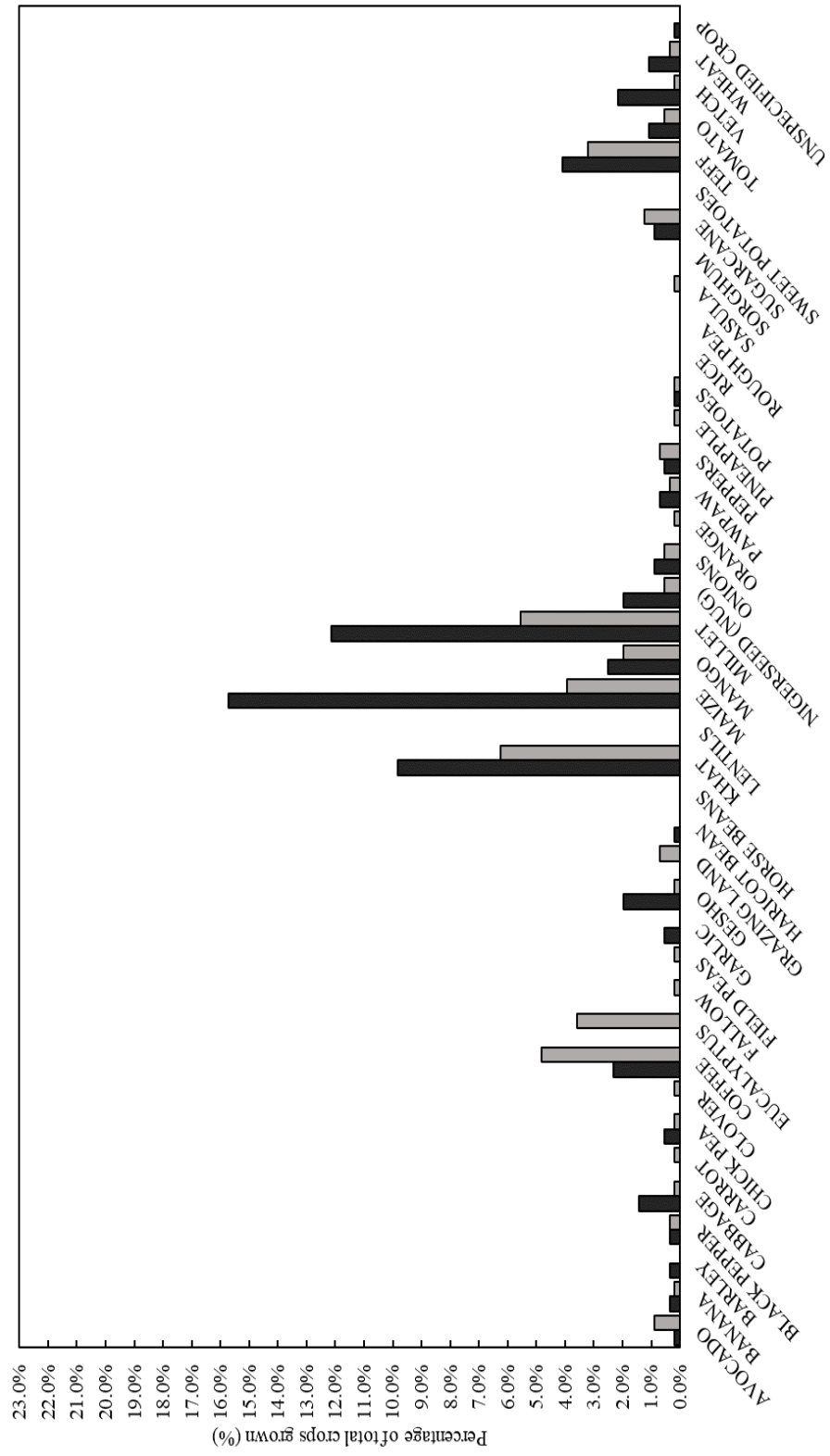
Source: Author's own work

Figure B-2. Distribution of land sample by crops sold and consumed for non-khat producers in Bahir Dar Zuria



