Social Networks and Access to Soybean Value Chains in Rural Mozambique

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A Dissertation

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Of the Requirements for the Degree

Doctor of Philosophy

By

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The undersigned, appointed by the dean of the Graduate School,

have examined the Dissertation entitled

SOCIAL NETWORKS AND ACCESS TO SOYBEAN VALUE CHAINS IN RURAL MOZAMBIQUE

Presented by Mary Fridah Karwirwa Mubichi

A candidate for the degree of

Doctor of Philosophy

And hereby certify that, in their opinion, it is worthy of acceptance.

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Dr. David J. O'Brien

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Dr. Jill L. Findeis

Dedication

This work is dedicated to the children of Africa who hold the future.

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Abstract

Mozambique is one of the poorest, malnourished and foreign aid dependent countries in Africa. About half of its 27 million people live below poverty in the rural areas and depend on agriculture. Over the last ten years, Mozambique has witness excessive flooding and drought which have exacerbated crop failures, declining soil fertility, increased food prices and scarcity. As a result, soybeans have been introduced as a means to assist resource poor farmers to gain access to food, income and improve soil fertility.

The agriculture sector employs over 80% of the population and contributes almost 30% to the country's GDP. Regardless, many of the smallholder farmers lack access to agriculture information, inputs and credit due to weak institutions. Studies on Mozambique farmers have suggested social networks as vital for agriculture technology adoption. However, unknown are the types and social networks that might promote access to soybean value chains.

The diffusion of innovation theory and social network analysis (SNA) were used to examine and explain what types of households participated in soybean uptake and the types of information and seed networks they accessed. The diffusion of innovations theory provides a framework through which the researchers could explain how soybean farming and practices related to soybeans moved across the community. SNA technique was used to construct, identify and assess the various agricultural information and seed networks accessed by those who adopted soybeans. Therefore, SNA was used to identify (a) what types of

networks men and women in rural Mozambique accessed and (b) how the existing networks facilitated access to soybean value chains.

This study used primary data that was collected by the Soybean Innovation Laboratory and the Mozambique Institute for Agriculture Research between 2014 and 2016 using the Mozambique Women Empowerment in Agriculture Index ($WEAI^{+}$), Soybean Uptake and Networks survey (SUNS), Network Pilot Survey (NPS) and focus group interviews. Soybean uptake was assessed using logistic regression models first at the “macro” (regional) level and “micro” (village) level. The micro-level data utilized was collected from two villages located in Manica province.

The overall findings suggested that there were regional differences on soybean uptake. Households located in the northern region were more likely to uptake soybeans compared to those in the central region. Socio-demographic characteristics such as gender, age, ability to speak Portuguese and access to extension services influenced soybean uptake at both the macro and micro-level. Women in married types of households as well as those who participated in decision-making on inputs to be purchased for cash crop farming were also more likely to uptake soybeans. The networks accessed for soybeans information were complex and provided smallholder farmers both bonding and bridging ties that promoted soybean uptake. We also found that even though women were more willing to uptake soybeans those with larger friendship networks were less likely to uptake soybeans and also had limited access to improved seed and information networks. Hence future studies should consider examining what types of bridging

networks could promote access to improved soybean seed and agriculture information.

CHAPTER 1: INTRODUCTION AND BACKGROUND

Conventional (western) wisdom suggests that Africa is a continent of extreme poverty, corruption, political unrest and foreign aid dependency (Moyo, 2009). Development scholars such as Easterly and Ross (1997) describe Africa's growth tragedy as based on ethnic divide, poor public policies and erratic economic indicators. Varying levels of education, high government deficits, and poor infrastructure are specifically noted as the main contributing factors to disparate levels of economic success. There are, however, considerable variations in the degree to which individual African nations possess these characteristics (Sen, 1999; Easterly, 2006; Banerjee & Duflo, 2011).

Recently, Olopade (2014) attempts to correct the Western perception of Africa as a dark and hopeless continent and suggests the perception of a b*right continent*. In her argument, Olopade reminds us that, although the World Bank effort in Africa have been noted as mottled, much of the development at the village level has been made possible by social networks such as the "*kanju*". *Kanju* are described as assets, a culture and creativity that is "born from African difficulty". As an asset, *kanju* provides resources, connections and social protection that upholds livelihoods in lean economies. As a culture, *kanju* promotes trust and creativity that fosters strong ties that lessen the negative effect of poor governance and failed state institutions (Olopade, 2014). Hence, *kanju* are social networks that play a vital role in social, political, technological and economic development.

Comparable to Olopade's *kanju* arguement (2014), Nagoli and Chiwona-Karltun (2017) reason that lineage networks around Lake Chilwa in Malawi cushion

poor households during the lake's recession and other climate-related calamities. According to the authors, many of those living around Lake Chilwa depend on fishing and water from the lake for their livelihood. However, extended droughts have led to longer dry seasons that threaten livelihoods and food security among community members. To cope with the increasingly challenging vulnerabilities brought about by climate change, the predominately matriarchal society has drawn on an ancient tradition known as "*mwambo wathu*". The *mwambo wathu* tradition promotes social cohesion, strong ties, and collective action among community members. As a result of the strong kinship ties, poor households are shielded from hunger by provisioning of food stuffs (Nagoli & Chiwona-Karltun, 2017).

Improved communication and transport technologies in the twenty-first century have facilitated globalization and opportunities for many to move out of poverty (Prell, 2012). McMichael (2011), DiMarcello, et al. (2014) and other globalization scholars have noted social networks as both positive and negative. Positive social networks have led to the development of social movements such as Fair Trade. Contrary to the conventional market that emphasizes profit maximization, the Fair Trade movement encourages improved working conditions and higher compensation for workers and producers in the Global South. On the other end of the spectrum, negative social networks have promoted the rise of negative networks such as the *Boko Haram* in West Africa, and the Islamic State in the middle east, known for kidnappings, jihadism and other terrorist-related activities (Bamidele, 2013; Onapajo et al, 2012).

Research motivation

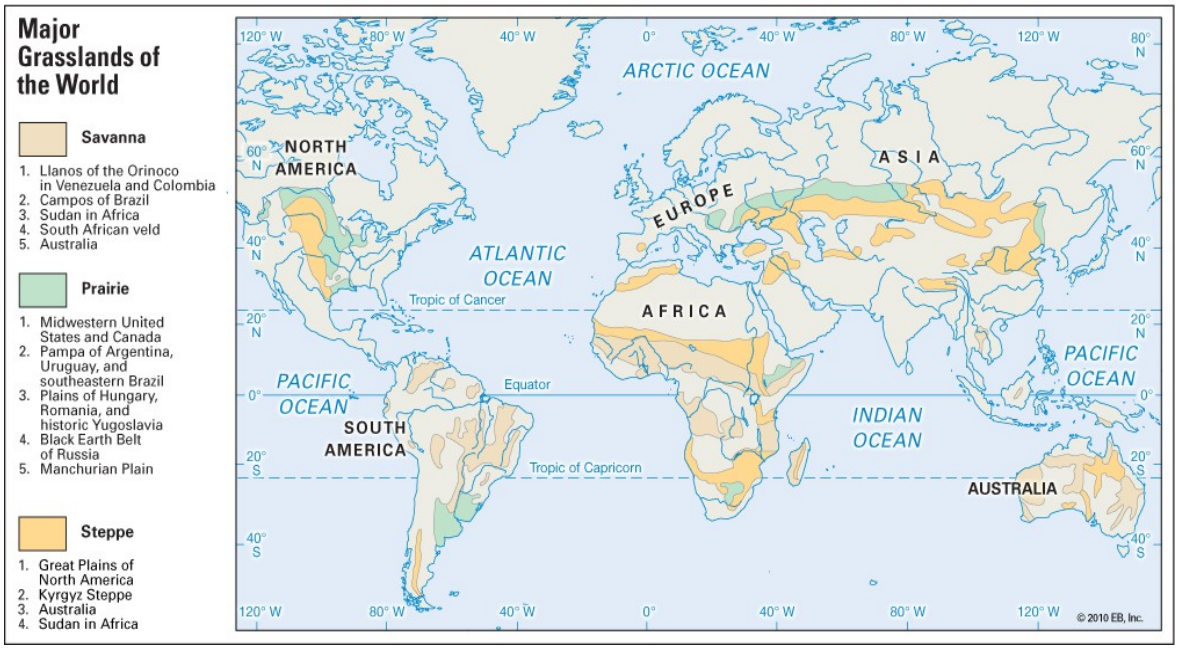
Agriculture is Central to Mozambique's social and economic growth, and attention is needed in understanding if and how social networks are inherent in the development of both. Extended droughts, floods and other climate-related changes are exacerbating malnutrition and rural poverty. To mitigate these trends, NGOs and government-sponsored research programs focused on soybean farming among smallholder farmers have been introduced. Current research suggests soybean farming could help address economic, environment and food security concerns among African smallholder farmers (Gasparri, Kuemmerle, Meyfroidt, Waroux, & Kreft, 2016; Parr, Griffith, & Grossman, 2016; Pauw, Thurlow, Uaiene, & Mazunda, 2012; Smart & Hanlon, 2014; van Vugt, Franke, & Giller, 2016; Walker & Cunguara, 2016).

Compared to traditional common beans (*Phaseolus vulgaris L*.), soybeans have a higher market value and makeup about 54% of the global oilseed market. Soybeans' multi-purpose use as a food, feed and fuel crop has also led to growing demand that can support employment opportunities within the soybean value chain (Walker & Cunguara, 2016; Varia, 2011). The growing middle class in Sub-Saharan Africa along with other developing countries such as Brazil, Russia, China, and India are also contributing to the increasing demand for meat and dairy products which drive soybean production (Varia, 2011; Mather, *et al*, 2015; Sinclair, *et al*, 2014; Walker & Cunguara, 2016;). Much of Mozambique's soils are depleted from excessive flooding and continuous maize farming, hence soybeans' natural ability to fix nitrogen in poor agricultural soils provides resource poor farmers an alternative to synthetic fertilizers needed to improve crop yields

(Ronner, et al, 2015; Parr, 2014; Baijukya, et al, 2010). Hence, soybeans present smallholder farmers in southeast Africa a pathway towards economic, social and technological development.

The soybean (*Glycine max*) is not native to Africa but rather to East Asia. Nonetheless, Mozambique shares similar agro-climatic characteristics to Latin America's Cerrado tropical savanna corridor that boasts one of the highest soybean production rates in the world (see figure 1.1). These agro-climatic conditions include latitude, annual precipitation volumes, and solar radiation rates that promote photosynthesis and favorable soybean plant growth (Cardoso da Silva, & Bates, 2002; Opperman & Varia, 2011; Gasparri et al. 2016).

Image 1: South of the equator savanna land deemed suitable for soybean production in South America and South Africa region



Source: http://christopherdeldridge.com/blog/wp-content/uploads/2011/05/grasslands.gif

Soybean production in Southeast Africa has increased over the last decade. According to Mather, Cunguara, and Tschirley (2014), Mozambique's soybean production has increased from an estimated 705 metric tons in 2002 to 5,023 metric tons in 2012. Walker and Cunguara (2016) estimate that Mozambique's soybean production will double by 2020 due to the growing population, poultry and aquaculture industries. The Niassa and Zambezia provinces, located in northern Mozambique, are noted as having the highest soybean production in the country, due to a thriving poultry sector in the region. Tete and Manica provinces, located in the Northwest and Central regions respectively, trail behind the Northeast region even though their agro-ecological environment has been found to be favorable for soybean farming. Various studies have also noted increased investment in soybean development in the Northwest and Central region (Opperman & Varia, 2011, Mather, et al., 2014. However, access to agricultural extension services, information, markets, credit, seed and other farm inputs remains limited (Walker & Cunguara, 2016; Findeis, *et al*; 2016).

Previous studies on agriculture technology adoption among African smallholder farmers have suggested local social networks facilitate social learning, labor practices, social capital sharing, employment, and market participation among others (Valdivia & Gilles, 2001; Fafchamps, 2004; Bandera & Rasul, 2006; Smith & Findeis, 2013; Sevilla, 2013). Diffusion of innovations and social network studies on African smallholder farmers have previously suggested that different types of intra-village and sub-village level networks affect information flow and technology uptake (Van den Broeck & Dercon, 2011). Network characteristics

such as size and heterogeneity are particularly noted as affecting information sharing, social learning, productive capacities and marketing behavior (Conley & Udry, 2001; Bandiera & Rasul, 2006; Smith & Findeis, 2013; Sevilla, 2013; Caudell *et al*, 2015).

Research on network structures that might affect technology adoption among African smallholder farmers is still limited (Rogers, 2010). Rogers (2010) diffusion of innovation theory has argued that there are five main variables that influence adoption. The five include, the perceived attributes of an innovation, the types of innovation decisions, the communication channel an innovation is transmitted through, the extent of the change agent promotional efforts, and the nature of the social systems. Although much effort has been made in understanding first four elements, research on the nature of social systems that affect adoption is still limited (Rogers, 2010). This study extends research on the nature of social systems that determine agricultural technology adoption. It specifically examines the structural characteristics of inter and intra-village networks that promote access to agricultural innovations in Mozambique.

Specific research objectives:

This study used primary data collected by the *Feed the Future Innovation Lab for Soybean Value Chain Research* (SIL), between 2014 and 2017 to establish the following objectives:

i. what types of households grew soybeans and what existing information and seed networks did they access?

ii. what are the bridges and barriers women and men use and face to access soybean value chains?

iii. how might existing information and seed networks be improved so that households have greater access to soybeans that (a) diversify their household income and diet (b) improve their subjective well-being, and (c) ensure women maintain higher levels of participation and influence in soybean value chains?

Significance of study

This study contributes towards the development of theory and literature on (a) diffusion of innovations and social networks and (b) agricultural development in Sub-Saharan Africa. Agriculture development literature suggests agriculture technology adoption that could benefit African smallholder farmers is limited by a dysfunctional agricultural extension service sector, which includes: limited access to information, markets, credit, and farm inputs such as improved seed and fertilizers. Although SNA has a longstanding tradition among social scientists, Cheliotis (2010) and other social network scholars have noted that SNA's methodological advancement has been primarily driven by mathematicians, physicists, biologists and computer scientists. Therefore this study contributes towards the development of SNA among sociologists.

Soybean Innovation lab

The *Feed the Future Innovation Lab for Soybean Value Chain Research* (SIL), is one of the 24 Feed the Future Innovation Labs funded by the United States Agency for International Development (USAID). SIL is a transdisciplinary and

collaborative research project composed of natural and social scientists from various American universities, international research institutions, NGOs, and private sector partners. The overall goal of SIL is to provide researchers, private sector companies, NGOs, agriculture extension and others involved in soybean development, critical information on genetic improvements, crop production, nutrition and market development.

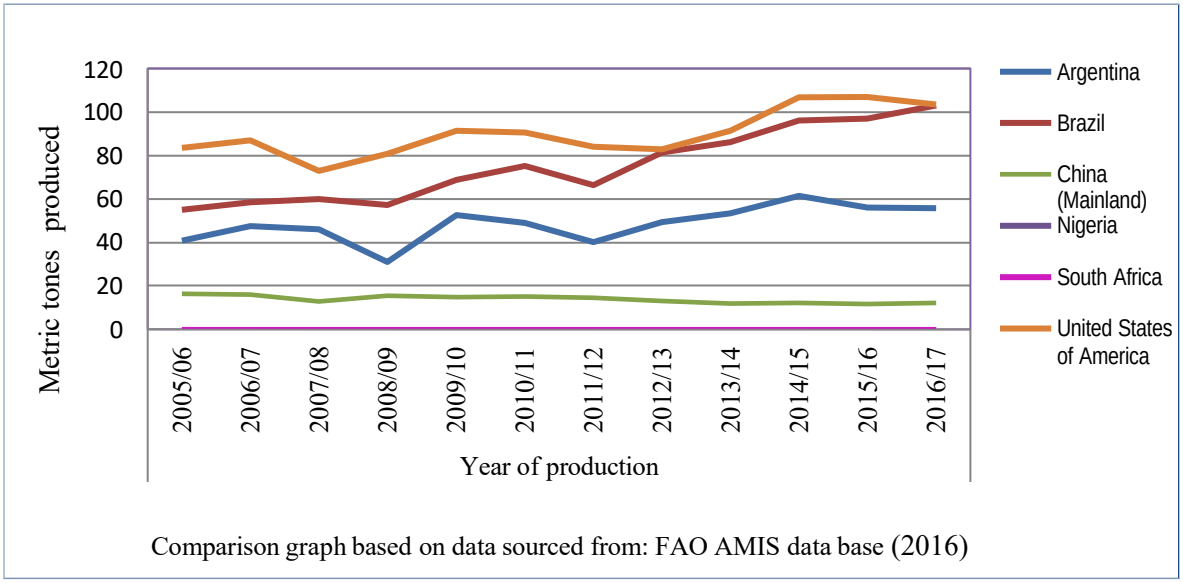
SIL's efforts in Mozambique are focused in the Central, Northwest and Northeast regions which have favorable bean growing conditions. SIL works researchers at the Agricultural Research Institute of Mozambique (IIAM) to address protein malnutrition, food insecurity and economic development in rural Mozambique. SIL supports various programs that promote village level training on soybean nutrition and household soybean processing; promote improved agronomic practices, and assess economic impacts and gender empowerment among others (http://soybeaninnovationlab.illinois.edu/programs). The SIL economic assessment team has been involved in collecting primary data over the last five years to conduct longitudinal and multilevel assessment of socio-economic factors that drive soybean adoption and sustainability among small and medium size farmers.

Role of soybeans in poverty alleviation and food security in southeast Africa

History shows soybeans were first cultivated in Mozambique in 1915 (Shurtleff & Akiko, 2009). Irrespective of this history, soybeans are still considered a new crop. There are currently 22 countries in Sub-Saharan Africa involved in soybean production. Nigeria and South Africa are the largest soybean producers

in Africa followed by smaller producers such as Uganda, Ghana, Zimbabwe and Malawi. Irrespective of the number of countries involved in soybean farming, Africa produced less than one percent of the global soybean output in 2016/17 (see Figure 1.

Figure 1: Multi-country comparison of estimated soybean production between 2005 -2017



Comparison graph based on data sourced from: FAO AMIS data base (2016)

The United States of America (USA) produced the highest (32%) quantity of soybeans followed by Brazil and Argentina (see figure 2). Despite the low soybean production rates observed in Africa and Mozambique, the current output is expected to double between 2010 and 2020 and continue growing due to the favorable climatic conditions, need for improved human nutrition in the region, growing poultry and aquaculture feed industry (Walker and Cunguara 2016).

To promote soybean development the Mozambique government has sponsored the Program of Triangular Cooperation for Agricultural Development of the Tropical Savannahs of Mozambique (ProSavana). ProSavana is a joint

soybean farming venture between the Brazilian agriculture research agency[1] (EMBRAPA), Cooperation Agencies of Brazil (ABC) and the Japan International Cooperation Agency (JICA). The soybean-farming venture was founded as a technology transfer program to promote soybean development within the country.

Soybeans have a higher ecological, economical and nutritional value compared to the traditional maize crop grown in the southeast African region. Ecologically, the natural ability of soybeans to fix nitrogen in poor agricultural soils promotes soil fertility and increases crop yields (Dlamini, Tshabalala, & Mutengwa, 2014). Dlamini et al. (2014) noted that when soybean is rotated with other grain crops such as maize it can maximize profits. Although soybean is a relatively new crop in South Africa, it production is favored by prevailing policy makers and researchers within the region who view soybean as a relatively simple and low-cost crop due to its short growing season (less than four months), and the ability of soybean to serve as a cover crop that can be easily rotated with maize to improve crop yield.

Challenges of soybean

Soybeans have been stereotypically assumed to be a large commercial and mechanized farm crop rather than a small and medium farm crop (Dlamini et al., 2014; Walker & Cunguara, 2016). As a result, adoption and production capacities have been slow and continued to vary based on the farmer's knowledge on the crop, access to seed, market, economic status, and prevailing government

1. Blog publication on development of soybean farming in Mozambique source: http://agdes.blogspot.com/2012/03/mozambiques-soybean-potential.html

policies. Dlamini et al. (2014); Walker and Cunguara (2016) also note much of the soybean seed and fertilizer available in the market is packaged in quantities which are often too large and expensive for smallholder farmers in rural areas. Decreased government budget allocations, cheap agricultural imports, and competing crops subsidies can also be argued to be hampering soybean production (Smart & Hanlon, 2014). Although Mozambique's national budget allocates 9% to agriculture development, the literature reviewed suggests that much of this funding is supporting state-run projects that promote commercial farming. For example, the Program of Triangular Cooperation for Agricultural Development of the Tropical Savannahs of Mozambique (ProSavana), is a joint soybean farming venture between the Brazilian agriculture research agency (EMBRAPA), Cooperation Agencies of Brazil (ABC) and the Japan International Cooperation Agency (JICA) (Nogueira et al., 2017; Shankland & Gonçalves, 2016; Shankland, Gonçalves, & Favareto, 2016).

Poor soybean production among smallholder farmers can also be argued to be due to poor climatic conditions and agronomic practices. Mozambique is prone to flooding which affects soil fertility (Parr, 2014). In studies examining soybean production among smallholder farmers in Malawi, Parr (2014) and van Vugt et al. (2016) both noted excessive flooding led to high soil pH levels and aluminum content which adversely affected the inoculants effectiveness (Parr, 2014;). Low phosphorus levels resulting from excessive flooding were also noted as contributing to stunted soybean growth, delayed flowering and delayed shoot growth (van Vugt et al., 2016). Insufficient organic soil matter, due to the region's

tropical climate and lack of access to soil testing services and expensive mineral fertilizers are also noted as slowing smallholder farmers' participation in soybean farming.

Mozambique country background

Geography and climate

Mozambique is located along latitute18.6657° S and longitude 35.5296° E along southeast Africa and the Indian Ocean (World Atlas, 2017). It borders Malawi (1,569 km), Tanzania (756 km) and Zambia (419 km)in the north; Zimbabwe (1,231 km); South Africa (491 km) and Swaziland (105 km) in the south (Nagle & Williams, 2013) (see image 1 on map of Mozambique). Mozambique is the world's 35th largest country and Africa's 16th largest country with a total land area of 801,590 square kilometers (World Fact book, 2016). Although 62% (50 million ha) of the total land area in the country is suitable for agricultural production, however, less than 12% is under cultivation (FAO, 2016).

According to AQUASTAT (FAO, 2016), Mozambique's climate varies from tropical to subtropical country. There are three unique geographic zones; the coastal belt which covers about 44% of the country; the middle plateau 29% and highlands the remaining 27% of the land area. In the north, there are rugged highlands which include the Angonia, Tete and Niassa highlands. The south is characterized by the Mashonaland plateau and the Central region by the Chimoio Plateau. The annual rainfall is approximately 800-1000 mm along the coast and approximately 400 mm along the South African and Zimbabwe boarder. The north and Central have much higher precipitation rates (1000 -2000 mm) because of the monsoon and highlands (FAO, 2016).