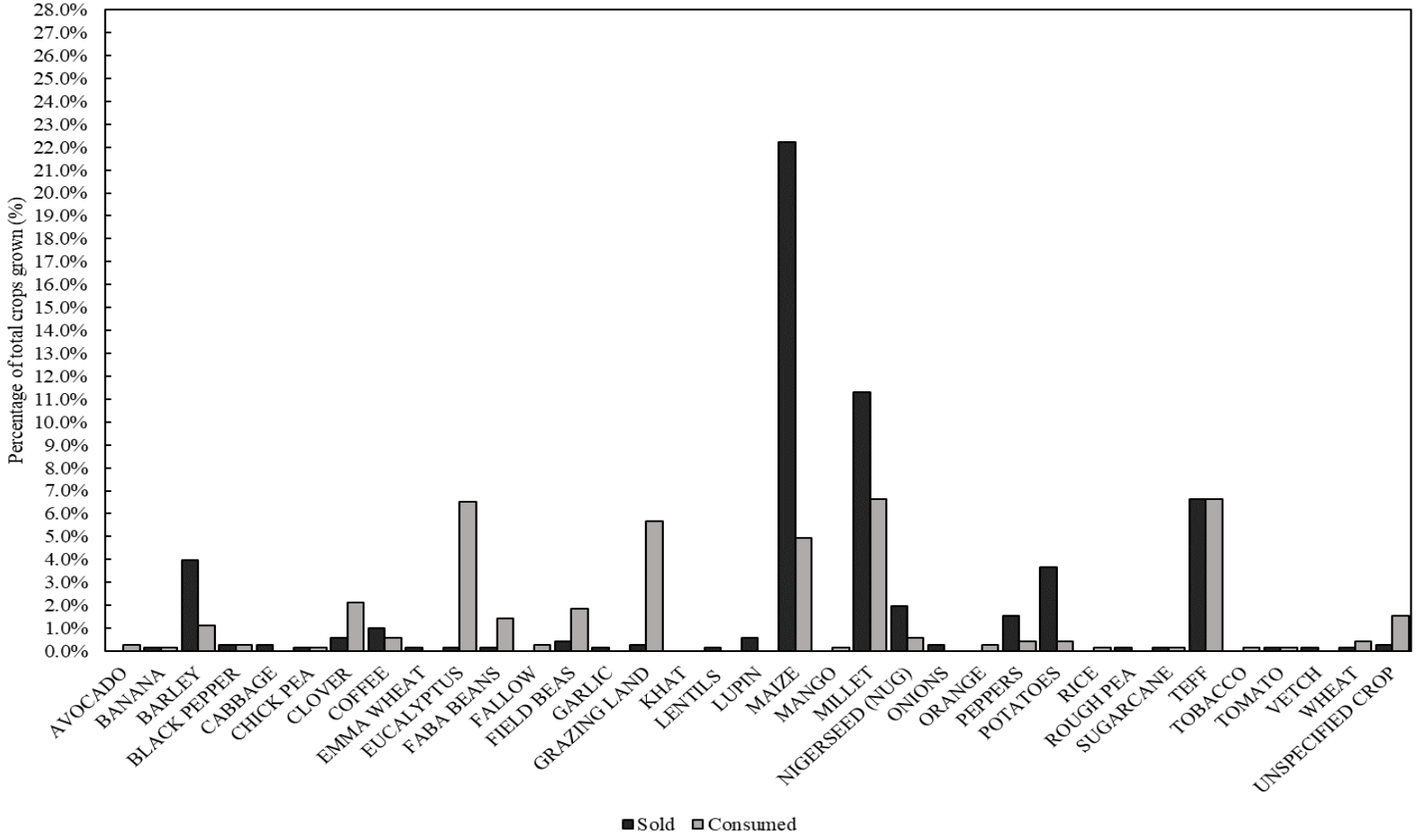
Source: Author's own work

Figure B-3. Distribution of land sample by crops sold and consumed for khat producers in Bahir Dar Zuria



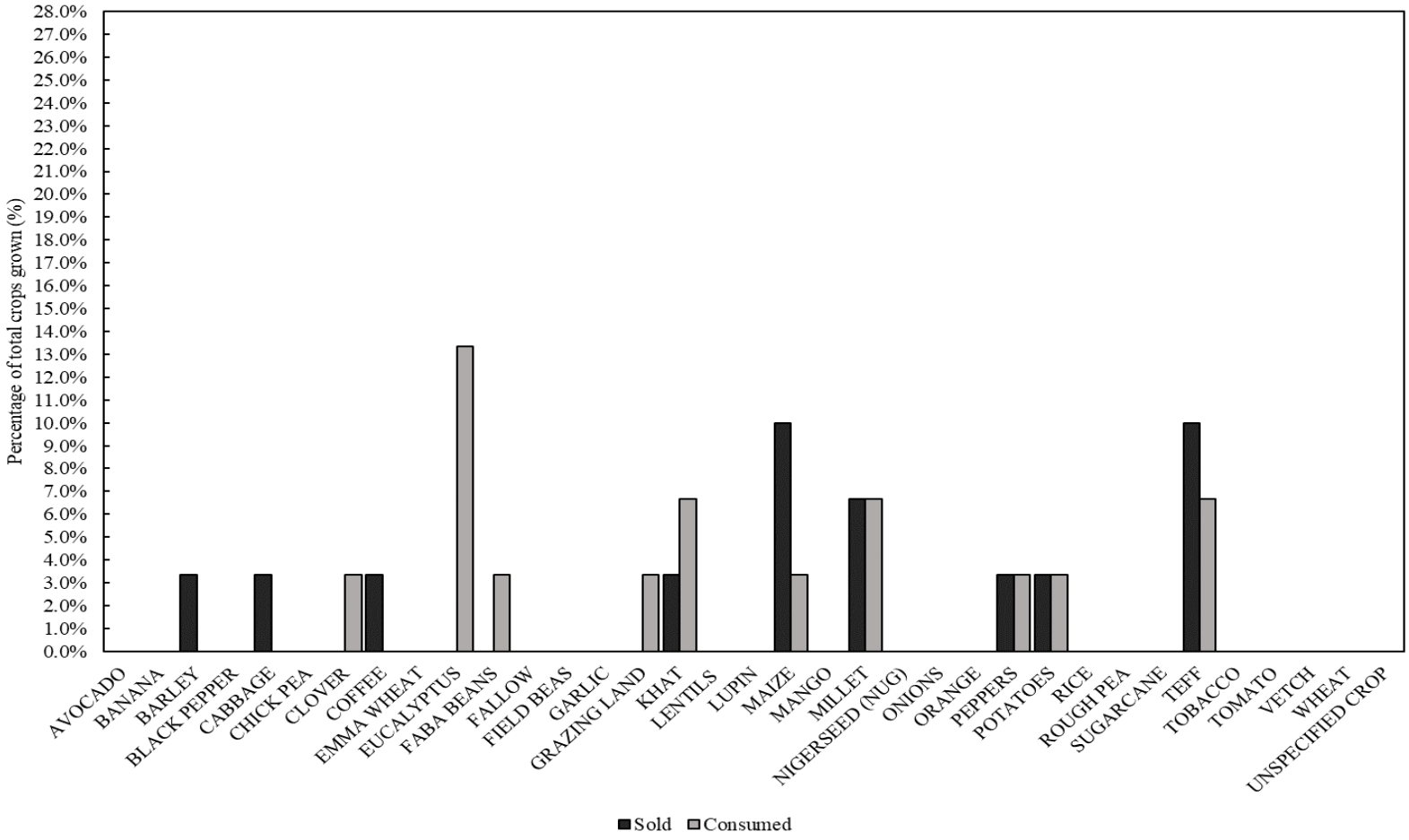
Source: Author's own work

Figure B-4. Distribution of land sample by crops sold and consumed for non-khat producers in Dangila