Image 2: Map of Mozambique

Source: i FAO AQUASTAT, 2016

Society

Mozambique's society can be described as culturally diverse. Almost 63% are Christians, 18% Muslim and the remaining 19% engage in the practice of other religions (The World Fact Book, 2016). Unlike most African countries whose social organization is either patrilineal or matrilineal, Mozambique shares both and as cultural norms vary depending on the social organization (Arnaldo, 2004). In a patrilineal society, a woman's reproductive power is completely transferred to her husband's family through payment of a bride wealth (Arnaldo, 2004). In a matrilineal society, women don't transfer their reproductive abilities and there is no payment of bride wealth as marriage depends on the couple's individual attributes. Women in matrilineal systems have strong land rights and decision-making capacities on use of land compared to those in patrilineal systems (Arnaldo, 2004; Nagoli & Chiwona-Karltun, 2017). Most communities in northern Mozambique are matrilineal while those in the Central and southern regions of the country are patrilineal.

Population

The World Bank (2016) estimates Mozambique's population at 27.98[2] million. Almost all (99.66%) are of African descent (CIA, 2014). Compared to Angola, a former Portuguese colony with about 2% mixed European-Africans and 1% Europeans, there are only 0.2% Euro-African and 0.06% European. There are

[2] The government of Mozambique provides a lower population estimate of 26,423,623 compared to the World Bank. (source: http://www.ine.gov.mz/ Accessed 10/18/2016)

over 20 ethnic groups and over 32 ethnic languages spoken, excluding Portuguese (Arnaldo, 2004, CIA,2014). The United Nations Development Program (2015) ranks Mozambique 180 out of 188 on the Human Development Index[3] (HDI). The life expectancy rate is estimated at 53.3 years, over 40% of children under five years are malnourished, almost 45% of the population is under 15 years, the primary school completion rate is under 48%, and the infant mortality rate is at 83/1000 (UNDP 2015; usaid.org). According to the CDC (2016), the low life expectancy rate is attributed mainly to HIV/AIDS (24%) and malaria (12%)

Mozambique has a high (2.45%) population growth rate compared to South Africa (0.99%) and the rest of the world (1.06%) (The World Fact book, 2017). According to the World Bank (2016) over half of Mozambique's population, 54.7%, is living below the national poverty level. The same data base also shows Mozambique's poverty head count ratio at $1.90 a day being 68.74%. This is relatively high when compared to Sub-Saharan Africa region 47.03% and the neighboring South Africa, 16.89% (World Bank, 2016). Income and socio-economic disparities between urban and rural populations are also noted as high (67%), due to limited social services and amenities in the rural areas (World Bank, 2015).

[3] The HDI is a geometric mean that encompasses summary measures on population long-term health, education level and standard of leaving (UN, 2016).

Political-Economy

Mozambique has a history of a volatile political environment. Unlike most previously European-colonized African countries that gained their independence between 1950 and 1960, Mozambique gained its independence in 1975. Two years later, the country erupted into a fifteen year long (May 30, 1977 – Oct.4, 1992) civil war that led to large-scale emigration and economic dependence on South Africa.

Mozambique has witnessed outstanding economic growth along with continued rural poverty over the last two decades (Cunguara and Hanlon, 2012; Smart & Hanlon, 2014). Compared to other Sub-Saharan Africa countries, Mozambique continues to receive the highest level of development assistance although faced with slow growth in job creation due to varying social-political factors (Smart & Hanlon, 2014). Mozambique's estimated GDP annual growth rate averaged seven percent compared to the region's 4.2% making it the strongest GDP growth in SSA between 2005 and 2015 (World Bank, 2015[4]). Much of this significant progress is attributed to increased donor funding targeted towards infrastructure development following the country's reconstruction efforts following the end of the civil war in 1992 (World Bank, 2015; Smart & Hanlon, 2014).

[4] World Bank country profile notes current GDP growth at 5.9% due to improvements in trade, manufacturing, extractive industries, transport and communication, and electricity production. The same report also shows public debt having risen to 55% and expected to settle at 60% - source http://www.worldbank.org/en/country/mozambique/overview)

Table 1.1: Summary of Mozambique's socio-economic development indicators

Socio-economic indicators	Current estimate
Population (2016 estimate)	27.89 Million
Median age	16.9 Years
Life expectancy at birth	52.6 yrs.
GDP (purchasing power parity –billion)	$29.76
GDP (real growth rate)	8.30%
GDP contributor:	
Agriculture	28.10%
Industry	21.60%
Service	50.20%
Unemployment rate (2007 estimate)	17%
Labor force (2016 estimate)	13.31 million
Percent labor force in Agriculture	81%
Percent labor force in industry	6%
Percent labor force in Service	13%
Population below poverty (2009 estimate)	52%
Dependency ratios	
Total population	94.50%
Youth (0-14 years)	88.10%
Potential Support Ratio	15.60%
Dependency ratio measures the population age structure and identifies the percentage of individuals that are likely to be economically dependent on others, e.g. 0-14 years and those over 65years old.	
Potential support ratio estimates the burden placed on working population by estimating the number of people aged between 15-65 years against those aged 65 years and older.	
Source:https://www.cia.gov/library/publications/the-world-factbook/geos/mz.html	

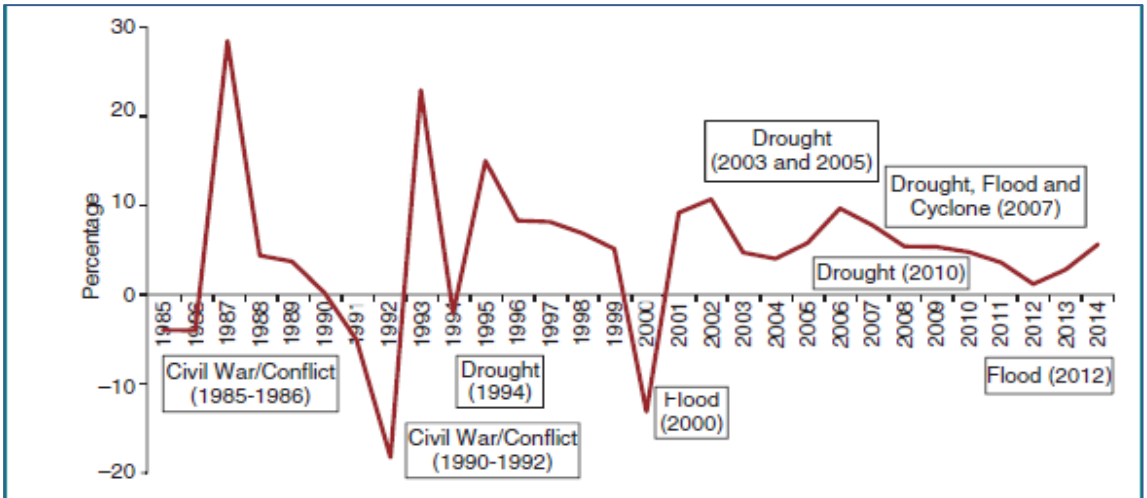
Agriculture

Over 80 percent of the population in Mozambique is employed in the agriculture sector. Many of those involved in agricultural production have access to less than 2 hectares of land and participate primarily in maize production (Kassie, et al, 2014). Most of this maize is consumed at the household level and surplus sold in the local market (Kassie, Abate, Langyintuo, & Maleni, 2014). Agricultural production in Mozambique is rain-fed and there is little mechanization used (Famba, 2011; Walker & Cunguara, 2016). Over the last ten years, weather-related-shocks such as flooding and drought have exacerbated crop failures and

declining soil fertility (Pauw, et al, 2012). According to the USAID (2016) supported Economic Analysis and Data Services (EADS), Mozambique's global food security index in 2016 was estimated at 29.4 points (out of 100). This was considerably lower compared to the overall 37.4 points reported for the Sub-Saharan Africa region.

Smallholder farmers are important for the country's growing economy. The majority of Mozambique's population (81%) is employed in the agriculture sector, which contributes almost 30 percent of the annual GDP. World Bank indicators show that agriculture's contribution to the country GDP declined by 1.6% between 2010 and 2014. Much of this decline is argued to be attributed to severe droughts, cyclones, and floods that have affected the country over the last decade. Poor market infrastructure and external links that facilitate access to farming inputs and participation in agriculture production decision making are also noted as impeding smallholder farmers from thriving (Hanlon, 2007; Cunguara & Hanlon, 2012; *de* Brauw, 2015; Kondylis, *et al,* 2015). Food insecurity between 2002 and 2009 was based on three key factors. First, low agricultural productivity in food crops led to decreased food access and income, as did climatic shocks and seasonal variations in production and income. Third, a global economic crisis which led to sharp increases in international food and fuel prices. Image 4 illustrates these major events with respect to agriculture production.

Figure 2: Major shocks to crop and livestock production in Mozambique



Source: World Development Indicators.

Update: Annual percentage growth in agriculture value added has dropped from 2011 at 5.8 percent to 2 percent in 2012 and 3.5 percent in 2013. A drop would be expected to be seen after the large flood of 2015.The figures that would reflect the effect of the flood in 2015 are currently not available.

CHAPTER 2: LITERATURE REVIEW

Social networks are ubiquitous in social, economic and technology development. Social networks provide access to information and resources needed to sustain development and diffusion of ideas, practices, and purposes. Improved communication and transport technologies in the twenty-first century have not only facilitated globalization but have provided more opportunities for many to move out of poverty (Prell, 2012:1). The development of mobile phones in Africa has allowed many to gain access to new information following the 1980 - 1990 structural adjustment programs (SAPs) that necessitated mandatory budget cuts and government spending on health education and other social services (McMichael, 2012). Social networks have the ability to promote positive outcomes such as, promotion of human rights, through social media and social movements or negative outcomes such as promotion of terrorism and increased inequality due to income distribution (McMichael, 2012).

The majority of those living in rural areas of Sub-Saharan Africa are often disadvantaged and lack access to new information, technological innovations, and markets. As a result of the limited access to social and communication infrastructure, many remain among the world's poorest populations. Most agricultural extension services in Africa are limited by scarce national budgets, trained extension officers, distance and lack of means of transportation. Therefore, many of those living in rural places depend on their external relatives, friends, and traders for the purposes of acquiring urgent farm inputs such as seed and labor, market, agricultural technology and agricultural practice systems.

The majority of Mozambicans, 67.8%, live in the remotest areas and depend on agriculture for their livelihoods (Smart & Hanlon, 2014; TheWorldFactBook, 2017). The majority of, rural households are poor and depend on two or fewer hectares of land, including rented land, for their household production and market production (Jayne et al., 2003; Tittonell et al., 2010). Agricultural markets in the rural areas are also often far removed from the villages and limited by poor communication and road infrastructure (Sevilla, 2013; Silva, 2008; Smart & Hanlon, 2014). As a result of the limited infrastructure, access is limited to agricultural extension services, and to key agricultural inputs such as seed, fertilizer, and credit (Smart & Hanlon, 2014; Walker & Cunguara, 2016).

Agricultural productivity in Sub-Saharan Africa remains among the lowest compared to the rest of the world due to existing agroecological complexities of the region, political instability, poor health, poor markets and limited communication infrastructure, among other factors (Evenson & Collin, 2003; Cunguara & Hanlon, 2012). As a result of these factors, development of improved agricultural technologies that might improve agricultural production and alleviate poverty has been slow (Evenson & Gollin, 2003; Fisher & Kandiwa, 2014; Sanchez, 2015; Suit & Choudhary, 2015; Walker & Cunguara, 2016). This chapter reviews studies based on diffusion of innovations and social networks in the southeast and eastern Africa.

Diffusion of innovations

The Green Revolution success of the late 1960's and 1970's is credited to agricultural innovations that increased agricultural productivity and addressed food

security concerns in Latin America and Asia (Eicher & Staatz, 1998). According to the Alliance for a Green Revolution in Africa (AGRA, 2016), Raleigh, Choi, and Kniveton (2015), Africa is seeking its *own green revolution* so as to address growing food security concerns, economic development, political stability and environmental degradation. Looking back at Asia's success, agriculture innovations that promote productivity and farming systems have been deemed necessary for addressing Africa's current and future social (e.g. food security and nutrition), economic (e.g. employment, national wealth) and environmental development (Collier & Dercon, 2014; Sinah & Oladele, 2016).

The Alliance for a Green Revolution in Africa (AGRA, 2016) has proposed developing agricultural innovations that maximize nutrient cycling in the soil, increase high-yielding crop varieties, improve human nutrition, safeguard biodiversity, decrease the carbon footprint and conserve wildlife in east and southern Africa. The New Partnership for Africa's Development (NEPAD[5]), has also adopted a comprehensive integrated framework for agriculture and rural development(CAADP[6]) which identifies agricultural innovations as necessary in

[5] NEPAD is the African Union economic development program that provides member states a similar policy framework with the purpose of promoting greater political, social and economic co-operation and integration.

[6] The Comprehensive Africa Agriculture Development Program (CAADP) was founded with the aim of launching a 'green revolution' in Africa (AGRA, 2016; Wiggins, 2014). CAADP recognizes majority of Africa's population living in the rural areas and dependent on agriculture. It also notes decreased government spending in agriculture development and therefore provides member countries a framework through which agriculture development might be promoted (Pauw, et al, 2012; Wiggin's, 2014).

developing and sustaining rural livelihoods of majority (80%) of Africans (Pauw et al., 2012; Wiggins, 2014).

Agriculture innovations have positive and negative outcomes. Positive outcomes include the development of improved varieties of seed, agricultural inputs e.g. fertilizers, and management systems that have led to higher yields, increased food security and profits (Collier & Dercon, 2014; Hamukwala, Tembo, Erbaugh, & Larson, 2012; Sinah & Oladele, 2016). Negative outcomes include promotion of wealth inequalities, gender inequality, landlessness, poverty and food insecurity among others (Dawson, Martin, & Sikor, 2016; Lunduka et al., 2013; Meinzen-Dick et al., 2011; Silva, 2008).

Social scientists, natural scientists, and policy makers in Africa are currently faced with the challenge of understanding how agricultural innovations might impact poverty and food security (Pardey, Andrade, Hurley, Rao, & Liebenberg, 2016; Schnurr & Mujabi-Mujuzi, 2014). Previous studies on diffusion of innovations have focused on understanding the mechanisms that motivate technology adoption, the impact of agriculture technology adoption on productivity, types of technologies adopted, and characteristics of the adopter (Doss, 2006; Bandiera & Rasul, 2006; Hamukwala et al., 2012; Smith & Findeis, 2013; Elias, et al., 2014; Dinh et al, 2015; Akinwale, et al., 2016; Sinah & Oladele, 2016).

Definition Diffusion of innovations:

According to Rogers (1962, 2010) diffusion of innovations can be described as the process by which an innovation spreads within a social system. Innovations comprise new abstract ideas, knowledge, concepts, objects or actual practices

(Rogers, 2010; Wejnert, 2002; Elia et al, 2014). Agricultural innovations comprise, new seed varieties, fertilizer, farming practice, farming equipment, labor organizations and institutions among others (Wejnert, 2002; Bandiera & Rasul, 2006; Smith & Findeis, 2013; Dinh, et al., 2015; Akinwale, et al., 2016; Sinah & Oladele, 2016). Agricultural innovations in Sub-Saharan Africa have been slow in developing due to limited institutions, human capital and resources. Most recently, debates on transgenic crops have shown lack of trust, lack of constructive engagement and lack of common purpose between stakeholders (Sinah & Oladele, 2016). Many of the smallholder farmers intended to benefit from the agricultural innovations being pursued are often excluded from the technology development under the assumption they are semi- or illiterate and thus unable to understand the complexities of the technology (Schnurr & Mujabi-Mujuzi, 2014; Sinah & Oladele, 2016).

A study by Hamukwala, et al. (2012) used the diffusion of innovations framework to examine the challenges and opportunities smallholder farmers faced when adopting improved sorghum and millet seed varieties in Zambia. The study used primary data collected from 130 farming households and 57 seed dealers located in Lusaka and Siavonga districts of Zambia. Hamukwala, et al. (2012) found that although sorghum and millet were traditional crops with existing market opportunities, development and release of improved varieties had been slow over a period of 20 years. The study found that most of the farmers involved in production of sorghum and millet were poor and dependent on saved seed, which was often of poor quality and contributed to low production. High transport cost

for seed and inputs, limited access to extension support services, limited access to credit and processing technologies also discouraged many from adopting new varieties. Competing government programs providing input subsidies for maize along with poor coordination among key actors' such as farmers associations, NGOs, the ministry of agriculture and livestock, responsible for varietal development, inspection, certification and provision of extension services delayed development. As a result of these obstacles, many of the private seed companies lacked incentive to market new varieties.

Similar to Hamukwala's study, Elias, et'al (2014) used the diffusion of innovations approach to investigate how access to and use of information facilitated use of scientific weather forecasting technology in Central Tanzania. The study used both quantitative and qualitative data collected from 84 farmers, one focus group discussion, agriculture extension officers and an NGO project manager. The study found that although seasonal climate forecasts (SCFs) were increasingly becoming available, farmers continued to use indigenous knowledge (IK) forecasting techniques when choosing planting dates and cropping patterns. Elias, et al. (2014), found that most farmers did not adopt SCFs because they were unfamiliar and unable to interpret the forecast provided by the new technology. Farmers, particularly older ones, preferred IK because it was based on the observation of migratory patterns of birds', insect behavior, flowering of trees, wind direction and the solar system. Famers also perceived conventional information provided by SCFs as unreliable and untimely. Farmers also alleged IK was more trustworthy because it was centered on tradition. The study concluded that

farmers recognized reliability and accuracy of IK was limited by changing climate patterns that had affected their local indicators and lack of information and knowledge of SCFs was the biggest barrier to adoption.

Gender and technology adoption

Sociologists have argued that gender and the nature of a networks affects the actors' access to resources (see Bourdieu, 1984; 1986; Marsden, 1987; Doss & Morris, 2001; O'Brien & Patsiorkovsky, 2005; Quisumbing et al, 2014, 2015). Gender refers to the socially constructed roles, behaviors, and expectations of men and women in society (FAO, 2014). These roles are often defined by prevailing religious, ethnic, economic, cultural and ideological factors. Hence as learned characteristics, gender roles vary across cultures and change over time (FAO, 2017).

Women play a crucial role in agricultural production across the globe. Women in Africa alone make up between 60 to 80 percent of the labor force in the agricultural sector compared to women in Southeast Asia (50%) and Latin America (20%) (FAO, 2011; Palacios-Lopez, Christiaensen et al. 2017). The International Labor Organization (ILO, 2017), has noted that less than 50 percent of the women in the world participate in the formal work force.

A majority of the women in developing countries work on their own family farms, this is in contrast with worldwide trends. Compared to men, women often have lower levels of education, are more likely to earn lower wages and are also hindered by social norms that designate women's roles outside the formal work space FAO, 2014). A recently released Gallup and ILO study (March 2017), for

example, found that a majority (70%) of the women and men (66%) preferred that women work at paid jobs rather than stay at home and take care of the family. These findings were based on a sample of 148,724 adults from 142 countries who had been asked if they preferred women (a) worked paid jobs, (b) stayed home and took care of family, (c) worked paid jobs and took care of family.

Almost half (47%) of the men in Sub-Saharan sampled said that they preferred women in their households worked in paid jobs and took care of the family. Another 32 percent of the men said that they preferred women only worked in paid jobs. The remaining 19 percent of men said that they preferred women stayed at home to take care of the family alone. Although the majority of the women who were sampled said that they preferred to work in paid jobs, 34 percent of the remaining women said that they preferred to work in paid jobs and take care of their families.

Doss, et. al, (2017), alongside with other gender and development scholars have noted that even though women farmers are heavily involved in farming, many are less likely to adopt improved crop varieties or management systems. This is often because women often lack access to productive resources such as land, credit, fertilizers, and extension services (Quisumbing et al, 2014; de Brauw, 2015; Karamba & Winters, 2015; Kristjanson, et al, 2017). The *National Agricultural Census Data* compiled by the FAO (2017), Gender and Land Rights database shows less than 35 percent of women own agriculture land in southeast Africa. Only 23 percent women in Mozambique, 32 percent in Malawi, and 34 percent in

Botswana own land. Hence a significant gender gap exists between men and women's land ownership.

Kristjanson, et al, (2017); Nyasimi and Huyerm, (2017), Karamba and Winters (2015) among others have found that gender inequality and gender roles affect agricultural development. Women often lack opportunity to information and resources that might improve their productivity. As a result, their agricultural productivity levels range between four and 25 percent lower compared to men (Kristjanson, et al, (2017). In a study evaluating agricultural productivity differences among Malawi smallholder farmers, Karamba and Winters (2015) found that competing economic interests between men and women within the same household often led to differing crop choices. Women were more likely to choose crops that could be consumed at the household level while men preferred crops they could sell in the market. Hence differing gender roles of men and women led to differing crop choices.

Recent studies on information and communication technologies (ICT) have noted that the use of mobile phones could help mitigate poverty and minimize existing gender gaps. ICT refers to any technology that allows users to receive, process or send information which maybe in form of text, voice, or picture (Ajani, 2014). Given that many of the women often lack access to agricultural extension services that could provide information on improved technologies, ICT's such as mobile phones provide an alternative with which knowledge gaps between men and women could be addressed.

Social Networks

Social networks play an important role in institutionalization and maintenance of existing and emerging systems in South Africa (Deumert & Maitra, 2005). Social networks comprise a set of social actors over whom one or more social relation/s are defined (Wasserman & Faust, 1994). Social relations within a network might be defined or motivated by economic profits, political ideology, or social structures (Van der Hulst, 2009; Nagoli & Chiwona-Karltun, 2017). Regardless of the motivation, social ties among actors in a network are crucial determinants to a network's sustainability and success (Marsden, 1987, Wasserman & Faust, 1994; Schaefer, 2002; Van der Hulst, 2009).

Individuals can be argued to be are products of the social networks that prescribe direction and behavior (Bourdieu, 1984; Marsden, 1987; Wasserman & Faust, 1994). According to Bourdieu (1986), the existence of a network of connections is not a natural given but is constituted by an initial act of institution. Therefore, connections in a network are as a result of conscious and unconscious efforts executed by individuals for the purposes of reproducing social relationships that are directly usable in the short or long term.

Structural properties of networks- size, density and diversity- are important to sociologists and development scholars because they have been found to affect access to specific knowledge and resources shared among actors within the system (Marsden, 1987; Doreian & Conti, 2012). Network size measures coverage and can be defined by the number of connections in an interactive environment (Marsden, 1987). Network size can also be described by spatial structures and

physical terrain such as coastline, village location, a commodity, or policy (Doreian & Conti, 2012; Sevilla, 2013; Manfre & Nordehn, 2013). Network density measures strength of relationships between individuals in a network. Thus, relationships are described as strong or weak. Diversity within a network examine heterogeneity within a group (Marsden, 1987). The general idea behind diversity is based on similarity of actors: the more similar actors are to one another the lower the degree of diversity, the more diverse their characteristics the higher the degree of diversity.