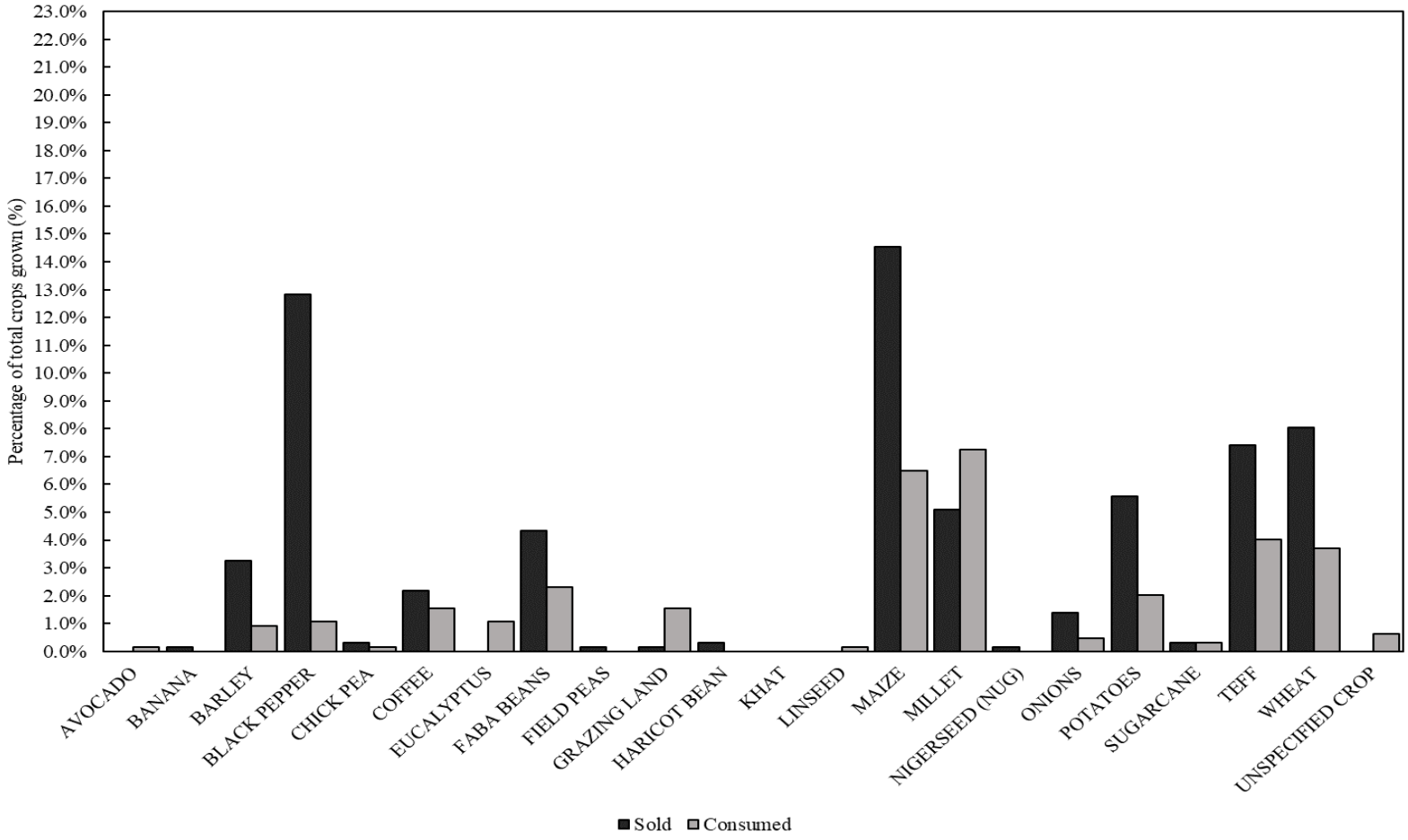
Source: Author's own work

Figure B-5. Distribution of land sample by crops sold and consumed grown for khat producers in Dangila