Studies from East Africa have shown that social capital in rural villages is key to social networks development (deHaan, 2001; Mehta et al, 2011; O'Brien et al, 2013; Caudel, et al., 2015). Social capital comprises tangible and intangible assets. Examples of tangible assets include land, livestock, means of transportation, and housing structures among others. Intangible assets comprise, trust, shared knowledge, understanding and patterns of interactions that a group of people bring to any productive activity (Bourdieu, 1984; Haan, 2001; Seville, 2013).

In a study examining the role of social capital in group-based technology transfer and how useful it was for women, de Haan (2001) found that social capital consisted of networks that provided access to information, human capital, financial capital and other resources often difficult for individuals to access on their own. More recently, Caudell, et al., (2015) have also noted socio-cultural attributes such as clan membership, religious affiliation, friendships, wealth status, gender, and geographic location as social capital that influences one's ability to access credit within informal lending networks in rural Ethiopia.

According to de Haan (2001), groups provide a unique form of social capital that facilitates access to resources, knowledge, information dissemination, and opportunity for risk pooling. According to the study's findings, women did not have access to many resources like men did due to prevailing cultural norms, therefore the groups gave them access to new resources. On the downside, groups do not necessarily promote community cohesion when accessed primarily for resource attainment.

A more recent study by Mehta et al., (2011) examined the role of trust in social networks of rural women involved in various agriculturally related activities in Tanzania. The study, found that interpersonal relationships and loyalty were more important than financial gains. Most (70%) of the women valued long term relationships over business relationships. Mobile phone use and access to the technology was considered crucial to their business success. Angello (2015) has also found use of mobile phones among livestock farmers in Tanzania most important. According to Angello (2015), at least 94% of the surveyed livestock farmers used one type of ICT. The study also notes use of mobile phones was most common because farmers felt it made communication easier.

Manfre and Nordehn (2013) noted varied structural differences in networks accessed by men and women. The women's networks were smaller compared to those of the men and often had fewer opportunities for learning about new productive and entrepreneurial opportunities. Agricultural information from extension officers and input suppliers was also presumed to be more trustworthy and as a result, all farmers tended to rely heavily on a single source of information

in the value chain. Hence, even though social networks facilitated access to technology, they sometimes lacked information that could improve a member's productive strategies (Manfre & Nordehn, 2013).

The literature reviewed above suggests social networks accessed using social capital maybe closed or open. As a result, social capital provides bonding or bridging opportunities in social networks (O'Brien, 2005). Closed networks are often informal, dense, and homogenous. In closed networks, all members tend to know each other and have poor connections with others outside their group. In open networks, most members don't know each other, and the networks tend to be more formal, sparse, and diverse (O'Brien et al, 2013). As a result of the weak/ strong emotional connections among members in open/ closed networks, members are described as having strong or weak bonding ties respectively. Churches and farmers associations are examples of open networks with strong network ties because they allow members to access information outside their immediate group.

Social networks and agriculture development in rural Mozambique

Smallholder farmers access information through a complex web of social relations that include family members, other farmers, extension agents and input supply dealers (Manfre & Nordehn, 2013). Empirical studies on African smallholder farmers note that social networks facilitate access to information that affects household economic status (Valdivia & Gilles, 2001; Fafchamps, 2004; Sevilla, 2013; Smith & Findeis, 2013; O'Brien et al. 2013; Caudell et al, 2015). This is because social relationships link individuals directly or indirectly to others and

promote access to resources such as credit, insurance, social security, risk pooling, off-farm employment opportunity, and markets.

The study of social networks and effect on technology acceptance/adoption in Mozambique is not unique to this study. Bandiera and Rasul (2006) previously examined the role that social networks played in agriculture technology adoption decisions in Northern Mozambique. Following the introduction of sunflowers in the region by the NGO, *Movimondo*, the researchers' sought to examine the effect of social learning and amount of information that was available to farmers based on their social networks. The study found that the probability of farmers adopting new technology was dependent on their individual network size and farmer's characteristics. More specifically, the adoption rate of the new technology increased when there were few adopters in an individual's network and decreased when there were many adopters. Individual characteristics such as age, literacy and knowledge of technology also influenced adoption choices. Older and literate farmers with access to information on the new technology were considered less vulnerable and more likely to adopt sunflower farming compared to younger farmers. Finally, the farmer's friends and family were found to be the most influential reference group when it came to adoption of new technologies compared to religious groups.

In a much recent study, Sevilla (2013) examined the influence of social networks on economic behavior of agricultural households in rural Mozambique. Using household level survey data from eight villages located in Central and northern Mozambique, he examined (a) the role social networks played in labor

allocation and off farm work choices, and (b) the impact social networks had on marketing behavior of rural households. Sevilla (2013) found the main role of social networks as providing coping strategies when faced with market failure, economic hardships and poor agriculture productivity. The auxiliary role of social networks was based on employment opportunity and income diversification.

Contrary to Bandiera and Rasul's (2006) study which had shown network size as a significant predictor of technology adoption, Sevilla (2013) found network size was not a significant predictor to off-farm work. Instead, the type of network accessed– kin or friendship- influenced access to off-farm employment opportunities and marketing behavior. Men with large kin networks were more likely to gain access to off-farm work opportunities compared to women. Women accessing off-farm work employment gained access through their friendship networks.

Contrary to previous studies in the region by de Haan (2001), O'Brien et al., (2013) and Caudell et al.(2015) that have presented social capital as positive and providing opportunity for economic diversification, Sevilla's (2013) findings are mixed. Large kin networks were found to have a positive effect on marketing behaviors of households while large friendship networks had a negative effect. More specifically, households with large friendship networks were less likely to participate in sale of maize, beans or other crops compared to those that had larger kin networks. As a result of these mixed findings, Sevilla's (2013) like Di Falco and Bulte (2011, 2015) suggest we consider the dark side of social capital.

Sevilla's (2013) study found that kin networks in rural Mozambique had diverse socio-demographic characteristics. For example, more educated women were less likely to participate in off-farm work and depended less on low wage jobs compared to lower educated women. Likewise, the probability of men working off-farm increased with higher levels of education. Social characteristics such as age and health status of the decision-makers were also found to be significant predictors for off-farm work and participation in selling of maize. Unknown however from this study are the structural characteristics of the networks men and women accessed for off-farm employment opportunities and agricultural markets. Building on Sevilla's research and others highlighted in this chapter, the following chapter presents the theoretical framework and study hypothesis examined in the study.

CHAPTER 3: THEORY AND RESEARCH METHOD

This chapter describes the theoretical framework, methods, hypothesis and variables adopted for the study. The first section presents the theoretical framework and study hypotheses that were adopted for this study. The second section describes the research design and survey instruments utilized in the collection of study data. The third section describes the study variables and analysis technique adopted to test the study hypothesis.

Theoretical framework: Social Networks and Diffusion of Innovations theory

There has been a growing interest on types of social networks smallholder farmers in Sub-Saharan Africa access for agricultural information and technology development (see Fafchamps and Minten 2001, Bandiera and Rasul 2006, Spielman, Davis et al. 2011, Thuo, Bell et al. 2014, Boogaard, Waithanji et al. 2015, Dawa and Namatovu 2015, Mtega, Ngoepe et al. 2016, Bandewar, Wambugu et al. 2017, Hermans, Sartas et al. 2017). However, knowledge on the structural characteristics of these networks is yet to be fully understood.

Following Bandiera and Rasaul (2006) study on the types of social networks that facilitate agricultural technology adoption, this study uses social networks and diffusion of innovations theory to examine structural characteristics of networks that facilitate uptake of soybeans (agricultural innovations) among smallholder farmers in rural Mozambique. Soybeans are not native to Africa and have been introduced in Mozambique as both a cash crop and food crop aimed at addressing food security concerns, reducing poverty and improving the declining soil fertility within the region.

The social networks and diffusion of innovations theory combines social network analysis and diffusion of innovations theory (Prell, 2012). Social network analysis (SNA) is a theoretical and methodological paradigm that allows us to study and understand complex social structures (Van der Hulst 2009, Valente, Chu et al. 2015). In other words, SNA provides us with a group of theories, tools and techniques through which we can detect and interpret patterns of human behavior, social interactions (ties), benefits and/ or limitations resulting from the social interactions (Van der Hulst 2009, Valente, Dyal et al. 2015, Valente, Palinkas et al. 2015). The diffusion of innovations theory provides the sociological concepts used to measure adoption/ uptake of an innovation (Valente 1996, Wipfli, et al, 2010; Valente, Chu et al. 2015).

Social network analysis (SNA) is a transdisciplinary method that combines social, physical and biological sciences to examine relationships between individuals, groups, social institutions and/ or organizations (Valente, Palinkas et al. 2015). Therefore, it uses empirical data to examine what elements connect people to others. SNA borrows from the physical sciences the arithmetic techniques to analyze relational patterns and connections of actors within a network. It also uses algorithms and draws heavily on graphic imagery. SNA borrows from the social and biological sciences knowledge on measures of Centrality/ influence for power, which allows us to identify characteristics of network activity, social roles, and positions of actors within a network. Therefore, SNA provides a means through which we can examine how an innovation gets transferred through a network and how individuals are influenced by their network

to adopt or reject an innovation (Valente 1996, Van der Hulst 2009, Fujimoto and Valente 2012, Schneider, Zhou et al. 2015, Valente, Chu et al. 2015, Valente, Dyal et al. 2015).

Social network theory is based on a framework that assumes network structures affect access to specific knowledge/ information shared among actors within the system (Bourdieu 1984). Connections within networks might be conscious or unconscious efforts executed by individuals for the purposes of reproducing social relationships that are directly usable in the short or long-term (Bourdieu 1984, Wasserman and Faust 1994). Social networks in Sub-Saharan Africa serve a variety of purposes such as enabling information flow, smoothing consumption needs, risk pooling, accessing labor resources, expediting access to credit and new agricultural technologies among others (Fafchamps, 2003; Bandiera & Rasul,2006; Van Den Broeck & Dercon, 2008; Seville, 2013). Thus, connections among African smallholder farmers allow them access to resources and information (Olopade, 2014; Caudel, et al., 2015; Nagoli and Chiwona-Karltun, 2017).

Rogers (2010) defines diffusion as the process by which an innovation is communicated through a channel over time and in within a social system. An innovation maybe an idea, behavior, object or practice perceived as new by individuals or adopters the first time they discover it. According to Rogers (2010), the development of hybrid corn in the late 1920's has been credited to the development and study of agricultural innovations today. Improved seed, mechanization and farm management systems comprise examples of modern day

innovations in agricultural development that have led to improved yields, income and quality of lives as farmers are able to produce more and earn more due to improved quantities and quality of grain. Regardless of these benefits, farmers don't adopt these novelties blindly. Instead, they go through a process that allows them to evaluate the costs and trade-off of the technology. These costs could be direct or indirect, desirable or undesirable, anticipated or unanticipated to an individual or an existing social system (Rogers, 2010). Hence because of varying personal characteristics, relationships and knowledge of an innovation, adoption rates vary across society.

According to Rogers (2010), adoption of an innovation is influenced by four elements: the characteristics of the innovation, the communication channels by which it is transmitted through, time, and the social system. The characteristics of an innovation include the innovation's perceived costs and benefits, a person's familiarity with the innovation, the perceived difficulty of use, trial-ability, and compatibility with the pre-existing social, economic, and environmental systems (Elia et al, 2014). Communication channels include face to face contact, radio, mobile phones and television advertisements among others. The time element refers to the period, stage or phase within which an innovation becomes widely adopted and successfully self-sustaining Social systems consist of prevailing culture, social networks and independent units such as relatives and community organizations involved in joint problem-solving to fulfill a common goal (Rogers 2010).

Diffusion manifests itself in different phases across different groups, cultures and fields (Rogers, 2010). Therefore, adopters are often classified into one of the five categories: innovators, early adopters, early majority, late majority, and laggards. The innovators comprise the smallest category (2.5%) followed by early adopters (13.5%), early majority (34%), late majority (34%), and laggards (16%) (Rogers, 2010).

Innovations often present private versus public outcomes. Private consequences are often described as micro-level consequences that are localized due to their geographic proximity, interpersonal relations, communication channels and pressure of social networks within which the innovation exists (Wejnert, 2002). Examples of these are rural development programs and women empowerment programs that promote women participation in entrepreneurial opportunities. Public consequences on the other hand may include malnutrition campaigns or soil conservation practices that promote social and environmental wellbeing respectively.

Valente (1995), Wejnert (2002) and Valente et al. (2015) have argued that adoption of innovations is influenced by the way information flows from the innovation source to the adaptor. Therefore, interpersonal relations, social status, geographic location, pressure of social networks, and communication channels accessed play an important role in diffusion. Individuals often considered as master farmers in the village are often noted as influencing agricultural technology adoption because they are often willing to engage with extension officers and

programs that introduce new crop varieties and farming practices using their farm (Olopade, 2014).

For many poor African farmers, adoption of a new crop such as soybean in lieu of a traditional crop like maize constitutes a unique trade-off. This is because adoption of a new crop might mean planting less of the traditional maize crop when land, labor and other limited resources are allocated to the new crop. On the other hand, a trade-off might not only be in the amount of land available for maize or quantity of maize foregone by allocating resources to a new crop, but the possible increase in maize yields because of the nitrogen fixing bacteria found in the soybean roots. Hence, people decide on whether to adopt or not adopt a technology based on its nature, its perceived characteristics, their previous, and newly acquired knowledge on the technology, and the conviction they have on the innovation (Rogers, 2010; Hamukwala, et al, 2012; Elias, et al, 2014).

Study Hypotheses

Much of our daily activities, employment, and relationships are influenced by others in our social networks. These Social networks are comprised of a series of relationships that link individuals directly to others within their circle and indirectly to those outside their circle of connection (Knoke and Yang 2008). The nature of these connections may be motivated by an institution such as family, church, school; location, time, event or personal characteristics such as gender (Granovetta, 1973, 1983; Marsden, 1987; Schaefer, 2002; Jackson, 2008; Easley and Kleinberg, 2010, Quisumbing, Meinzen-Dick et al. 2014). Hence, the networks are a product of investment strategies that result from individuals' effort to

consciously or unconsciously creating connections with others that provide short or long-term benefits (Brinton & Nee, 2001).

Social network and diffusion of innovations theory has been extensively adopted in numerous public health studies, see (Valente and Fosados 2006, Fujimoto and Valente 2012, Prell 2012, Schneider, Zhou et al. 2015, Valente, Dyal et al. 2015, Valente, Palinkas et al. 2015). Despite increased research, Rogers (2010), Valente and Fosados (2006),and Valente (2015) have argued there is limited research on the nature of social systems that determine the rate of technology adoption. Therefore, this study extends research on the nature of these social systems by examining the structural characteristics of smallholder farmer networks in rural Mozambique.

Hypothesis I

Agricultural development literature on Sub-Saharan Africa notes that lack of information slows development and promotes poverty among smallholder farmers. Olopade (2014) has widely argued that asymmetry of information witnessed across many African counties is a consequence of market failure (such as access to improved seed and commodity markets), and weak institutions, (e.g. limited agriculture extension services). Asymmetry of information in this case refers to lack of information, inconsistent or contrasting production or market information (Nakasone et al, 2014). Faced with poor public institutions and market information, many of the African smallholder farmers rely on social networks as an alternative through which information sharing and economic development occurs.

Previously, Bandiera and Rasul (2006) had suggested that farmer networks provided Mozambican farmers opportunity for social learning that in turn promoted technology adoption. Van de Broeck and Dercon's (2011) seminal study on Tanzanian banana farmers also found that the farmer's proximity to information sources determined the pace of attitudinal change and the speed by which an agricultural innovation (new banana varieties) were adopted. Building on Van de Broeck and Dercon's (2011) research which showed social networks had a positive effect on banana output, this study hypothesized that households with decision-makers who consulted agricultural extension officers or belonged to agricultural groups have increased opportunity of obtaining information and resources that promote their participation in soybean farming. Therefore:

H_1: Households with decision-makers who participate have access to extension services or agricultural groups will be more likely to participate in soybean farming.

Hypothesis II

International development scholars and network scholars have illuminated the important role social networks play in acquiring and multiplying social capital (see Coleman, 2008; Putnam, 1995; Easley & Kleinberge, 2010; Wasserman & Faust,1994; de Haan, 2001; Fafchamps, 2003; Van der Hulst, 2009, Meinz-Dick et al., 2014; Caudell,et al., 2015). Bourdieu (1984) and Roseland (2012) among others, have argued that social capital is often culturally specific and not analogous to physical capital such as land. Participation in agriculture groups, for example provides members with bonding and bridging capital such as trust, which allows

them access to assets, information, trust and even market opportunities (O'Brien, Phillips and Patsiorkovsky, 2005).

De Haan (2001) found that social capital among rural Tanzania women consisted of networks that provided access to information, human capital and financial capital. In a later study on East African dairy farmers, O'Brien et al (2013) similarly noted that participation in farmers associations and other forms of collective action organizations had a positive effect on household income. More recently, Karamba and Winters (2015) have suggested that access to productive land, credit, technical information and other farm resources are not the primary cause of gender driven inefficiencies in agriculture, but instead lack of access to non-labor inputs such as technology information and training. Building on O'Brien et al (2013) it is hypothesized that

H_2: Decision-makers who have diverse information networks or weak ties will be more likely to uptake soybeans.

Hypothesis III

Bandiera and Rasul (2006), study on agricultural technology adoption in Northern Mozambique found a positive relationship between agricultural technology adoption and large kin and friendship networks. According to their study, farmers who had access to more relatives and friends had increased access to information and knowledge on the new technology and were therefore more willing to adopt. Van de Broeck and Dercon's (2011) study on agricultural technology adoption behavior in Tanzania found a positive relationship between technology adoption and village kin networks. According to their study, the

adoption of the new agricultural innovation was facilitated by the size of kin and friendship networks within the village that facilitated faster transfer of information.

Most recently, Sevilla (2013) found mixed results on the effect of kin and friendship networks on off-farm labor participation and marketing behavior among men and women in six villages located in the Northeast, Northwest and Central Mozambique. According to Sevilla (2013) large friendship networks provided women access to off-farm employment opportunities but hindered their participation in the marketing of agricultural produce. The study also found that, larger kin networks reduced the probability of women's off-farm employment but increased men's access to off-farm employment. Building on Sevilla's (2013) study, this research hypothesized that:

H_3: Households with female decision-makers will:

i) be more likely to uptake soybeans because they will have diverse kin and friendship networks that facilitate access to soybean seed and information; and

ii) likely have more weak ties because of their diverse information networks that will facilitate soybean uptake.

Research Design & Method

Methodologically, this study employed household level survey data to estimate the effect of social networks on soybean uptake among smallholder farmers rural Mozambique. This was preceded by analysis of secondary data, focus group interviews, community mapping exercises and field visits to understand the local environment and were necessary for the development of the

survey instruments used to collect the quantitative data that was used in this study. Quantitative analysis techniques (logistic regression and social network analysis) and qualitative analysis were employed in this study (Creswell, 2003; Greene, 2007).

The survey data used in this study was collected in two phases over a period of three years starting in August 2014 by researchers from the *Feed the Future Innovation Lab for Soybean Value Chain Research* (SIL) and Feed the *Future Innovation Lab for Climate-Resilient Beans* (CRIB). The first phase of data collection utilized the Mozambique Women's Empowerment in Agriculture Index-plus (WEAI$^+$) survey to collect macro-level survey data from nine study villages located in the provinces of Manica, Angonia, Tete, Zambezia and Niassa. The second phase utilized the Network Pilot Survey (NPS), and Mozambique Soybean Uptake & Network Survey wave I (SUNS) to collect micro-level survey data from two study villages located in Manica province. The two study villages surveyed in the second phase had been previously surveyed in the first phase using WEAI$^+$.

Sampling and data collection

Both men and women aged 18 years and older who were identified as the primary decision-makers in their households were interviewed. The decision-makers had varying marital statuses, educational attainment and were residents of the surveyed villages. A random sampling technique was used in selecting households that were surveyed using the Mozambique WEAI$^+$ and Mozambique SUNS. The focus group participants comprised of self-appointed individuals identified by the local chief, IIAM agricultural technician and the Ministry of

Agriculture and Food Security (MASA) extension officers. The NPS collected survey data from all households in Manica village 4 and Manica village 5.

Google Earth maps were used to identify the study villages and households in the study. Using (4 x 2) feet printed maps, we made sure all the households within the village were numbered with the help of the IIAM agricultural extension officers who lived and worked in the village (see images of study villages on appendix B- image B1 and image B2). All survey instruments and protocols adopted in this study were approved by the University of Missouri Institutional Review Board (IRB). The studies were funded by the United States Agency for International Development (USAID) - *Feed the Future Innovation Lab for Soybean Value Chain Research* (SIL) and *Feed the Future Innovation Lab for Climate-Resilient Beans* (CRIB). Survey data from each identified household was collected by a male and a female interviewer, both of whom were fluent in Portuguese and the local languages.

To ensure that participants were ethically protected and felt free to participate in the interviews, women and men were interviewed separately by an enumerator of the same sex. Female enumerators took female participants to a private room or place for the interview and vice versa and obtained consent before collecting any information. The focus group discussions were held in a community designated public meeting space. Circle seating was used to ensure that all participants were heard. Although there was no perceived risk (nothing out of the ordinary), every reasonable measure to protect participant privacy was taken by the researcher/s. There were no direct monetary gifts or in-kind gifts provided to

the study participants. However, information obtained from the study is expected to help facilitate seed policy development and knowledge on agriculture technology diffusion networks within rural Mozambique.

Both male and female survey enumerators were trained by the research teams from the University of Missouri, Mississippi State University[7], and IIAM. Enumerator training took place in May 2014 and May 2016 in Chimoio, Mozambique. Each team member passed the Human Subjects Research online course offered by the Collaborative Institutional Training Initiative (CITI) Program. Enumerators who spoke and understand the local dialects were chosen to form the team that surveyed the nine villages in this study. A single team of enumerators was used across all villages to increase consistency in survey enumeration and data recorded. Since the study participants may have had concerns about sharing personal information with local surveyors whom they know, enumerators from outside the nine villages were employed to conduct the interviews.

[7] Facilitated only WEAI^{+} training in 2014.

Instruments

This study employed both quantitative and qualitative research instruments. The quantitative instruments include, the Mozambique Women's Empowerment in Agriculture Index-plus (WEAI^{+}), Mozambique Soybean Uptake & Network Survey (SUNS), and the Network Pilot Survey (NPS). Qualitative survey instruments comprise focus group discussions (FGDs) and the researcher's field notes. The following section describes each of these instruments.

Mozambique Women's Empowerment in Agriculture Index-plus (WEAI^{+})

This study adopted the Mozambique WEAI^{+} survey instrument that was designed as a multi-country survey instrument by researchers at the University of Mississippi in collaboration with the University of Missouri, the Agricultural Research Institute of Mozambique (IIAM), and Catholic Research Services (CRS) in Ghana. WEAI^{+} was originally developed in English and later translated into Portuguese for Mozambique. WEAI^{+} was designed using the Feed the Future *Women's Empowerment in Agriculture Index* (WEAI) and included questions on soybean farming and access to soybean seed.

WEAI is a multidimensional tool designed to examine women's empowerment, agency and inclusion in agriculture (Alkire, Meinzen-Dick et al. 2013, Malapit and Quisumbing 2015). WEAI was developed by the International Food Policy Research Institute (IFPRI) and Oxford Poverty and Human Development Initiative as a monitoring and evaluation tool for Feed the Future programs (FTF). WEAI collects survey data from women and men in the same

household so as to compare their state of empowerment and gender parity (Alkire, Meinzen-Dick et al. 2013). The WEAI comprises of two sub-indexes: the five domains of empowerment (5DE) and the gender parity (GPI). The 5DE examines the degree to which women are empowered in (i) agricultural production decision-making, (ii) own or have access to productive resources, (iii) control over use of income, (iv) participate in leadership roles within their community[8], and (v) time allocated to work and leisure (Malapit and Quisumbing 2015). For the purposes of this study, the 5DE and GPI were not calculated. Instead, questions based on the five domains of empowerment (5DE) were adopted to test women's participation in soybean farming and technology uptake.

The WEAI^{+} was comprised of 22 modules which compared men's and women's participation in agriculture production, asset ownership, control and decision-making, specifically, income use, participation in soybean production, consumption and marketing of soybeans (see instrument in appendix B1). For the purposes of this study, only 10 of the 22 modules in WEAI^{+} were used. Table 3.1 lists the modules that were adopted by this study and defines the types of information collected under each of the modules.

[8] WEAI uses household level survey data to evaluate program, regional, and country empowerment scores. Hence survey data used to calculate empowerment scores must be regionally representative.

Table 3.1: WEAI+ modules adopted by the soybean uptake study

Module A	Decision-makers demographic information
Module C.1	Household demographics
Module E.1	Participation in household decision-making
Module F.1	Access to productive assets
Module F.2	Access to social capital and credit
Module G	Access to extension (agriculture/livestock/fisheries)
Module H.1	Individual leadership and influence in the community
Module H.2	Group membership
Module K.1	Soybean and other seed access
Module K.2	Soybean cultivation

Mozambique Soybean Uptake & Network Survey wave I

The *Soybean Uptake & Network Survey* wave I (SUNS) was designed by researchers at the University of Missouri in collaboration with IIAM, University of Mississippi and CRS-Ghana. Similar to the WEAI^{+}, the SUNS is a multi-country survey instrument that was first designed in English and later translated into Portuguese for Mozambique. The SUNS collected survey data from a random sample of men and women who identified as the primary decision makers of the household.

The SUNS was comprised of 17 modules that collected information on the types of crops cultivated for household consumption and market, knowledge on soybean cultivation, participation in farmers' association groups, receipt and disposition of free soybean seed, seed sharing networks, sources of information, and household income. For the purposes of this study, only 10 of the 17 modules in SUNS were utilized in estimating the models. Table 3.2 lists the SUNS modules

that were adopted by this study and defines the types of information collected by each module (see complete instrument in appendix B2).

Table 3.2: SUNS modules adopted by the soybean uptake study

Module A	Household demographics
Module B	Crops grown by Household to eat in the last year
Module C	Crops grown by Household to sell in the last year
Module D	Self-Knowledge of soybean cultivation & soybean markets
Module E	Farmers Association
Module F	Soybean cultivation
Module I	Receipt & disposition of free soybean seed in the past 24 months
Module N	Sources of household income over the last 12 months
Module O	Influencers –Social network
Module Q	Sources of Information

Network Pilot Survey

The Network Pilot Survey (NPS) was designed by the researcher to collect sociometric data from the two Manica villages that were used to study structural characteristics of farmer networks. The NPS was designed to gather three primary forms of information: (i) the existing social and agriculture networks present in the village/s (ii) identify the role social networks play in development of soybean value chains in rural Mozambique, (iii) identify the types of seed sharing and trade networks that exist inside and outside the village.

To capture the relevant information on types of kin and friendship networks in the village, the respondents were first asked to identify where all their relatives and friends in the village lived based on printed and coded village maps (see

Appendix B1 and B2). To capture information on existing agricultural networks, the respondents were asked to identify who people in the village usually consulted for various agricultural information; whom they consulted for agricultural information and inputs as well as whom they had shared, sold or traded seeds with over the last five years. Third, the respondents were asked to identify all the individuals they consulted on agricultural practices, seed, farm inputs, soybeans and agricultural market information. Information including the gender of the person consulted, type of relationship shared, length of time known, as well as how close one felt to the individual consulted on the various occasions was recorded. This information allowed the researcher to visualize the types of networks that were present in the village, network characteristics such as size, density, multiplexity (a whether relationships were of, a single type, or multiple relations between two actors).

Table 3.3: NPS modules adopted for the soybean uptake study

Module 1	Socio demographic information
Module 2	Information and sharing networks
Module 3	Ego networks and Network ties
Module 4	Community groups
Module 5	Subjective wellbeing
Module 6	Cultural awareness

Research journal & focus groups discussion notes

Starting March 2015, the researcher kept an extensive travel and research journal in which field observations, informal face to face interviews and conversations with IIAM researchers, agriculture extension officers, community

members, the United States Department of Agriculture (USDA) Foreign Agricultural Services (FAS) officer, soybean processor and commercial poultry farmers were recorded. Trip reports, field pictures and google maps compiled during the study period are considered part of the research journal and used in describing and visualizing survey data and networks identified by the study.

Notes from focus group discussions (FGDs) are used in the interpretation and discussion of the logistic regressions output. The FGDs were designed by the researcher and a public health specialist at the Health Communication Research Center at the Missouri School of Journalism. The primary goal of the FGDs had been to learn about the attitudes, preferences, practices, and resource networks of rural farmers in rural Mozambique; by exploring issues related to farming common beans and soybeans. The secondary goals were to identify agricultural development information gaps, understand attitudes and behaviors towards soybeans and common beans as food and income generators among smallholder farmers.

Focus groups discussions provide multiple advantages (Jakobsen 2012, Nagle and Williams 2013). Among these, FGDs facilitate conversation, questioning, challenging and answering among participants (Jakobsen 2012) FGDs provide an opportunity for group interaction between members of the target population that allows the researcher to capture a deeper and more meaningful understanding of the phenomena under investigation capture non-verbal communication and explore unmapped terrain such as taste preferences between men and women in rural Africa (Jakobsen 2012). Compared to quantitative

surveys, FGDs are economical because they allow one to collect a large amount of data from multiple respondents at the same time and with a limited budget (Creswell and Clark 2007).

The FGDs were led by researchers from the University of Missouri and the Social Economic Division of IIAM, all working with SIL and CRIB. The focus group interviews were approved by the Institutional Review Board (IRB) at the University of Missouri in advance of the fieldwork. The FGDs participants comprised individuals who had volunteered themselves, been recruited by the IIAM agricultural extension officer, and those nominated by the traditional chief. The recruitment method employed allowed us to increase participant ownership on the research process and deCentralized the role[9] of the researchers and local authority. Given the low literacy rates within the study villages, FGDs were translated from English to Portuguese and the local language. Following Boogaard, Waithanji et al. (2015) study that noted gendered differences in Mozambican asset ownership and farming knowledge, the groups were segmented by gender and geographic location. Discussions lasted approximately 60-75 minutes and responses were recorded verbatim using pen and paper. The transcribed notes were later converted into word documents using Microsoft Word, combined and all duplicate sentences removed for coding and qualitative analysis.

[9] Jakobsen (2012) noted validity and reliability of focus group discussions particularly in Africa is often due to power relations. He also reminded researchers who assume the Central role in FGD to allow participants to re-phrase and ask the questions in their own words. This would ensure they did not impose their own meaning.

Data analysis

The researcher used logistic regression/ logit models to estimate the likelihood of soybean uptake among smallholder farmers. This was necessary because most of the adopted independent variables were categorical or ordinal in nature (Gordon 2015). Also, *soybean uptake* (the dependent variable) was measured as a binary outcome (planted soybean/ did not plant soybean). The coefficients obtained from the logit/ logistic models were evaluated using the Wald test (Z-test) scores at p-value 99.99% (α=0.001), 95% (α=0.05) and 90% (α=0.10).

Microsoft Excel 2010/ 2013/ 2016, Statistical Package for the Social Science (SPSS), Stata/SE (special edition) and NodeXL Pro were used in recording, cleaning, coding, and analysis of data. The SPSS software used was developed by IBM Corporation and has been broadly used in social sciences to conduct statistical analysis, text analytics, reporting, and manage data. Stata is developed by STATACorp as a general purpose statistical software package for the purposes of data management, statistical analysis and is also widely used by social scientist for statistical analysis (Rabe-Hesketh and Everitt 2003). There are no technical differences between SPSS and STATA/ SE, however the researcher found it more convenient to uses SPSS for data cleaning and STATA for data analysis. NodeXL Pro is an advanced network analysis and visualization software package for Microsoft Excel 2007/ 2010/ 2013/ 2016 (Smith, Shneiderman et al. 2009, Hansen, Shneiderman et al. 2011). NodeXL Pro is developed as an add-on feature for Microsoft and works similar to UCINet, R, Pajek and Gephi, all commonly used in social network analysis.

This study used two types of network data (one-mode or two-mode) in the SNA techniques adopted. The one-mode data adopted was based on “ego network data” which was based on a single set (individual) information on how actors were tied to one another. Household numbers of all relatives residing in the same village are an example of one-mode network data. Two-mode networks deal with two sets of data and examine how actors are affiliated (tied) to an event. Data collected on sources of information, events e.g. participation in farmer field days/ schools, demonstration plot all comprise examples of two mode-data. This study used two-mode networks instead of one-mode network to examine the network structural characteristics of households that up took soybean.

The network data used in this study was first coded using Microsoft Excel software and then exported to NodeXL (an add-on feature in Excel), and UCINET for modeling. The NodeXL and UCINET allowed the researcher to generate network graphics as well as obtain measures of Centrality, visualize inter and intra-village networks, bridging ties and other network structural characteristics. For the purposes of this study, all households and contacts identified outside the map were coded as 999 or “off map”. Missing links/ connections within the matrix were coded as 0 (zero) and all connections as 1(one).

This study also used qualitative data analysis technique based on deductive content analysis were used in analyzing qualitative data obtained from focus groups discussions (FGD), field notes, google maps, pictures, information obtained from websites and peer reviewed journal articles used in development of this study. Deductive content analysis approach was chosen because it allowed

for subjective interpretation of text data through a systematic classification process of coding and identifying themes based on the theoretical framework adopted (Moretti et al. 2011; Debzub & Lincoln, 2005). To establish trustworthiness and transferability of information obtained from the FGDs and meetings, triangulation of qualitative data and emailed discussion notes between the researcher, other SIL and CRIB researchers and people contacted were contacted to ensure the correct information was captured.

Study variables

This study adopted three broad categories of independent variables: sociodemographic variables, productive capital variables, and social network variables to examine soybean uptake. The following section describes the study variables adopted in this study.

Soybean uptake

This study adopted "*soybean uptake"* as the dependent variable. The soybean uptake variable is a binary variable coded as either 1 (uptake) or 0 (no uptake). For the purposes of this study soybean uptake is estimated based on if individuals planted soybeans.

Sociodemographic data

This category of independent variables comprised individual and household characteristics. Individual characteristics included information on gender, age, education, reported marital status, ability to speak Portuguese, ethnicity and

religion. Household characteristics included, type of household, size of household, age of household members, village, region and the main religion of household.

Female

This was a binary variable based on the respondent's sex. For the purposes of this study, all female decision-makers interviewed were coded 1 and men as 0 (zero)

Agricultural development and gender scholars have argued that women are often disadvantaged when it comes to adopting new technologies and practices due to prevailing cultural norms (Doss,2001; Meinzen-Dick et al, 2011;, *de* Brauw, 2015). Women often have lower level of education, have limited access to land, credit and access to market compared to men. Based on this knowledge, the study hypothesize there would be negative relationship between females and soybean uptake.

Age

Is an interval measure based on the reported decision-maker's age (number of years). To estimate the effect of age on technology uptake the variable "age" was used to construct two other variables- "age-squared" and "age-categories". The age-squared variable was a covariate (explanatory variable) based on the square of age. The age-category variable was a categorical variable based on six age cohorts (18-25yrs, 26-34 yrs., 35-43 yrs., 44-52 yrs., 53-61 yrs., and 62-99 yrs.). By adopting age, age-squared and age-category, the researcher was able

to test the type of relationship age had with soybean uptake. The study hypothesized (i) a curvilinear relationship between age of decision-maker and soybean uptake; and (ii) a positive relationship between age, size of network size and soybean uptake.

Education

This is an ordinal measure associated with the highest level of education attained. The respondent's level of education was coded as one of the following seven: *no school, primary, secondary, college, vocational school, technical school, and other*. For the purposes of this study, the education variable was re-coded into four categories: *no formal education = 0; Primary education =1, Secondary education =2, and College & Other formal education*[10] *= 3.* Those who had not completed any years of formal school were coded as zero while those who had completed some secondary education were coded as "2" and so forth. Based on the literature reviewed, this study hypothesized that there would be a positive relationship between education and soybean uptake. In other words, individuals who had obtained at least primary level education would be involved in soybean farming.

[10] Since there were very few respondents who identified as having attained some college level or vocational education training, we choose to recode all those who had obtained college, vocational, technical and other forms of formal education as one category to ensure we did not lose any observations during the statistical analysis.

Marital status

This is a nominal variable based on the respondent's reported marital status. Based on the various survey instruments, the respondents had identified themselves as either: married, separated, divorced, never married or widow/ed. For the purposes of this study, marital status was recoded into a binary variable (1=married, and 0= not married). All those who had identified themselves as either separated, divorced, never married or widow/ed were coded as not married. Based on Nysaimi & Huyer (2017), *de* Brauw's (2015) and Sevilla's (2013) studies that suggested women alone were more likely to report lower agricultural productivity or participate in new agricultural technologies, this study hypothesized that there would be a positive relationship between marital status and soybean uptake.

Ability to speak Portuguese

This is a binary variable based on the respondent's reported ability to speak Portuguese. Portuguese is Mozambique's national language and therefore the preferred language for market/trade. Based on our surveys, respondents had identified themselves as either able or not able to speak Portuguese. Based on these responses, *ability to speak Portuguese* was recoded as either Yes = 1 or No = 0. Based on the literature reviewed, this study hypothesized there would be a positive relationship between one's ability to speak Portuguese participate in soybean uptake.

Ethnicity

This is a nominal variable based on the respondent's identified ethnic group. The WEAI+ survey had asked respondents to identify themselves based on one of the seven provided categories: Yao, Njanja, Lomue, Macua, Chechewa, Shona, Chiute or Other. Recognizing that most African tribes tend to be location specific, this variable was useful in testing the effect of ethnicity on soybean uptake. Benzer, et al. (2007) and Parr (2014) have suggested smallholder farmers in northern Malawi as successful soybean farmers. This success was a result of community based Soil Food and Healthy Communities program (SFHC), which provides smallholder farmers extensive training and resources that promoted soybean production and market development opportunities applicable to their communities. Based on this evidence, this study hypothesized that individuals who identified with ethnic groups in the north (Yao, Njanja, Lomue, Macua) would be more likely (+) to participate in soybean farming compared to those who identified as Chechewa, Shona and others (see maps on Mozambique's administrative boundaries, linguistic and ethnic groups in Appendix A1 and A2). In other words, ethnicity was expected to have mixed results (+/-) on soybean uptake.

Type of household

This is a nominal variable based on the reported type of household. Survey data obtained identified respondent's households as either a married / dual couple, "female-headed type of household, or male-headed only type of household. Gender scholars such as Doss (2001) have suggested that agricultural technology adoption projects consider examining household systems (male versus female-

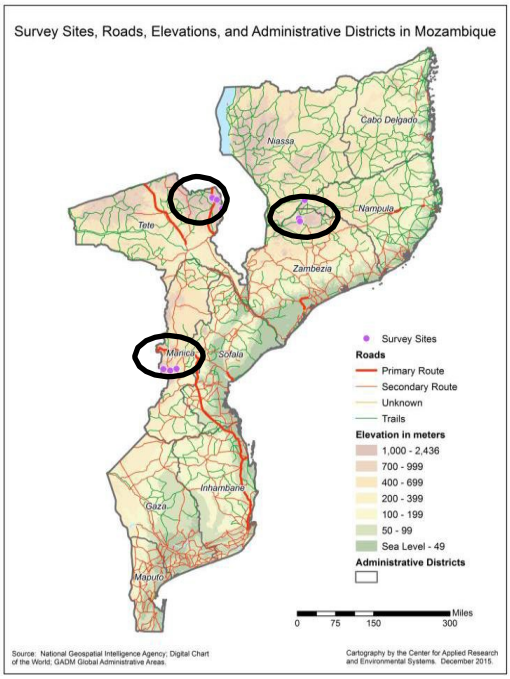
headed households) separately when assessing agricultural technology adoption because gender dynamics often affect adoption. Similarly, Malapit and Quisumbing (2015), Quisumbing, Rubin et al. (2015) have suggested that female-only households are often poor, lack access to productive resources and social status that might improve their participation in improved agricultural activities. Karamba and Winters (2015) have also suggested that men in Malawi tend to allocate their wives and children as labor on their plots. Therefore, based on this knowledge, households with married couples were hypothesized to have a positive (+) relationship with soybean uptake.

Location

Region/village

This is a nominal variable derived from the surveyed household's geographic location and district. The WEAI+ baseline survey (2014-2015) collected data from nine villages (see Figure 3.1) located within five districts (Sussundenga, Angonia Gurue, Lichinga, and Malema). These five districts were grouped according to Mozambique's designated national administrative provinces of; Manica, Tete, Nampula, and Zambezia (see Appendix A Figure A1). The provinces were further collapsed into three regions: Central,

Figure 3.1: Figure 3.1: Location of nine study villages



Northeast, and Northwest, based on their geographic location in respect to the country as illustrated in figure 3.2.

Figure 3.2: Regional variable used in study based on province and district

Household in the Northwest region, close to Malawi were expected to participate more in soybean farming compared to those in the Central region and Northeast region. IITA has been noted as promoting soybean farming within the Northeast and Northwest region of Mozambique (TechnoServe is only involved in the Northeast region). Based on this knowledge, the study hypothesized there would be a positive relationship between households in the Northwest region and a negative relationship between households in the Central and Northeast region.

Productive capital

Household labor index

This is an interval measure based on a weighted labor potential for each household member. The household labor index is based on the number of reported persons residing within a household and is useful in evaluating income and income inequality among rural households. O'Brien and Pat͡siorkovskiĭ (2006) described household members as a form of human capital embedded in social

capital. As such a large sized rural household is expected to contribute more towards agricultural production.

The household labor index used in this study ranges from zero to one (0-1) and is estimated using both the number of people in a household and their age. Household members aged less than eight years and more than 80 years of age were assigned a weight of zero (0). Those aged eight to 11 years and 75 to 79 years, 0.25; those aged 12 to14 years and 71 to74 years, 0.5; those aged 15 to16 years and 66 to 70 years, 0.75; and those aged 17 to 65 years, 1. Similar to O'Brien and Patsiorkovskiĭ (2006) this study hypothesizes a positive (+) relationship between size of household and soybean uptake.

Decision-making on input use

This is an ordinal measure variable based on the decision-maker's reported level of participation in food crop and cash crop farming. Survey respondents who had participated in food crop and/ or cash crop farming in the immediate past cropping season were asked to rank their level of participation in the activity on a scale of 1 (no input) to 5 (input in all decisions). For the purposes of this study, the responses were coded as; None = 0, Few= 1, Some =2, Most = 3 and All=4. Current literature on gender and agriculture development in southeast Africa suggests that women are more likely to engage in food crop farming instead of cash crop farming for the purposes of providing for their households (*de* Brauw, 2015; Karamba & Winters, 2015). Walker and Cunguara (2016) have noted that soybeans are stereotypically assumed to be a cash crop rather than a food crop.

Based on this knowledge, this study hypothesized there would be mixed (+/-) relationship between women's level of participation in decision-making on input use and soybean uptake.

Land

Is an interval measure of estimated land size. The study hypothesized a positive relationship between land size and soybean uptake.

Livestock

This is a binary variable based on whether a household owned large livestock. Based on Walker and Cunguara (2016) smallholder farmers depend on oxen and other large animals to plough the land and transport farm produce or inputs. Based on this knowledge, this study hypothesized there would be a positive relationship between livestock and soybean uptake.

Radio

This is a binary variable based on whether the household owned a radio. For the purposes of this study ownership of radio was coded as yes (=1) or no (=0). For the purposes of this study, all missing responses were recoded as "0" (no). The study hypothesized a positive relationship between access to radio and soybean uptake.

Cellphone

This is a binary variable based on whether one had access to a mobile phone. Responses were coded as Yes = 1 or No = 0. Ajani (2014), Aker (2001), Fafchamps and Minten (2001) have all previously noted use of mobile/cell phones as promoting access to agricultural commodity markets and prices. Although cellphone technology is relatively new in rural Mozambique, this study hypothesized a positive (+) relationship between mobile phone access and soybean uptake.

Transport

This is a binary variable based on if a household had access to a bicycle, motorcycle, car or any other means of transportation. Responses are coded as yes (=1) or no (=0). The study hypothesized a positive relationship between transport and soybean uptake.

Credit

Access to NGO credit, in/formal lending sources, loans and gifts from friends and relatives was all considered as form of credit. For the purpose of this study, credit is coded as a binary variable (yes= 1, no= 0) based on if a decision-maker or any of their household members had received a loan or in-kind gift from any of the listed sources. The study hypothesized a positive relationship between credit and soybean uptake.

Agriculture groups

This is a binary measure that identifies the decision-maker as a member of an agricultural group. *de* Haan (2009) noted women who belonged to livestock/ agriculture groups in Tanzania were more likely to succeed. Likewise, this study hypothesized that households that belonged to agricultural groups would have access to resources and information that supported soybean uptake. Hence, a positive a positive (+) relationship between group membership and soybean uptake is hypothesized.

Extension

Access to extension services is measured using both a binary measured and an ordinal scale. Households are first evaluated on if “anyone in household consulted agricultural extension services over the last 12 months. Responses were coded as either yes (=1) or no (=0). The frequency a household consults with an extension officer is also adopted as an ordinal measure. This study hypothesized that households that had contact with extension services would participate in soybean uptake and therefore a positive relationship between access to extension and soybean uptake is hypothesized.