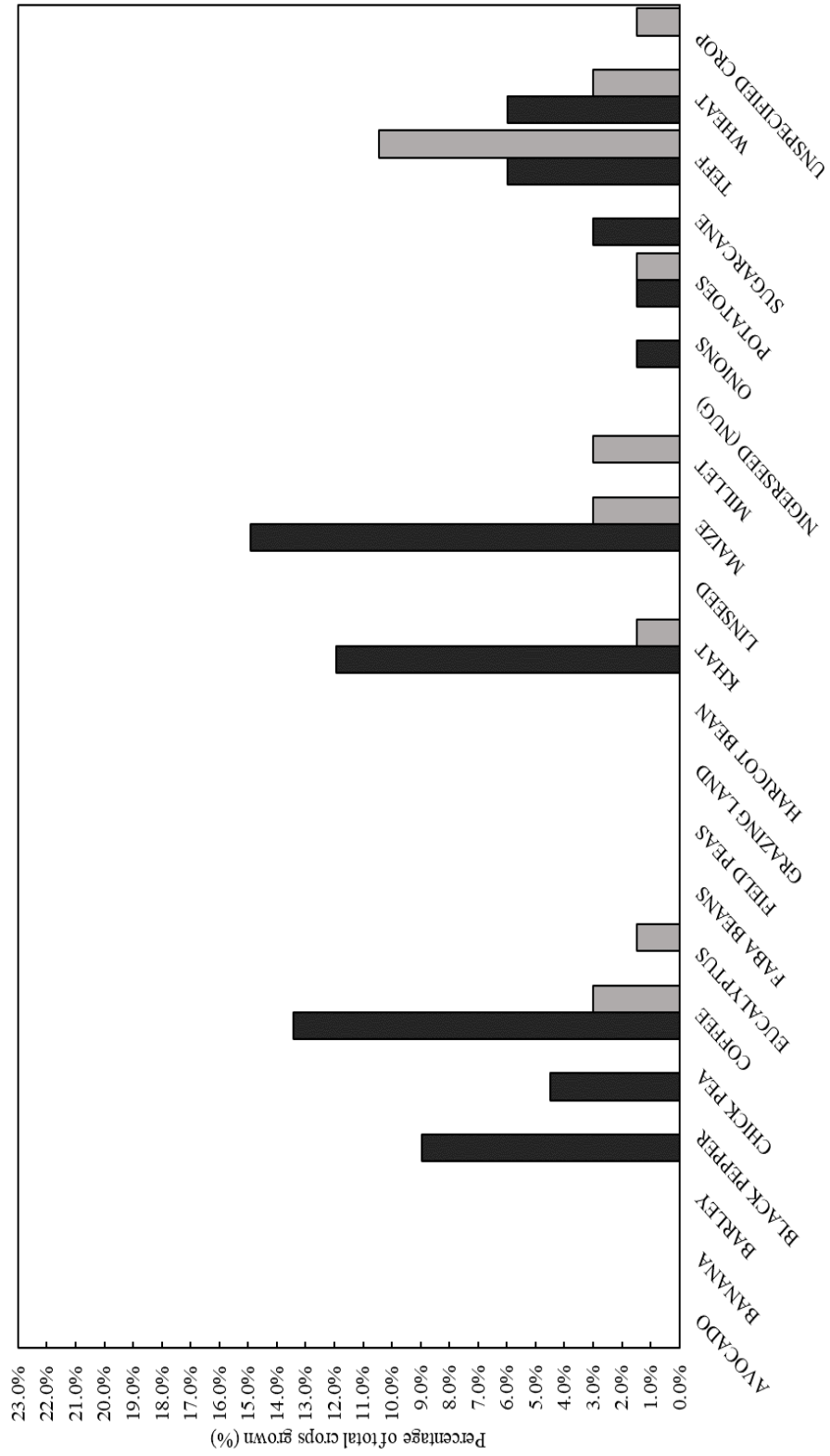
Source: Author's own work

Figure B-6. Distribution of land sample by crops sold and consumed grown for non-khat producers in Bure