Network characteristics and measures

For the purposes of this study network characteristics of smallholder farmers in rural Mozambique are using network measures that examine size, Centrality, density, diversity (Marsden 1987).

Network size

This is an interval measure based on number of actors in a network. The size of kin, friendship, seed sharing, information sharing networks, etc. were all determined by the number of ties in a network (number of persons identified). The study hypothesized there would be a negative relationship between network size and soybean uptake.

Centrality

Measures the extent a person (node) occupies a prominent position in the network or person with fewest steps from the center.

Density

Refers to the proportion of ties in a network or number of links in a network expressed as a proportion of all links possible (Prell, 2012; Valente et al, 2015). Network density or degree of connectedness in an undirected network can be measured by the ratio of existing links (T) to the total number of possible links (n) based on the following formula:

$$Density = \quad ^{T}$$

$n(n-1)/2$

High network density scores suggest there is a network comprised almost exclusively of persons who are emotionally close to one another. Low density networks, on the other hand typically are comprised of individuals who are particularly close to another. Therefore, a network with some moderate level of density would be expected to contain enough individuals to provide bonding social capital but also contain individuals who provide bridging social capital to outside sources of information.

Strong/weak tie

This is an interval measure based on how close a person felt to the person consulted. Responses were coded between 1(distant) and 3 if the respondent felt they were very close to the person consulted. The scores were then summed up and divided by total number of ties in network. The study hypothesized a negative relationship between strong ties and soybean uptake.

Diversity

This is an ordinal measure that estimates the proportion of different types of persons or relationships a decision-maker consults for information on soybeans. Persons consulted are described based on gender, location (village, market, urban center), relationship (relative, neighbor, friend, community leader, extension officer, agro-dealer, or trader). Bandiera and Rasul (2006) study in northern Mozambique suggested that farmers who consulted both kin and non-kin members were more likely to uptake new agricultural technology. Likewise, this study

hypothesized that decision-makers who consulted their relatives, friends, agricultural extension officers and others would be more likely to uptake soybeans. In other words, there would be a positive (+) relationship between diversity and soybean uptake.

Table 3.4: Summary of main study variables tested in models and their expected signs of significance

Variable	Definition of adopted variable	Expected sign of significance
Socio-demographic characteristics		
Female	Sex of decision-maker is female (1/0)	(-)
Age	Reported age of decision-maker	(+/-)
Married	Type of household (Married=1, unmmaried = 0)	(+)
Education	Highest level of education attained by decision-maker	(+)
Speak_Port	Decision-maker is able to speak Portuguese (1/0)	(+)
Ethnic	Ethnicity of decision-maker (1/0)	(+/-)
Location		
Region	Region of Mozambique household is located in (1/0)	(+/-)
Village	Name of study village (1/0)	(+/-)
Productive capital		
HH_labor index	Weighted labor potential for each household member	(+)
Size_HH	Size of household	(+)
Part_CC	Level of decision-making on cash crop inputs	(+)
Part_FC	Level of decision-making on food crop inputs	(+)
Land	Size of land cultivated by household	(+)
Radio	Decision-maker has access to radio (1/0)	(+)
Cellphone	Decision-maker has access to cellphone (1/0)	(+)
Transport	Decision-maker has access to bicycle, motorcycle or other means of transport	(+)
Credit	Decision-maker has access to NGO, in/formal org. or micro-credit groups	(+)
Group	Decision-maker is a member of farmer group or agricultural marketing group (1/0)	(+)
Exten	Decision-maker has access to agricultural extension services	(+)

Farm_sch	Decision-maker has particpated in farmer field school in past 5 years	(+)
Demo	Decision-maker has particpated/ attended a demonstration plot in past 5 years	(+)
Social networks		
Kin	Number of relatives living in the village	(+)
Friends	Number of friends decision-maker has in the village	(+)
Soy_ntw	Total number of people in the village decision-maker consults for soybean information	(+)
Network density	Proportion of ties within a network	(-)
S/W	Strength (intensity) of ties a decision-maker has with people consulte on soy	(-)
Diversity	Proprortion of types of people consulted for soybean iinformation	+

Note: (0/1) = coding for dummy variable

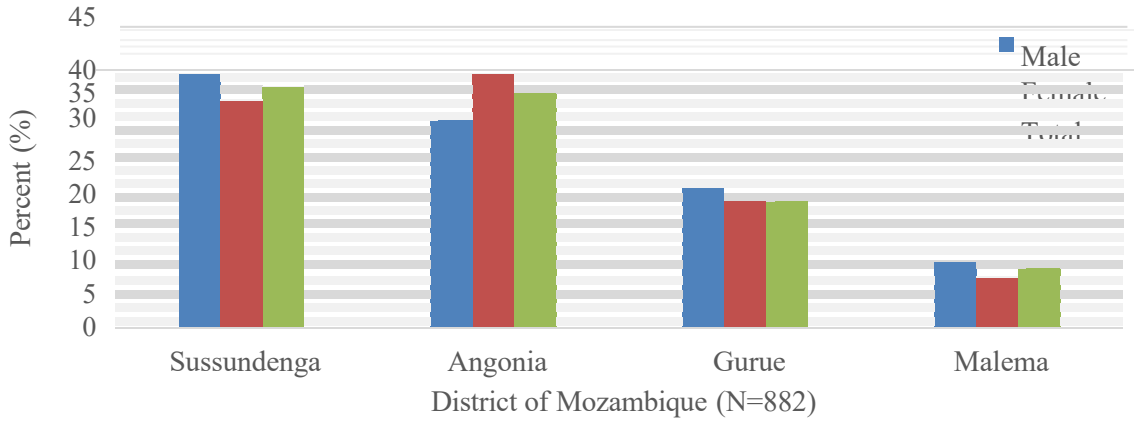
CHAPTER 4: MACRO-DATA

This chapter presents macro level data based on the WEAI+ survey instrument. Survey data was collected from nine villages located in four districts of Central, Northeast and Northwest Mozambique, see list of study villages in appendix C-Table C5.

Socio-demographic characteristics

A total of 882 men and women between 18 and 95 years old, were interviewed across all three regions of Mozambique (see sample breakdown on Appendix C-Table C1). All of the respondents identified themselves as primary decision-makers within their households. The total sample comprised 53% women (n= 471) and 47% men (n= 411). About 36% of the respondents were from Sussundenga district located in Central Mozambique; 35% were from Angonia district, located in Northwest Mozambique, and the remaining 29% were from Gurue and Malema districts, located in Northeast Mozambique as illustrated by Figure 4.1.

Figure 4.1: Study sample breakdown by gender and district surveyed using the WEAI+ Survey in Mozambique in 2014-15



Religion

The majority (87%) of the surveyed respondents identified themselves as Christians, almost 10% said they engaged in the practice of traditional worship/religion and less than four percent (3.72%) practiced Islam. The Northeast region had the highest (93%) number of Christians, followed by the Northwest region (89.12%) and Central region (79.61%) (See Appendix C- table C2).

Marital status & type of household

The majority (90.6%) of those interviewed identified themselves as married. Less than six percent were widowed and almost four percent were divorced or separated. When asked to describe their household in terms of decision making, almost 90% (N=882) said they were in a dual type/ married couple household (see table C1). A little less than ten percent identified themselves as the sole decision-makers in female-only type of household, and only one percent were sole decision-

makers in male-only type of household. The types of households were classified in three categories: dual couple, female-only, and male-only.

To establish if there were regional differences on reported types of households a one-way ANOVA test was conducted. The results showed, the Northwest region had the largest number (18.57%) of female-only type of households. The Northeast region had slightly fewer (4.6%) female only types of households compared to the Central region (5%). These differences were statistically significant based on ANOVA ($F(2,878) = 13.25$, $p = .000$). To better understand these differences a Scheffe post-hoc test was used. The results suggested that the Northwest region was 0.123 more likely to have female only types of households compared to the Central region and Northeast region.

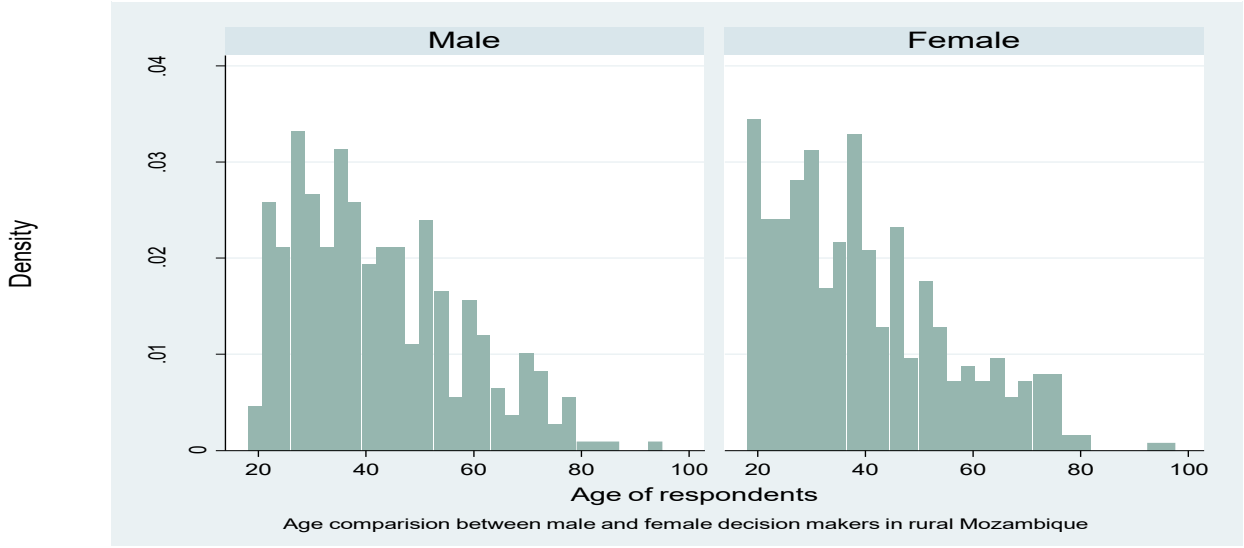
Age

The WEAI^{+} survey data suggested there is a relatively young population across all three regions of Mozambique. Almost 22% of the surveyed households included children aged between zero and five years old, 36.11% between six and 15 years old, and only 2.28% household members were over 65 years (see Appendix C- Figure C1). The ages of our decision-makers ranged from 18 years to 95 years old. About 18% were aged between 18 and 25 years old, 22.3% were aged between 26 and 34 years, 22.2% were aged between 35 and 43 years, 9.3% were between 53 and 61 years and the remaining 13% between 62 and 95 years (see table A4 in appendix). The mean age of decision makers across all three regions was 40.89 ±15.79 years. The mean age for men was 42.1 ± 0.76 years and women 39.82 ± 0.74 year. Overall men were 2.3 years older than women and

the age differences were statistically significant based on an independent t-test (877)= 2.1531, *p*=0.0316. The following figure 4.2 illustrates the age distribution between men and women based on the WEAI⁺ survey data.

To establish if there were regional differences in the age reported by the decision-makers, a one-way ANOVA test was used. The ANOVA showed that there were statistically significant regional differences in the decision-maker's age (F 12.35, *p*=0.000). A further analysis to better understand these differences was conducted using a Scheffe post-hoc test. The results obtained by the Scheffe test showed that decision-makers in the Northwest region were the oldest while the Northeast region had the youngest. Decision-makers in the Northeast region were also 57% younger compared to the Northwest, and 26.7% younger compared to those in the Central region.

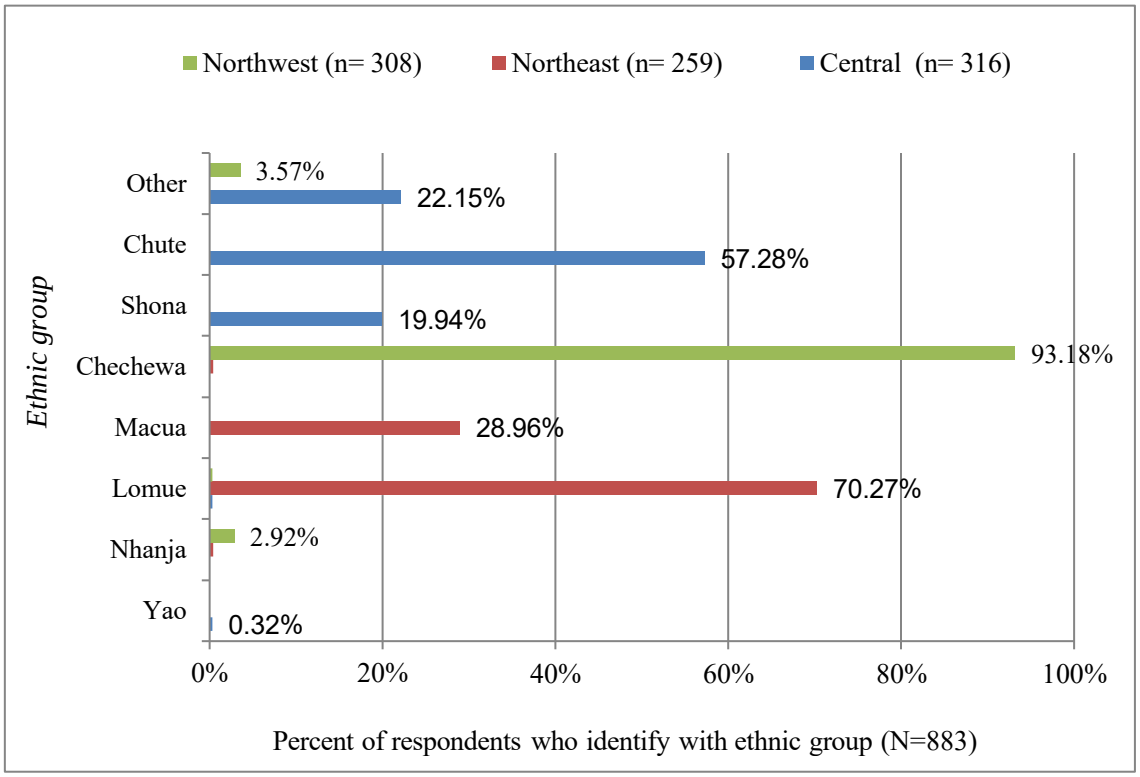
Figure 4.2: Age comparison between male and female decision makers based on WEAI+ survey data



Ethnicity

The survey results show diverse ethnic and linguistic characteristics at the regional level. Overall, respondents located in the Central region reported belonging to more ethnic groups compared to those in the Northeast and Northwest regions. About 22% respondents in the Central region identified with other tribes outside the main seven found in the region. Only less than four percent of other ethnic groups were found in the Northwest region where the majority (93%) identified as Chechewa. Figure 4.3 and Appendix C- Table C5 summarize the reported ethnic and linguistic languages reported across all three regions.

Figure 4: Figure 4.3: Respondent identified ethnic group based on three survey regions



Overall respondents from the Central region (n=316) reported more spoken languages compared to the Northeast (n=259) and Northwest (n=309) regions. The majority (94.82%) in the Northwest spoke Chechewa. In the Northeast, 67.95% spoke Lomue and 31.27% Macua. About 58% of those in Central region spoke Chiute, 17% Shona and 23.42% Chimanhica. The remainder spoke other languages. We also found slight linguistic differences between men and women. More women compared to men in the Central region reported speaking Chimanhica. We however notice this was not the case across the other two regions. Table C4 in the appendix provides data on the languages spoken at the home as reported by both women and men in all three regions.

Education

Based on our data, Mozambique's rural population can be described as poorly educated. Almost half (47.56%) of those surveyed had attained less than a primary school level education. Only 43.4% had attained primary level education, 8.5% had a secondary level of education and less than 0.5% had attained college or technical level education. For the purposes of this study, educational attainment was ranked into four categories: (1) less than primary school, (2) primary school, (3) secondary school, (4) college & other (4). The mean education attainment across our sample was 1.62 ± 0.66.

Cross regional comparison on education attainment of decision-makers further showed that the Central region had attained higher levels of education (mean=1.9 ±0.674) compared to those in the Northwest who had a mean score of 1.3 ± 0.56) (see Table 4.1). A one-way ANOVA was conducted to assess these

regional differences. Further analysis using the ANOVA test reviewed that educational attainment across the regions was statistically different (F (612) = 66.07, p = .000). To better understand these differences the Sheffe posthoc test was used. According to the posthoc test educational attainment in the Central region was 0.10 (p>0.1) lower compared to the Northeast region and 0.58 (p<0.001) lower compared to the Northwest region. Education attainment in the Northeast region was also 0.48 (p<0.001) lower compared to the Northwest region. Therefore, even although the mean scores on educational attainment obtained across all three regions (see table 4.1) suggested decision-makers located in the central region had the highest level of education, this was not the case.

Table 4.1: Regional comparison on highest level of education attained

Region of Mozambique	Mean	Std. Dev.	Freq.
Central	1.905063	0.674129	316
Northeast	1.667954	0.561849	259
Northwest	1.277778	0.559241	306
Total	1.61748	0.658934	881

Note. Bartlett's test for equal variances: chi2(2) =14.1805, Prob>chi2 = 0.001
Analysis of variance - F statistic =85.21 (p=0.000)

When education attainment was compared by gender, women were found to be less educated than men. About 59.2% of the women compared to 34.3% men had no formal education; 35% women compared to 53% men had attained some primary school level education and only 5.1% women compared to 12.4% men had attained secondary level education (see Appendix C- Figure C2). To

establish whether these differences were statistically significant, an independent samples t-test was used to compare education attainment between men and women. Our t-test results suggested the mean educational attainment for men was 1.73±0.35, and women 1.43 ±0.0356 and the mean difference was 0.297 ± 0.05. These differences were statistically significant based on, t=7.28 (P<0.001) indicating that men had attained higher educational levels compared to women.

Ability to speak Portuguese

Only 51% of our respondents were able to speak Portuguese. There were fewer women (38.2%) than men (66.4%) were able to speak Portuguese (see Appendix C- Figure C3). An independent t-test was run on a sample of 881 decision-makers to determine if the suggested linguistic differences were statistically significant. The results showed the mean for women speaking Portuguese as 1.65±0.027 and men as 1.35 ±0.027, meaning women had lower abilities to speak Portuguese compared to men. These differences statistically significant t (611) = -8.1060, p = 0.000.

To establish if there were regional differences on ability to speak Portuguese, a one-way ANOVA was conducted. There was a statistically significant difference between the regions as determined by one-way ANOVA F (2,880) = 122.36, p = .000). Those in the Central and Northeast regions of Mozambique were more likely to speak Portuguese compared to those in the Northwest region. A Scheffe post-hoc test revealed that ability to speak Portuguese was statistically significantly higher in the Central region (0.026) when compared to the Northwest region. Table 4.2 provides results of ANOVA test on

regional differences in ability to speak Portuguese based on the reported responses of 880 decision makers from the Central, Northwest and Northeast region of Mozambique.

Table 4.2: One-way ANOVA comparison on regional differences in ability to speak Portuguese

(I) Study region of Mozambique	Mean Diff. (I-J)	Mean	Std. err	Sign.	Lower	upper
Central	NW	-.501*	0.036	0.000	-0.59	-0.41
	NE	-0.026	0.037	0.783	-0.12	0.07
Northwest	Central	.501*	0.036	0.000	0.41	0.59
	NE	.475*	0.037	0.000	0.38	0.57
Northeast	Central	0.026	0.037	0.783	-0.07	0.12
	NW	-.475*	0.037	0.000	-0.57	-0.38

Note. *p=0.05 level of statistical significance

Household labor index

Based on a One-way ANOVA test, the overall average household labor index across all three regions was 2.86. The Central region had the highest labor index with a mean of 3.35 ± 1.72, the Northeast region had a mean of 2.7 ± 1.23, and the Northwest had the lowest labor index mean at 2.56 ± 1.166. To establish whether there were regional differences on household labor index, a one-way ANOVA test was conducted. The homogeneity of variance test showed that the three regions did not have equal variance (F = 16.349, P=0.00) and the population variance observed within groups was almost 15% and ANOVA F(2) =14.638, p<0.001. Therefore, based on these results, there were statistically significant regional differences on the household labor index.

Table 4.3 : One-way ANOVA comparison of household labor Index by region

(I) Region	(J) Region	Mean Diff. (I-J)	Std. Error	Sig.	95% CI Lower	Upper
Central	Northwest	.79167**	.15298	.000	.4320	1.1514
	Northeast	.65512**	.16709	.000	.2622	1.0480
Northwest	Central	-.79167**	.15298	.000	-1.1514	-.4320
	Northeast	-.13655	.16178	.676	-.5170	.2439
Northeast	Central	-.65512**	.16709	.000	-1.0480	-.2622
	Northwest	.13655	.16178	.676	-.2439	.5170

Note. *p=0.01, **p= 0.05, ***P =0.001 level of significance

Given that the group sizes across the three regions were unequal, we used harmonic means of the group sizes based on the Tukey HSD post hoc tests to further compare these regional differences. Based on the Tukey results, the labor index in the Central region was 0.79 points higher compared to the Northwest and 0.14 higher compared to the Northeast region. Since these differences were statistically significant at α=0.05 we concluded there are regional differences in household labor index as shown in Table 4.3.

Decision-making in food crop & Cash crop inputs

Almost everyone (99.54%) participates on decision making regarding inputs used in food crop farming. Only less than one percent of women (n=461) said they did not participate in deciding what inputs were used in food crop farming. When the same group was asked if they participated in deciding what inputs to use on cash crops, 80.2% (n=865) said they participated in various capacities. When responses were compared by gender, there were slightly more men (83.3%)

compared to women (77.5%) who participated in deciding what inputs were to be used in cash crop farming.

An independent t-test was used to test if there were any statistically significant differences between men and women's participation in deciding what inputs to use on cash crops. The t-test showed that there were statistically significant differences in the participation of men and women in deciding what inputs were to be used in cash crops, t (863) = 2.1342, p = 0.033. The mean for male participation was 0.832 ± 0.0185 and women 0.775 ± 0.0195. Therefore, men had higher levels of influencing what inputs were to be used on cash crops compared to women.

Productive capital

Access to productive capital was measured using responses obtained from 13 possible physical assets and five credit/ loan lending sources that a household might have access to. The physical assets comprised agricultural land for farming, livestock, farming equipment, cellphone, radio and means of transportation. Credit/ loan sources included NGOs, formal lending institutions such as banks, informal lenders, relatives and friends, and microfinance groups that were available in the village.

Based on our survey data, all (99.9%) respondents said they had access to agricultural land for farming. About 67% said that they owned land jointly with their spouse, 9% said that the land was owned by their spouse, 23% owned the land alone and a little over one percent had access to land that other household members owned (see Table 4.4). Fewer women (12%) than men (40%) reported

owning large livestock by themselves. More men (28%) also reported owning small livestock alone compared to women (17%) and majority (65%) reported owning small livestock jointly with their spouse.

The majority (93.1%) of the decision-makers said that their household owned non-mechanized farm equipment. Very few households (9.4%) owned mechanized equipment or had access to non-farm (business) equipment (7.6%). A little over 65% identified their households as owning a radio. When asked about ownership, 39% of the men compared to 23% of the women said they owned the radio alone. More women 19.3% compared to men (2.4%) said that their spouse owned the radio. When a t-test was used to test for difference between men and women access to radio, we found slight differences ($p<0.05$) suggesting men were more likely to own radio compared to women by 0.098 ± 0.032.

A little over half (51.7%) of our decision-makers said they had access to a cellphone. A subsequent question examining who owned the asset reviewed that were more men (65%) compared to women (30%) owned the cellphones (alone). More women (29.6%) compared to men (3.6%) said that their spouses owned the cellphone. Despite these differences, an independent t-test comparing cellphone ownership between men and women showed these differences were not statistically significant. Thus, men and women had equal access to cellphones in rural Mozambique.

Table 4.4: Reported access to productive capital/asset ownership between men and women based on WEAI+ baseline survey 2014-2015

Type of asset	Ownership	Percent of gender who own the asset		
Agriculture land		Male %	Female %	Total %
	Self	23.2	22.08	22.61
	Spouse	7.9	9.96	9
	Self & Spouse	67.65	66.45	67.01
	Other household member	1.23	1.52	1.38
Large livestock				
	Self	40	12.3	25.6
	Spouse	4	21.7	13
	Self & Spouse	53.5	63.21	58.4
	Other household member	2.97	2.83	3
Small livestock				
	Self	28.2	17	22.32
	Spouse	7.05	13.45	10.4
	Self & Spouse	62.1	67.8	65.14
	Other household member	2.6	1.75	2.14
Radio				
	Self	39	23.2	31.2
	Spouse	2.4	19.3	10.8
	Self & Spouse	58.1	56.1	57.1
	Other household member	0.35	1.4	0.87
Cellphone				
	Self	65.2	30	47.1
	Spouse	3.62	29.6	17
	Self & Spouse	29	34	31.5
	Other household member	2.3	6.4	4.4

Access to credit

The majority of our respondents (N=861) did not receive loans, in-kind gifts or any form of credit from NGO's, banks, informal lenders, micro credit organizations, relatives or friends. The number of sources of credit available ranged from zero to five. As demonstrated in Table 4.5 below, only six percent had received loans, in-kind gifts from NGOs and informal lenders respectively. Almost eight percent had received loans from banks, nine percent from friends and relatives, and six percent from micro-lending groups within their village. Women

reported accessing slightly more loans and in-kind gifts from NGO's, informal lenders, banks and micro-credit lending groups. The percent of men accessing credit/ loans from their relatives and friends was slightly higher (9.7%) compared to women (8.8%). Based on Pearson Chi-square tests these differences were statistically significant ($p<0.05$).

Table 4.5:Percent of households and decision-makers with access to credit in rural Mozambique

Household obtained credit, loan or in-kind gift received from:	Total (n=861)		(%) Percent who received loan or gifts	
	% No	% Yes	Male	Female
NGO	93.73	6.27*	4.46	7.88
Informal lender	94	6**	3.7	8.1
Bank	92.07	7.93	6.68	9.03
Relatives & Friends	90.79	9.21	9.7	8.77
Micro-lending group	93.61	6.39*	4.46	8.1

Note. *p <0.01 **p<0.05 level of statistical significance

Given the complexity of estimating the productive capital the researcher tried to use the principal factor method[11] to reduce the broad dimensionality of the two module, and identify clusters or groups of related items (*factor*) to be used in the logistic regression model. The eigenvalue measures obtained from variables measuring access to productive capital and access to credit did not show any variance in the observed variables. As a result, no factors were used in the

11 Factor analysis is a variable reduction technique used to reduce number of variables in a data set. Therefore, factor analysis allows us to explore the data, tease out variables that are highly correlated and redundant (variables that measure the same thing), drop or group independent variables into a small number of latent variables/factors (unobserved factors) that can explain all correlated observations.

models. Table 4.6 presents an example of rotated factor loadings obtained when access to credit was assessed.

Table 4.6 Rotated Factor loadings and unique variance on productive credit

Variable	Factor 1	Factor 2	Uniqueness
Credit from NGO	0.7309	0.6784	0.0056
Informal credit	0.7304	0.6684	0.0198
Credit from formal lender	0.7562	0.6297	0.0315
Credit from friends/relatives	0.6362	0.7565	0.0230
Group based micro-finance	0.6782	0.7282	0.0098

Access to Extension

Respondents had been asked to list the number of times they had consulted with an agricultural extension officer over the last 12 months (year). For the purposes of this study, these responses were categorized into four categories that ranked consultancy from one time to four and more times. Only 26.5% of our respondents (N=858) said they had met with an extension officer. About 27.3% (n=109) of those who had met with an extension officer were men, and the remaining 25.7% (n=118) women.

Respondents who had met with an extension officer were then asked to list the total number of times they had met with the agriculture extension officer over the last year. Responses ranged from one time to 48 times. Almost 66% of the women and 49.6% of the men had met with an extension officer once in the last year. About 22.5% of the women and 20.7% men had met with an extension officer twice in the year. Women made up 9.2% of the 7.4% respondents (n=231) who said they had met an extension officer three times in the previous year. This was slightly higher when compared with the 5.41% men who said they had only met

with extension three times that year. Contrary to men who continued to report an increased frequency on meeting with agriculture extension officers, we noted a decline on the number of women who met with extension officers more than three times a year. There was only one woman who said she had met with an agriculture extension officer six times in a year (this was also the highest number of times reported by the 120 women who answered the question). Two men (1.8%) and six men (5.4%) out of the 111 reported having met with extension 36 and 48 times respectively over the last 12 months.

The majority (58%) had only consulted agricultural extension services once in 12 months, another 22% had consulted extension twice and only 7% had consulted agricultural extension officers three times in 12 months. Similar to our primary findings, there were more women (65.8%) compared to men (49.6%) who had consulted an agricultural extension officer only once in the 12 months and 24.3% men who had consulted extension officers four and more times in the previous year. To establish if the reported differences on number of consultations made by men and women were statistically significant an independent t-test was carried based on the 231 decision makers who had answered the question. The mean frequency for men consulting agriculture extension officers was 2.045 ± 0.12 and women 1.48 ± 0.07. The t-test results ($t(229) = 4.178$, $p < 0.001$) showed that men were more likely to consult agricultural extension officers compared to women.

To establish if there were regional differences on accessing extension services we compared responses of those who had consulted extension officers

across the three regions of Mozambique. We found almost 50% of the 37.8% (n=223) were from the Central region. At least 37.3% were from the Northwest region and almost 22% from the Northeast region. When the same were asked how comfortable they felt speaking with extension officers, 36% of the respondents in the Central region, 25% respondents in the Northeast and 9 percent respondents in the Northwest felt very comfortable speaking with extension agents. Almost 38% of respondents in the Northwest, 27% of respondents in Northeast and 18% of respondents in the Central region reported that they had 'great difficulty' speaking with extension agents about agricultural practices and policies.

On comparing the frequency of meeting with extension officers across the three region, we found that 81% of those in the Northwest region, 44.7% of those in the Central region and 33.3% of those in the Northeast region had met with an extension officer only once that year. About 51.5% of those in the Northeast region, 19.4% in the Central region, and 13.7% from the Northwest region had met with extension officers twice that year. Overall, more respondents from the Central region (25.4%) compared to the Northeast (3%) and Northwest (2.1%) had met with an extension officer four or more times. To establish if these differences were statistically significant a one-way ANOVA comparison between number of visits/ consultancy with extension officer by region was run. The ANOVA ($F=21.52$, $p<0.001$) showed these differences were statistically significant. A Scheffe post-hoc test further revealed that the frequency of consulting agricultural extension

officers in the Northwest region decreased by 0.902 (p<0.001) compared to those in the Central region and 0.62 (p<0.05) compared to the Northwest.

Soybean Uptake

The Mozambique WEAI$^+$ data obtained showed that only 54.4% of the decision-makers interviewed identified their households as having participated in soybean farming in the past. The majority (71.1%) of these households that had previously planted soybean were in the Northwest region, and the least in the Central region. These differences were statistically significant when compared using a one-way ANOVA test (F (876) =34.69, p = 0.000).

Table 4.7: Descriptive statistics on soybean uptake by region of Mozambique based on WEAI+ sample of 876 respondents

Region	Mean	Std. Dev.	Freq.
Central	0.36102236	0.4810661	313
Northwest	0.67647059	0.46858905	306
Northeast	.45384615	0.49882547	260
Total	0.49829352	0.50028174	879

Based on the ANOVA test, households in the Central region were less likely to have planted soybeans compared to households in Northeast Mozambique. Households in the Northwest region had a slightly higher (30%) probability of participating in soybean farming compared to those in the Central region (26.3%). Comparison between responses obtained from men and women showed that slightly more men (55.3%) compared to women (53.6%) knew someone in their household who had planted soybean in the past. Irrespective of the reported differences on household participation in soybean uptake, there were no

statistically significant differences found when the responses were compared using the t-test, t (595) = -0.4113, p=0.68).

Only 51% of our respondents (N=882) had planted soybeans in the past. The majority (67%) of those who had planted or tried soybean in the past were from the Northwest region. About 46% were from the Northeast region and only 35% from the Central region had ever tried soybeans in the past. There were slightly more women (51.7%) compared to men (50.2%) reported as having ever planted soybeans on their own. These differences were not statistically significant, t (880) = 0.5606, p =0.575.

CHAPTER 5: MICRO-DATA

This chapter presents micro level data based on the NPS and SUNS survey instruments. The data described in this chapter is based on responses collected from men and women residing in Manica village 4 and Manica village 5 located in the Sussundenga district, Manica province, Central Mozambique.

Socio demographic data

The NPS and SUNS survey instruments collected information from men and women who identified themselves as primary decision-makers of their households. The NPS collected network data from a total sample of 287 men and 314 women (n=601) living in Manica village 4 and Manica village 5. The SUNS collected information on type and size of households, soybean farming, access to extension, household income and sources of information among other, from a random sample of 205 men and 224 women (n=429) who identified themselves as the primary decision-makers in Manica village 4 and Manica village 5.

Most of our respondents, 94% identified themselves as married, and 3.5% were single and 2.6% widow/ed. Almost all the men (99%) identified themselves as married and only one percent as single. A little over 89% of the women identified themselves as married, 5.8% as single and 4.9% as widowed. For the purposes of this study, marital status was categorized into three categories (married, single and widow/ed). To examine if the observed differences between men and women's reported marital status were different, an independent t-test was

run. The results showed that men had a 1.16 ± 0.032 statistically significant higher chance of being married compared to women, (t (427) = -4.3, p = 0.000).

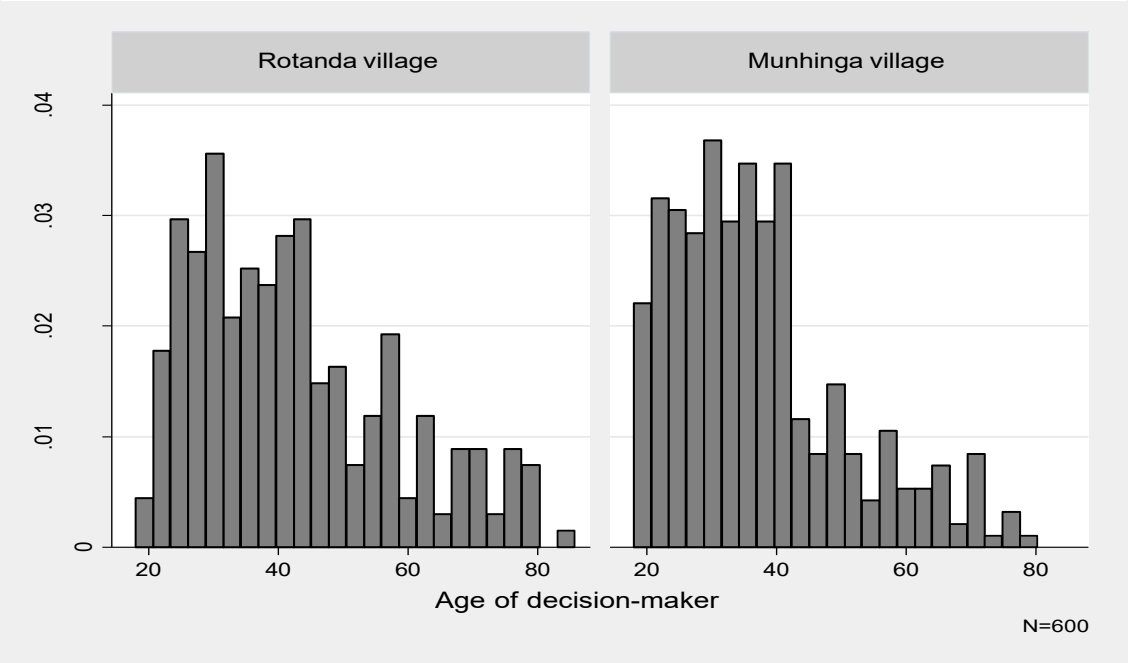
To establish the types of households, respondents were asked to describe their households based on one of the three categories: dual couple/ married type of household, female-only or male-only type of household. The majority, 94.2% of our respondents described their households as married types of household, four percent were female-only type of household and two percent were male-only type of household. Between the two villages, Manica village 5 reported slightly more (95%) married types of the household compared to Manica village 4 (90.5%). We noticed there were slightly more (7.4%) female-only types of households in Manica village 4 compared to Manica village 5 (2.1%), and 2.5% male-only type of household in Manica village 5 compared to Manica village 4 (2%). When we tested for statistical significant differences between the two villages using the Pearson chi-square test and t-test, we found there were no statistically significant differences on the types of households in both villages, t (427) = 1.2, p =0.23.

Age

Our micro-level survey data suggests a relatively young population. According to our NPS data, the decision-makers (n=600) in both villages were aged between 18 and 83 years old, and the mean age was estimated at 39.2 ± 14.47 years. About 15% of the decision-makers were aged between 18 and 25 years old, 28% were aged 26 and 34 years old, almost 26% were between 35 and 43 years, and the remaining 31% between 44 and 83 years old. The mean age for the 249 decision-makers in Manica village 4 was (42.33±0.974 years), and

(36.977±0.714 years) for the 351 decision-makers in Manica village 5. Age across both villages was skewed to the left as illustrated in figure 5.1.

Figure 5.1: Age comparison between Manica village 4 and Manica village 5



Our data and the distribution curves on Figure 5.1 suggested that Manica village 5 might have a younger population compared to Manica village 4. Majority, 86% of the decision makers in Manica village 5 were aged between 18 and 52 years old. This was almost 12 percent more decision-makers below 52 years old compared to MV4 which had 75%. Also, only 12% of Manica village 5 decision makers were aged older than 62 years compared to Manica village 4 25%. To test if the observed differences in age between the two villages were statistically significant, an independent t-test was used. The results confirmed that decision-makers in Manica village 5 were 5.36 ± 1.2 years statistically significantly younger compared to decision-makers in Manica village 4, t-test (t (598) = 4.539, p>0.001.

Education

The mean educational attainment by the 369[12] men and women in our sample was 5.22 (SD 2.99) years and ranged from zero to 12 years. Data on educational attainment of decision-makers collected at the micro-level was based on the number of years of school completed. At least 12.5% had not completed any years of school. Half (50%) of our sample had completed between three and five years of formal education, with an additional 25% reaching a maximum of 3 years and less than two percent completing 12 years.

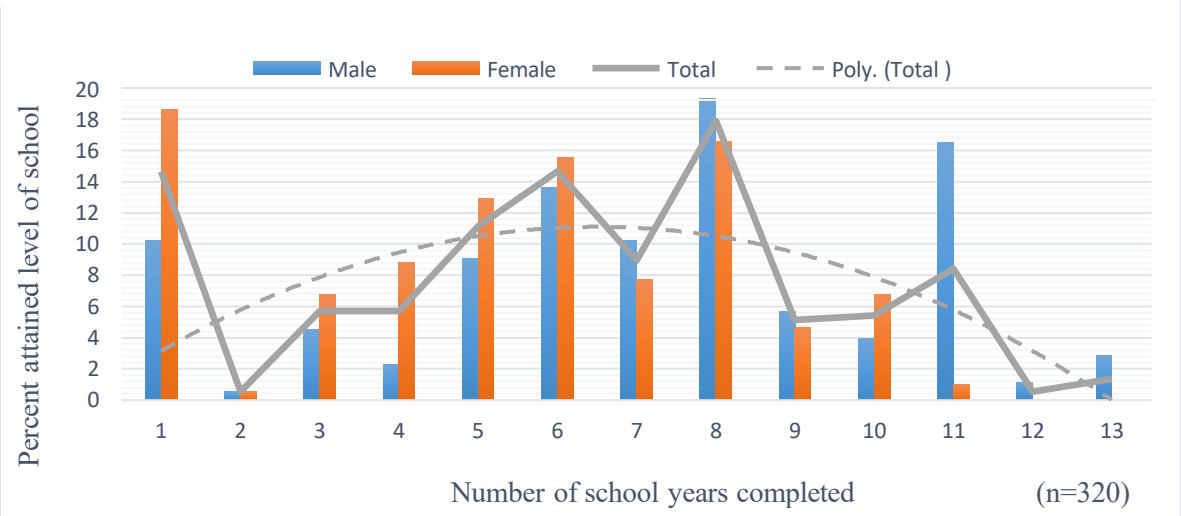
Almost 54% of the decision-makers in Manica village 4 (n=308) had completed a maximum of five years of school and the remaining 46% completed between six to twelve years of school. This was slightly lower compared to Manica village 5 where 54.1% of the decision-makers (n=61) had completed a minimum of six years of school. An independent t-test was conducted to examine if the observed differences in education attainment between the two villages were statistically significant. The results obtained showed that 249 MV4 decision-makers had completed an average of 5.22 ± 0.181 years of school. The mean for the 71 MV5 decision-makers was 5.28 ± 0.409 years, and the combined mean difference between the two villages was 5.22 ± 0.17 years. Based on the results, t (318), p = 0.94, there were no statistically significant differences on number of

[12] Almost 39% of the surveys administered to respondents in Munhinga village were missing education variable.

years of education completed by decision-makers in Manica village 4 and Manica village 5.

Our data suggested educational attainment between men and women as slightly skewed to the left as illustrated by Figure 5.2. Overall men had completed more years of school compared to women in both villages. The average years of school completed by women in Manica village 4 was 4.56 years and 4.1 years by women in Manica village 5. Men in Manica village 4 had completed an average of six years of school, and 6.5 years of school in Manica village 5. Across the villages, women in Manica village 4 had completed slightly more years of school compared to women in Manica village 5. An independent t-test was run on the sample of 320 decision-makers to examine if the suggested gender differences were statistically significant. The results showed the overall mean education attainment for both men and women was 5.22 ± 2.99 years. Women on an average had completed 4.46 ±0.21 years of school compared to men who had completed 6.1 ± 0.25 years of school. These differences were statistically significant (t (318) =5.069, p <

Figure 5.2: Comparison of years of schooling completed by men and women in Sussundenga district, Central Mozambique

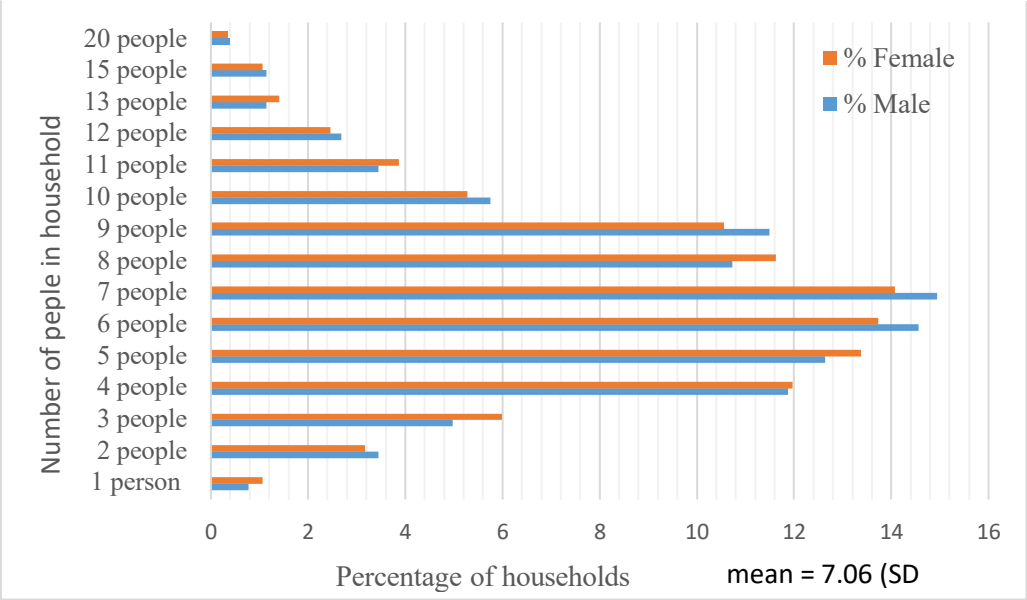


0.001) and that men had completed almost two more years (1.64 ± 0.323) of school compared to women.

Size of household

The number of persons residing within a household ranged from one person to 20 people, with the average household having 7 people. The size of households reported by men (n= 189) and women (n=236) appeared to be normally distributed with a mean of 7.05 as shown on Figure 5.3. Overall, woman reported slightly larger households (7.3, SD 2.7) compared to men 6.8, SD 2.8). The majority (63%) men and women reported having a maximum of seven people in their household (see Figure 5.3). A little over 22% of the women and 21% of the men reported having a maximum of four people, and 9% of the women compared to 8.8% of the men reported having between 11 and 20 people in their households. An independent t-test was used to test if these differences were statistically significant. Our results showed the mean number of persons reported by men as living in a household was 6.8 ± 0.21, and 7.3 ± 0.14 by women, these differences were statistically significant at α = 0.10. Men reported statistically significant 0.49 ± 0.3 less persons living in their households compared to women, t (424) = -1.7879, *p*=0.074. Between the two villages, households in Manica village 4 were reported as slightly smaller (6.92, SD 2.5) compared to Manica village 5 (7.15, SD 2.95). However, these differences were not statistically significant (t (423) =-0.8123, *p* >0.1) based on an independent t-test.

Figure 5.3: Size of household reported by male and females (N=601)



Network characteristics

Friendship and kin network characteristics in Manica village 5 and Manica village 4 vary in size and composition as demonstrated in Table 5.1. The number of friends and relatives reported in each village ranged from zero to four and the average decision-makers (in both villages) identified one (0.857, SD 0.822) relative living within their village and two friends (1.727, SD 0.879) living in their village.