Source: Author's own work

Figure B-7. Distribution of land sample by crops sold and consumed for khat producers in Bure



Source: Author's own work

Appendix C - Supplemental Empirical Results

Table C-1. Coefficient estimates for binary logit models

Variables	(3)	(4)
No_kids	-0.071	-0.031
	(0.115)	(0.148)
No_adults	-0.135	0.144
	(0.127)	(0.150)
HHH_sex	0.079	-0.328
	(0.459)	(0.555)
HHH_age	-0.006	-0.001
	(0.018)	(0.021)
1bn.HHH_educ	0.537	0.809
	(0.437)	(0.514)
2.HHH_educ	1.013	2.327
	(0.574)*	(0.930)**
4.HHH_educ	1.431	1.494
	(0.486)***	(0.534)***
Seedsaving	-1.195	-1.334
	(0.377)***	(0.546)**
Improvedseed	-0.091	1.802
	(0.823)	(0.679)***
Consvn	0.583	-1.203
	(0.394)	(0.585)**
Tractor	0.318	-1.635
	(0.402)	(0.635)**
No_plots	0.527	0.317
	(0.112)***	(0.136)**
No_cropsgrown_nokhat	-0.737	-0.550
	(0.165)***	(0.215)**
Owns_donkey	1.063	1.255
	(0.402)***	(0.504)**
Owns_irri	3.163	1.624
	(0.449)***	(0.522)***
CStaple	-0.847	-0.496
	(0.374)**	(0.485)
SCash	-1.912	-2.101
	(0.421)***	(0.492)***
Off_farmjob	-1.906	-1.354
	(0.947)**	(1.045)
Credit_loan	-2.132	0.071
	(0.686)***	(0.739)
FM_ext	0.917	0.239
	(0.384)**	(0.547)
AFL_ext	-0.025	0.054

	(0.648)	(0.690)
2bn.Woreda_code		-6.056
		(1.057)***
3.Woreda_code		-4.459
		(0.808)***
_cons	-1.167	1.645
	(1.331)	(1.382)
N	353	353