Table 5.1: Comparison of kin and friendship network size by village

Network type	Village	N	Mean	Std. Dev.	t	df	Sig (2-tail)	Low	Upp.
Kin	MV4	249	1.07	0.84	5.53	599	0.00	0.237	0.498
	MV5	352	0.7	0.78	5.458	507.42	0.00	0.235	0.5
Friendship	MV4	249	1.88	0.99	3.61	599	0.00	0.119	0.402
	MV 5	352	1.62	0.85	3.58	514.88	0.00	0.117	0.403

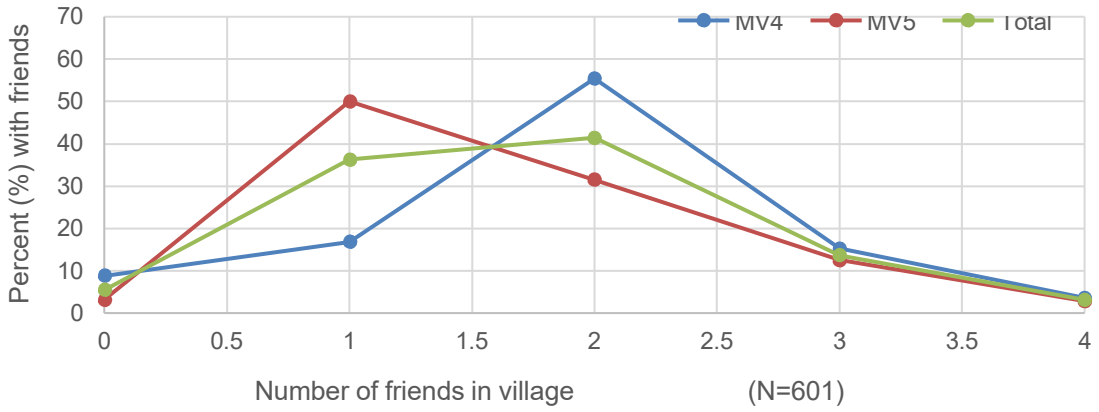
Note: MV4 = Manica village 4, MV5 = Manica village 5

Friendship networks

The majority of those interviewed (94.5%, N=601) identified at least one friend their village. The mean size of the friendship network in Manica village 4 was 1.88 (SD. 0.90), and 1.62 (SD 0.84) for Manica village 5 as illustrated in Table 5.1. Almost four percent of the decision makers in Manica village 4 identified four friends in their village compared to 2.8% decision makers in Manica village 5. Similarly, 15.3% of the decision-makers living in Manica village 4 (n=249) compared to 12.5% of decision-makers in Manica village 5 (n=352) identified at least three friends living within their village. Over 55% of the decision-makers in Manica village 4 and almost 32% of decision-makers in Manica village 5 identified a maximum of two friends. It was however interesting to note that half (50%) of the decision makers in Manica village 5 compared to 17% of the decision-makers in Manica village 4 identified only one friend in their village as illustrated in Figure 5.4. An Independent t-test was used to test if the size of friendship networks between the two villages were different. The results showed the combined mean size of friendship networks between the two villages was 1.73 ± 0.358. The mean size of Manica village 4 friendship networks was 1.88 ± 0.057 and 1.62 ± 0.045 for Manica village 5. These differences were statistically significantly different based on t(599) 3.61, $p<0.005$, and indicated Manica village 4 friendship networks were 0.26 ± 0.072 larger compared to Manica village 5 friendship networks. When we compared size of friendship networks by gender we found the mean size of male friendship networks was 1.70 ± 0.88 and 1.74 ± 0.88 for women. These differences

were not statistically significant, implying that size of friendship networks was not affected by gender.

Figure 5.5: Comparison of friendship network size between Manica Village 4 and Manica Village 5

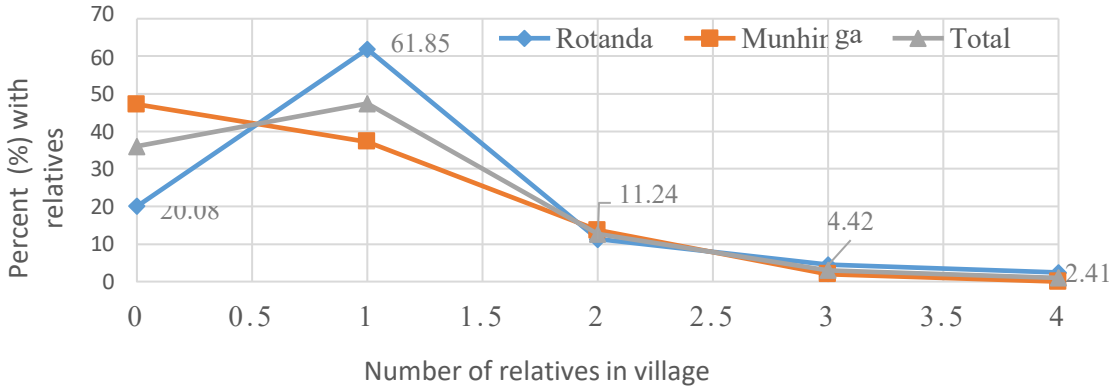


Note: MV4 represents Manica Village 4, MV5 represents Manica Village 5

Kin networks

The size of kin networks in Manica village 5 were smaller compared to those of Manica village 4. The mean size of the kin networks in Manica village 5 was 0.704 (SD 0.776) compared to Manica village 4, 1.07 (SD 0.84). Almost half (47.2%) of the decision-makers interviewed from Manica village 5 did not have relatives in their village. This was more than twice (20%) the number of decision-makers in Manica village 4 who did not have relatives in their village as illustrated in the Figure 5.5 below. Majority (62%) of those living in Manica village 4 and 37.2% of those in Manica village 5 had at least one relative, 11.24% of the decision makers from MV4 and 13.6% from Manica village 5 had at least 2 relatives and the remaining four percent from both village had more than two relatives living in the same village.

Figure 5.5: Comparison of kin network size between Manica village 4 and Manica village 5



Note: MV4 represents Manica Village 4

MV5 represents Manica Village 5

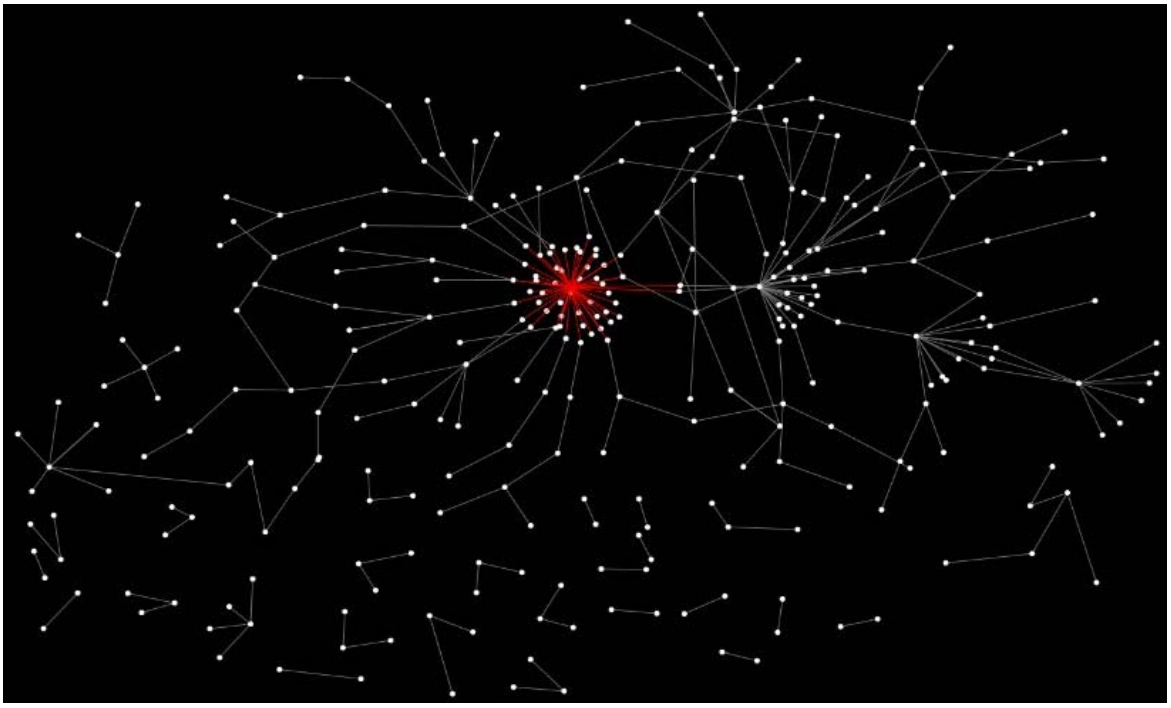
Women reported slightly larger kin (0.84 ±0.8) networks compared to men (0.87 ± 0.84). At least 4.5% of the women compared to 3.5% of the men had more than two relatives living in their village, 13% of the men and 12% of the women had two relatives and 47% of the men and 48% of the women had at least one relative living in their village. Almost 36% (N=601) of both men and women did not identify any relatives living in their village. An independent t-test was used to examine if the observed differences between men and women's kin networks were different. The results showed that the mean size of men and women's kin networks was 0.857 ± 0.034 and the difference was not statistically significant, t(599) = -0.4895, *p*=0.620.1.

Source of agricultural Information

To establish sources of agricultural information within the two villages, we asked respondent to identify whom people usually went to for agriculture information. About 62% identified one person, 18.8% two people and 19.2% three people in their village. When this data was ploted using SNA, the agricultural information networks within both villages appeared to be Centralized and clusters around a few nodes as illustrted by graphs in Figures 5.6 and 5.7.

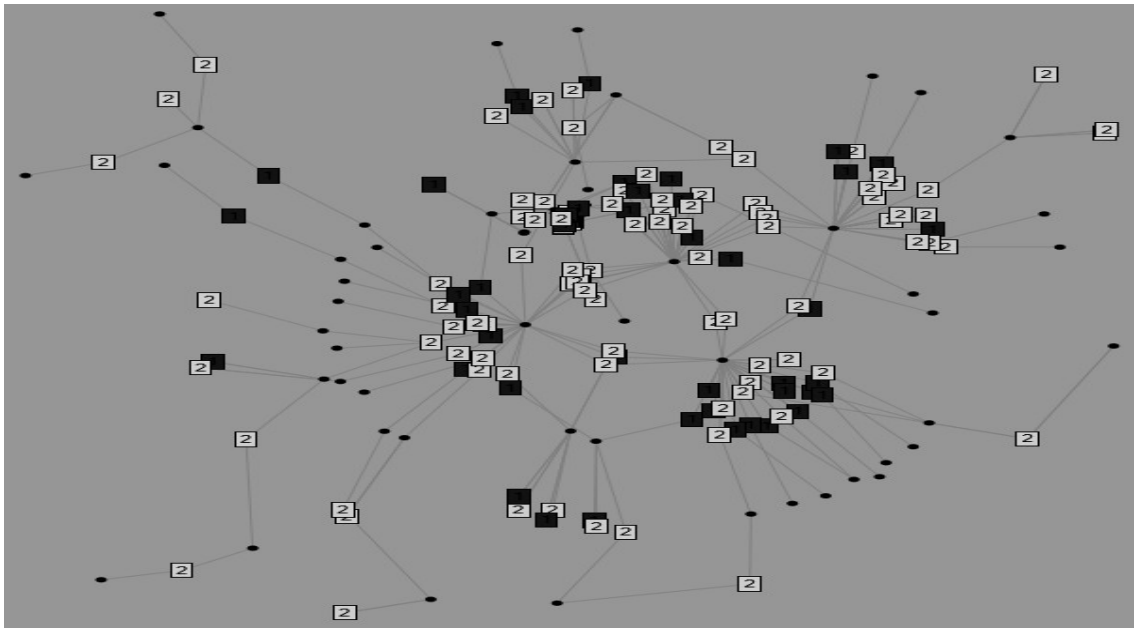
Sources of agriculture information in Manica village 4 were more Centralized compared to those of Manica village 5 as illustrated by the graph on Figure 5.7. When the Manica village 4 agricultural information networks were closely examined, we found smaller networks along with ego networks that were clustered around the Central network (see Figure 5.6 and Figure 5.8)

Figure 5.6: Structure of full village agriculture information network in Manica village 4



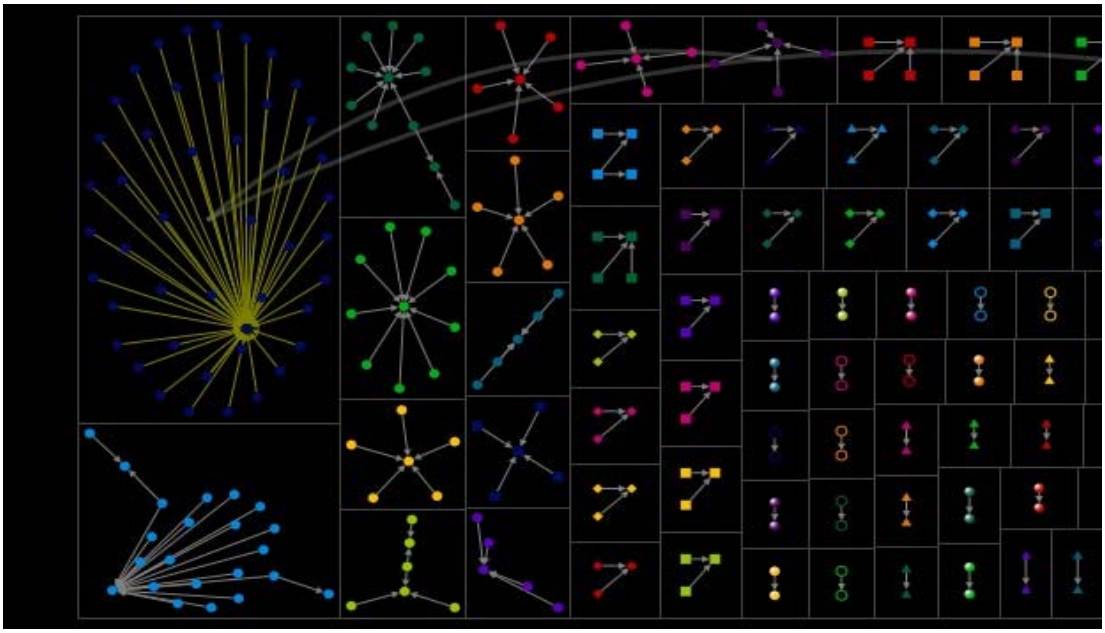
Most people in Manica village 4 (76%) identified a single source (one person) that was consulted for agricultural information. However, in Manica village 5, only 48.6% identifed only one person as their primary source for agricultural information. Almost the same number of respondents (18.5% in Manica village 4 and 19% in Manica village 5) identified two people their village. We did however notice that more people (32.4%) in Manica village 5 compared to Manica village 4 (5.2%) identified three people consulted for agricultural information. When responses from men and women in both villages were compared, we noticed a normal distribution between number of sources of agriculture information identified (60.5% of men and 63.4% of women identified one person, while 20.4% men and 18.2% women) identified three sources of information. An independent t-test run on a sample of 629 respondents confirmed there were no statistically significant differences on number of persons identified by both men and women.

Figure 5.7: Structure of agriculture information networks reported by men and women in Manica village 5



Note: nodes coded as 1 represent female, nodes coded as 2 represent

Figure 5.8: Manica village 4 agricultural information sub-groups



Soybean uptake

Only 15.76% of the decision makers interviewed (n=425) had planted soybeans in the immediate past season. For the purposes of this study, respondents were asked if their household had planted soybean in the immediate past cropping season. The responses obtained were coded as yes (1) or no (0). According to our data, most (23.7%) of those who had planted soybean were from Manica village 4 and the remaining 10.5% from Manica village 5. There were more women (17.8%) compared to men (13.23%) who said they had planted soybean in the immediate past cropping season. An independent t-test was run on a sample of 425 decision-makers in Manica village 4 and Manica village 5 to determine if there were statistically significant differences in soybean planting between the two villages. The results obtained showed there were statistically significant differences between soybeans planting between the two villages, $t(423) = 3.68$, $p = 0.000$. Decision-makers in Manica village 4 had a 0.131 ± 0.036 statistically significant chance of having planted soybeans compared to those in Manica village 5.

To estimate the amount of land allocated to soybean farming, we had asked decision makers to appropriate the amount of land they had planted soybean in the past season. For the purposes of this study, land was categorized into four categories (less than 0.25 ha, 0.25 ha, 0.5 ha, and 1 ha.). These categories were based on the raw data obtained which showed 31% had planted soybeans on less than a quarter hectare, 36% on 0.25 ha, 12% on half a hectare and 21% on 1 hectare. No one responded to having planted more than one hectare. The

average size of land allocated to soybean farming was less than a quarter (0.25) hectares. A little over 16% had planted one hectare of soybeans, 12.3% had planted half a hectare, 48% had planted a quarter (0.25) hectares of soybean, and the remaining 23% less than a quarter of a hectare. An independent t-test was used to test if there were statistically significant differences between amounts of land allocated to soybean farming between the two villages. The results showed, there were no statistically significant differences between the amount of land allocated for soybean farming in Manica village 4 and Manica village 5, t (65) 0.68, p= 0.5.

Soybean information networks

To establish the size of the village soybean information sharing networks, respondents were asked to identify persons (within their village) that they consulted with regarding soybeans. The number of persons consulted within each village ranged between one and three with the average person consulting only one person. A little over half the total sample (N=601) said they did not consult with anyone in their village regarding soybeans. However, of those who consulted with others in their village 79.4% (n=296), consulted at least one person, 17% consulted two people and only 3.4% consulted three people. Almost 79% (n=171) of those who consulted others in MV4 identified one person while the remaining 20% consulted between two and three people. This was comparable to decision makers in MV5 as demonstrated in Table 5.2. Slightly fewer men (32.75%) compared to women (38.85%) identified only one person within their village that they consulted regarding soybean information. A little over 10% of the men

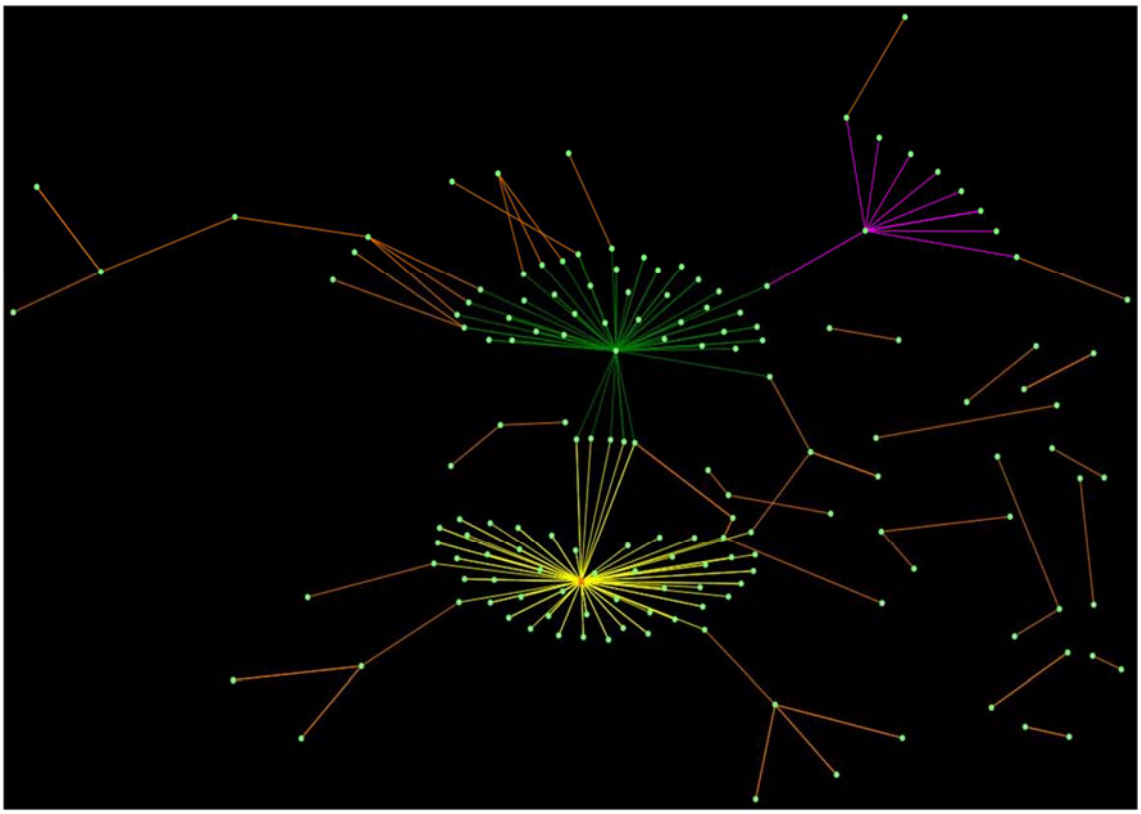
compared to seven percent of the women identified two people in their village, and less than two percent (1.74% men and 0.96% women) identified three people.

Table 5.2: Number of persons residing within village consulted on information on where to purchase, market or cultivate soybeans in MV4 and Manica village 5s of Central Mozambique.

Number of persons consulted for soybean information within village.	% consulting in MV4 (n=171)	% consulting in MV5 (n=125)	Total % consulting (n=296)
1 person	78.95	80.0	79.39
2 Persons	16.96	17.6	17.23
3 Persons	4.09	2.4	3.38
Mean =1.24, (SD =0.501), $\chi 2$= 0.6404, p >0.05			

The soybean information network in Manica village 4 and Manica village 5 can be described as highly Centralized as illustrated by the social network graph on Figures 5.9 and 5.10. Based on our network data, 35% of those participating in soybean farming in Manica village 4 consulted an agricultural officer who lived within the network. Another 7.5% identified persons living outside their village and the remaining 30% said that they did not consult anyone for information on soybeans. When this information was graphed, we noticed most of the soybean farmers in Manica village 4 were connected to one Central node either directly or indirectly as illustrated by the network graph on Figure 5.10. Based on the sociodemographic characteristics of persons consulted within Manica village 4, the Central node represented a male agricultural officer who resided within the village.

Figure 5.9: Soybean information networks in MV4



In Manica village 5 majority (66.6%) who participated in soybean farming said they did not consult anyone in their village. However, 22.5% consulted community leaders (node #50 M and #61 M on figure 5.11). The remaining six percent consulted traders (node #65 M) for soybean information.