** p<0.1; ** p<0.05; *** p<0.01*

Table C-2. Full OLS regression results; fixed woreda

	MLAB	FMLAB	INC	EDUC	FCS	FDSHMO
Khatgrow	18.711	8.580	-1,067.557	-147.078	-1.653	0.017
	(8.172)**	(4.892)*	(836.780)	(209.737)	(2.348)	(0.345)
2bn.Woreda_code	6.164	-4.220	-3,233.901	467.289	4.025	1.289
	(8.614)	(5.102)	(872.440)***	(220.038)**	(2.458)	(0.359)***
3.Woreda_code	-7.620	-2.194	-5,594.169	-85.249	-8.920	-0.060
	(8.814)	(5.267)	(898.429)***	(228.318)	(2.520)***	(0.370)
Number_in_hh	-0.874	0.215	-623.927	-94.483	0.239	-0.047
	(1.424)	(0.802)	(139.359)***	(38.961)**	(0.394)	(0.058)
1bn.HHH_educ	17.090	5.763	-387.009	241.573	0.249	-0.027
	(6.304)***	(3.698)	(640.860)	(164.845)	(1.799)	(0.264)
2.HHH_educ	1.270	-2.405	1,223.320	574.547	1.923	-0.328
	(9.473)	(5.555)	(961.774)	(261.755)**	(2.739)	(0.396)
3.HHH_educ	-11.176	-26.371	-2,860.463	1,875.819	-7.545	-0.810
	(27.461)	(16.502)	(2,894.258)	(707.313)***	(8.111)	(1.191)
4.HHH_educ	8.164	-0.228	578.706	-17.328	4.532	-0.097
	(7.636)	(4.513)	(770.447)	(198.761)	(2.174)**	(0.321)
HHH_age	-0.077	-0.064	1.078	25.811	0.021	0.010
	(0.247)	(0.142)	(24.358)	(6.679)***	(0.069)	(0.010)
Owns_radio	-4.889	-0.220	-380.032	141.478	1.885	0.033
	(5.386)	(3.174)	(545.199)	(140.277)	(1.538)	(0.225)
Owns_mobph	10.955	6.257	869.225	67.228	2.609	-0.594
	(6.100)*	(3.565)*	(611.707)	(158.456)	(1.731)	(0.253)**
Total_crop_ha	-1.635	1.121	1,025.401	21.305	3.037	-0.436
	(3.607)	(2.129)	(367.550)***	(94.651)	(1.043)***	(0.152)***
Grows_cashcrop	-34.113	-13.635	911.752	43.539	-5.597	0.034
	(6.342)***	(3.619)***	(622.988)	(159.892)	(1.748)***	(0.257)
_cons	76.693	37.655	7,167.147	-472.024	40.079	1.154
	(15.905)***	(9.004)***	(1,537.224)***	(404.240)	(4.320)***	(0.635)*
R^2	0.21	0.13	0.25	0.13	0.28	0.14
N	326	348	360	321	356	357

** p<0.1; ** p<0.05; *** p<0.01*

Table C-3. Full OLS regression results; fixed kebele

	MLAB	FMLAB	INC	EDUC	FCS	FDSHMO
Khatgrow	0.696	2.517	19.753	-96.681	-1.754	0.086
	(6.831)	(4.599)	(495.487)	(108.215)	(2.987)	(0.191)
Number_in_hh	-0.245	0.453	-703.536	-90.932	0.659	-0.064
	(0.989)	(0.831)	(317.340)**	(89.331)	(0.421)	(0.050)
1bn.HHH_educ	9.190	2.970	-143.707	178.652	1.986	-0.089
	(5.069)*	(3.193)	(539.616)	(190.790)	(2.003)	(0.278)
2.HHH_educ	7.148	4.714	246.934	534.589	5.567	-0.306
	(5.872)	(4.558)	(1,049.650)	(362.266)	(2.134)**	(0.599)
3.HHH_educ	-17.029	-17.385	-232.931	1,699.218	8.886	-1.857
	(6.593)**	(3.915)***	(793.890)	(244.737)***	(1.332)***	(0.336)***
4.HHH_educ	4.325	-3.036	923.180	-63.212	5.723	-0.201
	(5.889)	(3.390)	(763.636)	(140.068)	(2.284)**	(0.474)
HHH_age	-0.565	-0.273	-7.904	24.541	0.038	0.010
	(0.160)***	(0.109)**	(26.917)	(10.642)**	(0.052)	(0.011)
Owns_radio	-8.789	-4.975	194.694	57.646	0.503	-0.059
	(4.662)*	(3.193)	(525.810)	(158.694)	(1.622)	(0.193)
Owns_mobph	2.730	2.689	925.500	24.379	1.862	-0.338
	(5.390)	(2.589)	(868.004)	(189.969)	(2.028)	(0.205)
Total_crop_ha	4.700	2.829	1,214.113	57.261	0.815	-0.248
	(3.726)	(1.908)	(578.455)**	(82.373)	(1.135)	(0.149)
Grows_cashcrop	1.843	3.952	76.560	-35.878	-2.033	-0.246
	(6.277)	(3.325)	(419.528)	(207.562)	(1.504)	(0.363)
R^2	0.54	0.53	0.39	0.21	0.58	0.36
N	326	348	360	321	356	357

Note: Std. Err. Adjusted for 26 clusters

** p<0.1; ** p<0.05; *** p<0.01*