Network density (tie strength)

There are differences in the perceived types of relationships across villages, gender and age groups. To establish network density across respondents, we used responses obtained when respondents were asked to rank the strength of their relationships with persons consulted for soybean on a scale of 1 (distant) to 3 (close). More than half (57.4%) of the 122 respondents from Manica village 5 said that they consulted persons they felt closest to on information regarding soybeans. The remaining 36% were neutral about their relationships and 3.3% distant with those consulted within the Manica village 5. Overall 33% of Manica village 4 residents consulted persons they felt closest to, almost 34% were neutral towards the person consulted for soybean

Figure 5.10: Manica village 4 soybean information network

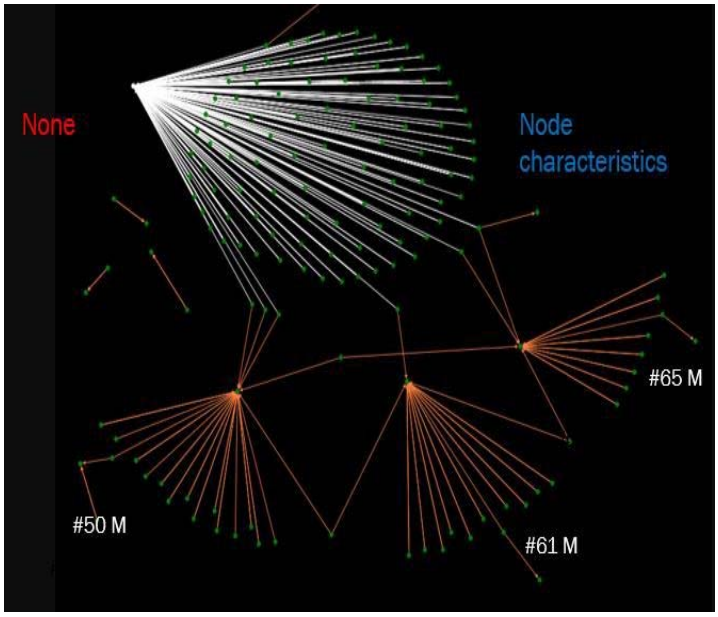
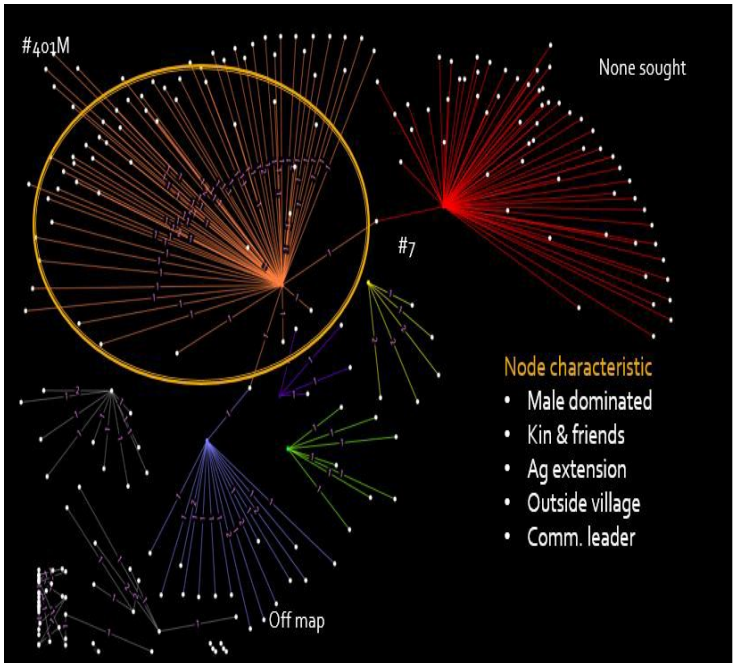


Figure 5.11: Manica village 5 soybean network node characteristics



information and almost 25% felt distant to the person consulted.

There were slight differences between men and women's relationships. Our data suggested that men were more likely to obtain information regarding soybeans from persons they were not close to compared to women. About seven percent of the men in Manica village 5 compared to no (zero) women, said they obtained soybean information from persons they were not close to. There were also more men (45%), compared to women (28%) in Manica village 5 also described their relationship with persons consulted on soybeans as neutral (see Table 5.3). On the contrary, 25% of Manica village 4 women said they obtained information on soybeans from persons they were not close to. Almost 32% of the men and 36% of the women in Manica village 4 said they felt neutral towards the person consulted on soybeans within the village. However, 34% of the men and 33% of the women in Manica village 4 said that they consulted people they felt closest to on soybeans. The following table 5.3 provides comparison data of men and women between both villages based on their reported network densities (strength of ties on persons consulted for soybean).

Table 5.3: Network density score comparison by village and gender based on source consulted for soybean information within the village

Network density score	Manica village 5			Manica village 4		
	% Men (n=58)	%Women (n=64)	%Total (n=122)	% Men (n=79)	%Women (n=92)	%Total (n=171)
1	6.9		3.28	24.05	25	24.56
1.5				2.53	1.09	1.75
1.67				1.27		0.58
2	44.83	28.13	36.07	31.65	35.87	33.92
2.33				1.27	0	0.58
2.5	1.72	4.69	3.28	5.06	4.35	4.68
2.67				0	1.09	0.58
3	46.55	67.17	57.38	34.18	32.61	33.33

An independent t-test was adopted to test if there were statistically significant differences in the reported densities between villages and gender. The mean score for both villages based on a sample of 293 was 2.3 ± 0.421. The mean score for Manica village 5 was 2.56 ± 0.501 and Manica village 4 2.11 ± 0.059. The combined density score for both villages was 2.3 ± 0.81, and the mean difference -0.45 ± 0.81 (t (291) =-5.536, p<0.001). Based on these results, network densities among residents of Manica village 5 were stronger (more dense) compared to those of Manica village 4.

The independent t-test comparing network densities between men and women showed the mean network density for men at 2.24 ± 0.62 and mean for women at 2.31 ± 0.58. Although the mean combined density score for both men and women was 2.29± 0.42 (t (291) = -1.265, p>0.1) and the differences between men and women's network densities were not statistically significant. Based on these findings, we concluded that network densities (strength of ties) observed between men and women were similar and not statistically significantly different.

When we compared network densities (strength of ties) across the six age categories, we noticed a bimodal distribution between age and strength of relationships as demonstrated by the data on Table 5.4. For example, 32% of those aged 35 and 43 years described their relationships with those they consulted for soybean information as neutral (1.66) and strong (2.66), those aged between 44 and 52 years old expressed having distant (1.5) and neutral relationship with those they consulted on soybean information.

Although persons between 26 and 34 years of age were more likely to contact person they felt closest to (33.1%) when compared to the other age groups, the same group was also most likely to consult with persons they felt distant to (34.8%). About 25% of those aged between 18 to 25 years old felt that they shared a little more than neutral (2.5) feelings with those consulted. Although our data suggested there were differences on the reported relationship strengths, a one-way ANOVA tests showed that these differences were not statistically significant, (F=0.439, P=0.897).

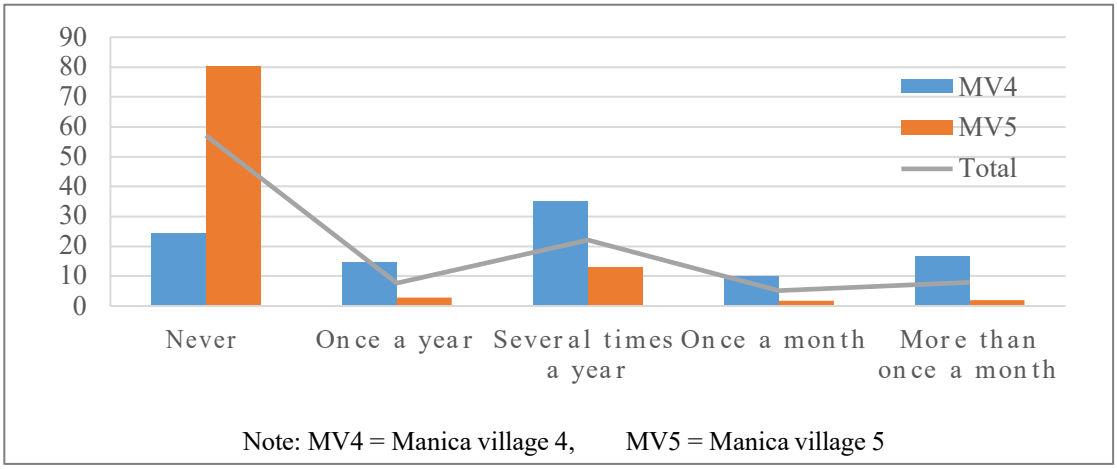
Table 5.4: Comparison on strength of tie based on the decision-maker's age group

	Strength of ties with person consulted on soybeans								
Age	1	1.5	1.67	2	2.33	2.5	2.67	3	% Total
18-25 years	13.04	0	0	13.86	0	25	0	11.81	13.01
26-34 years	34.78	33.33	0	21.78	0	33.33	0	33.07	29.11
35-43 years	17.39	0	100	31.68	100	16.67	100	24.41	26.03
44-52 years	19.57	33.33	0	16.83	0	8.33	0	14.96	16.1
53-61 years	10.87	0	0	8.91	0	16.67	0	7.87	8.9
62-99 years	4.35	33.33	0	6.93	0	0	0	7.87	6.85

Access to agricultural extension

To evaluate access to agricultural extension services we asked respondents how many times they had spoken or consulted with an agricultural extension officers over the last 12 months. About 57% (N=601) reported as never speaking to an agricultural extension officer. Only 22% reported speaking to an agricultural extension officer several times a year, eight percent spoke to an extension officer once a month, five percent consulted an agricultural extension officer once a month and almost eight percent said they had spoken to an agricultural extension officer only once over the year. The estimated mean of speaking with agricultural extension officers in MV4 was 2.8 (SD. 1.355) and MV5 1.42 (SD 0.921). Overall residents in MV5 were less likely to consult agricultural extension officers compared to those in MV4 and these differences were statistically significant based on the Pearson chi-square test (4) = 196.155 ($p<0.001$).

Figure 5.12: Comparisons on how frequent respondents consult agricultural extension by village



Note: MV4 = Manica village 4, MV5 = Manica village 5

Only 28% of our respondents had participated in farmer field schools over the last five years. Slightly more men (30.3%) compared to women (25.8%) said they had attended farmer field school in the last five years. Comparisons between the two villages showed majority (49.4%) of those who had attended farmer field days were from MV4. Likewise, few (33%) had ever participated in demonstration plots over the last five years. However, contrary to our previous question there were statistically significant gender differences on participation in demonstration plots (Pearson chi2 1=4.7 $p<0.05$). Almost 38% men and only 29% women had participated in demonstration plots over the last five years. Like our previous question, residents in MV4 (55.4%) were more likely to have participated in demonstration plots compared to those in MV5. These differences were also statistically significant at $\alpha=0.001$ based on Pearson chi-square test.

Table 5.5: Access to agricultural extension services, farmer field schools and demonstration plots by village

Access to agricultural extension	Study village	N	Mean	Std. Dev.	Std. Err. Mean
How often do you talk to agriculture extension agent?	MV4	249	2.80	1.355	0.086
	MV5	352	1.42	0.921	0.049
Have you participated in farmer field school in the last 5 years?	MV4	249	1.51	0.501	0.032
	MV5	352	1.87	0.334	0.018
Have you participated in demonstration plot or field day visit in the last 5 years?	MV4	249	1.45	0.498	0.032
	MV5	352	1.82	0.381	0.020

Note: MV4 = Manica village 4
MV5 = Manica village 5

Access to land

The average land size owned by households in MV4 and Manica village 5s was 2.756 ± 1.875 hectares. The average size of land cultivated by a random sample of 148 decision-makers in MV4 was slightly larger (2.83 ± 0.114 ha)

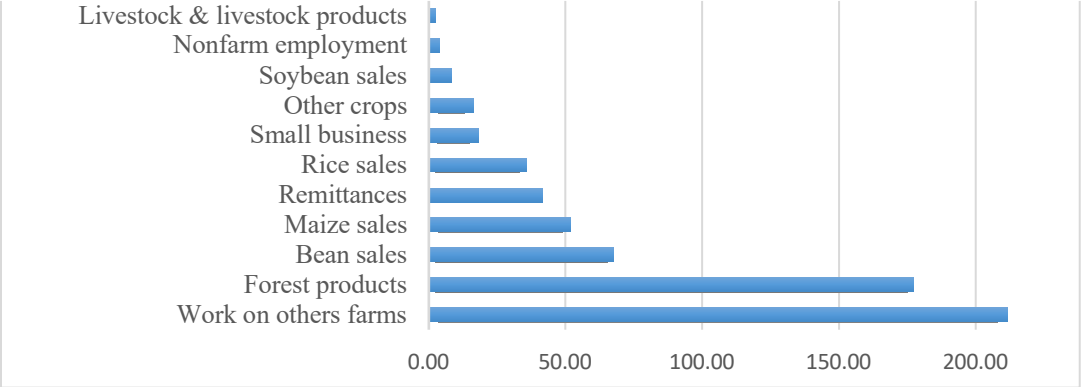
compared to that cultivated by the random sample of 281 from Manica village 5 (2.72 ± 0.125 ha). Regardless of these slight differences, the size of land cultivated in Manica village 4 was not statistically significantly larger than Manica village 5 based on the results (t (427) = 0.597, p = 0.551). An independent t-test was also used to test for differences in sizes of land accessed by both men and women. The results showed the average (mean) size of land accessed by both men and women was 2.8 ± 0.90 hectares. Men accessed slightly larger 2.78 ± 0.13 ha. of land compared to women 2.7 ± 0.125 ha. Based on our results, t(427)) = 0.397, P>0.1), there was no statistically significant difference between size of land accessed/ cultivated by men and women in MV4 and Manica village 5.

Household income

The average household income based on a sample of 425 decision makers in both Manica village 4 and Manica village 5 was approx. USD 589.67[13] (41, 715.75 Metical's). The estimated household income was generated based on the total income reported on sale of crops such as soybeans, maize, beans, livestock products, work on othe'rs farms, remittances, small business and non-farm employment reported under SUNS. Households earned the highest level of income by working on other people's farms and selling of forest products as illustrated by Figure 5.13.

[13] The Mozambican Metical (MZN) exchange rate was estimated based on Dec 31,2016 foreign exchange rate of 70.7450 MZN to 1 USD as provided by www.oanda.com/currency/converter.

Figure 5.13: Mean household income (USD) based sale of farm products and employment



Overall, households in both villages reported having earned only eight dollars in the previous year from soybeans compared to $68 earned from sale of common beans, cowpea and other beans, and $52 earned from maize. Households earned the least amount of income ($2.5) from livestock and livestock products. The reported household income ranged from no income (zero) to $ 8, 057.11 (57,000 MZN). The combined mean of household income between both villages was estimated at $ 589.66 ± 71.13 (41,715.75 MZN). The mean household income in Manica village 4 was $503.23 ± 112.67 (MZN 43,179.66 ± 65414.25).

An independent t-test was run on the sample of 425 responses obtained from the two villages to determine if there were differences on the reported income. The results showed that households in Manica village 4 reported slightly higher income levels, $610.36 ± 82.69 compared to households in Manica village 5 $ 576.00 ± 57.23. Regardless of these differences, the reported household income in both villages were not statistically significantly different, t (423) =0.2935, p= 0.77. An independent t-test was also run to test if there were differences in the reported household income based on gender. The mean income reported by 189 men was

(MZN 61,484.97 ± 7125.10) and (MZN 25,883.62± 4,281.437) by 236 women. These differences were statistically significant, t (423) 4.4665, *p*=0.00. Household income reported by men was (MZN 35,601.35 ± 7,970.715) more statistically significant compared to that reported by women.

CHAPTER 6: RESULTS

This chapter presents results based on the data discussed in the previous two chapters. The first part of this chapter presents the macro-level analysis based on the WEAI+ survey instrument data. The second part presents results on the micro-level analysis based on the NPS and SUNS survey instruments.

Macro-Level Results

As previously discussed in the methods section, this study adopted a macro-level analysis approach because it provided a unique lens through which through which differences in soybean uptake among smallholder farmers in rural Mozambique could be examined.

An independent t-test examining relationship between soybean uptake and gender was run on a random sample of 410 men and 469 women who identified themselves in the WEAI+ survey as the primary decision-makers of their household. Soybean uptake was measured as 1 (uptake) and 0 (no uptake). The results showed statistically significant differences in soybean uptake between men and women, t (877) = 2.410, p = 0.3655. Men were more likely to uptake soybean (0.5146 ± 0.0247) compared to women (0.48401 ± 0 .0231).

Findings based on one-way ANOVA test used to test for regional differences in soybean uptake across 881 households found that the mean number of households that had grown soybean was 49.6 percent. The Central region had the lowest mean at 36.1percent followed by the Northeast region at 45.2 percent. The Northwest region had the highest mean of households that had grown

soybeans in the past. Based on analysis of variance test, these differences were statistically significant (F =34.15, P<0.001). The Schaffe post-hoc test noted significant differences between the Northwest and Central region and between the Northeast and Northwest region.

Effect of sociodemographic characteristics on soybean uptake

To test our first hypothesis on the effect of extension services and agricultural groups on soybean uptake, several logistic regression models using varying sociodemographic characteristics were estimated. The assessed sociodemographic characteristics assessed included, gender, type of household, level of education, ability to speak Portuguese and religion. Results obtained from the socio-demographic models could explain only 2.5% of the variation observed in soybean uptake within our sample population as noted on table 6.1.

A second model controlling for ethnic diversity explained at least 13% variance observed in soybean uptake. The model also showed that, there was a curvilinear relationship between age of the decision-maker and soybean uptake. According to the beta coefficient obtained by ethnic model, a one-year increase in the decision-makers age increased soybean uptake by 5.6%. The positive relationship between age and soybean uptake was observed up to the age of 56.9 years[14]. In other words, soybean uptake could be expected among decision makers aged below 57 years old. This finding was statistically significant at p-value 0.05.

14 Turning point for the age quadratic term is based on: X*= ((0.143/2(-0.00134))

Table 6.1 Logistic regression models estimating on soybean uptake among smallholder farmers in rural Mozambique based on sociodemographic characteristics

Variables	Socio-dem (N=875)	Ethnic (N=875)
Gender of decision–maker (female)	-0.0156	0.0558
	(0.153)	(0.164)
Age of decision-maker	0.0429*	0.0556**
	(0.0236)	(0.0252)
Age squared	-0.000377	-0.000524**
	(0.000248)	(0.000264)
Type of household (ref: unmarried)		
Married (dual couple)	-0.103	0.0364
	(0.252)	(0.267)
Educational attainment (ref: no education)		
Primary level	-0.290	-0.112
	(0.254)	(0.275)
Secondary level	-0.560	-0.442
	(0.353)	(0.384)
College/technical training	0.752	0.602
	(1.175)	(1.242)
Able to speak Portuguese	-0.377	-0.777***
	(0.255)	(0.285)
Religious affiliation (ref: Muslim)		
Christian	1.896***	1.644***
	(0.547)	(0.567)
Traditionalist & Other	1.953***	1.669***
	(0.580)	(0.603)
Ethnicity (ref: Lomue)		
Macua		-2.463***
		(0.407)
Chechewa		0.628***
		(0.219)
Shona		-0.117
		(0.319)
Chute		-1.118***
		(0.228)
Other		-0.311
		(0.281)
Intercept	-2.056**	-1.473
	(0.953)	(1.017)
-2 Log Likelihood	30.57**	153.21***
Pseudo R^2	0.0252	0.1263

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.

We also found out that having the ability to speak Portuguese did promote soybean uptake. This finding is interesting because Portuguese is the main language for Mozambique. Persons who identified themselves as Christians or Traditionalist were also more likely to uptake soybeans compared to those who identified as Muslims.

The results showed ethnicity played a significant role in soybean uptake. According to our logistic regression model on table 6.1, the probability of soybean uptake among decision-makers who identified themselves as belonging to the Macua tribe and Chute was less compared to those of the Lomue tribe, holding all other factors constant. As such, decision makers from the Macua tribe were more than twice less likely compared to those of the Lomue tribe to uptake soybeans. This finding is statistically significant at p-value 0.001. On the contrary, decision-makers who identified as part of the Chechewa tribe were expected to uptake soybeans at an increased rate of 62.8% compared to those who identify as Lomue. This finding was also statistically significant at p-value 0.001. Since our data had noted that the decision-makers interviewed were of diverse ethnicities, our subsequent model controlled for ethnic differences. The Pseudo R^2 obtained from this model was 0.1263, as shown on table 6.1. Therefore, we could explain almost 13% of the variation observed on soybean uptake among smallholder farmers in rural Mozambique by taking into consideration their ethnic background.

Given that our data had shown regional differences in soybean uptake and that ethnic groups found within our sample were predominantly organized by region, our next models controlled for regional differences within our sample

population. The Lomue and Macua were the main ethnic group in the Northeast region, while the Shona and Chute were located in the Central region. Using this knowledge, we tested the effect of region on soybean uptake while controlling for socio-demographic factors. The model adopted was a good fit (LR =164.78, p<0.001) and explained 13.57% of the variation observed in soybean uptake. To ensure our data was in the range we estimated we found that the predicted mean of 878 observations was 0.4971 with a standard deviation of 0.2036. Based on these findings our data was in range and we could correctly estimate the probability of soybean uptake.

The logistic regression results obtained from our regional comparison model presented on table 6.2 showed statistically significant regional differences. Households located in the Northwest region of Mozambique were almost twice more likely (1.963 log odds) to uptake soybeans compared to households in the Central region, holding all other factors constant.

Table 6.2: Logistic regression output on effect of sociodemographic characteristics and region on soybean uptake

Variables	Sociodemographic (N=875)	Regional comparison (N=879)
Gender of decision-maker (female)	-0.0355	-0.0343
	(0.162)	(0.163)
Age of decision maker	0.0672**	0.0617**
	(0.0270)	(0.0271)
Age squared	-0.000650**	-0.000587**
	(0.000283)	(0.000285)
Education level (ref: no education)		
Primary education	-0.115	-0.0735
	(0.274)	(0.276)
Secondary education	-0.380	-0.267
	(0.382)	(0.385)
College & Other	0.629	0.675
	(1.244)	(1.241)
Person speaks Portuguese	-0.836***	-0.866***
	(0.285)	(0.288)

Married household	-0.0276	0.0866
	(0.137)	(0.143)
Ethnic group (ref: Other)		
Nhanja	2.994***	1.540
	(1.096)	(1.265)
Lomue	0.745**	0.555
	(0.290)	(1.235)
Macua	-1.760***	-1.965
	(0.452)	(1.294)
Chechewa	1.389***	-0.262
	(0.282)	(0.676)
Shona	0.555	0.793**
	(0.363)	(0.378)
Chute	-0.453	-0.222
	(0.294)	(0.312)
Size of household	-0.00473	0.00208
	(0.0354)	(0.0357)
Region of Mozambique (ref: Central)		
Northeast		0.450
		(1.245)
Northwest		1.963***
		(0.722)
Intercept	-0.538	-0.932
	(0.907)	(0.923)
Pseudo R2	0.1293	0.1357

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.

In-depth assessment of socio-demographic characteristics by village

Based on a sample of 879 respondents from all three regions, 50% of those surveyed reported that no one in their household had ever tried to grow soybeans in the past. The remaining 49.8% reported someone in their household had tried to grow soybeans in the past. These differences were statistically significant based on the Pearson Chi-square test (64.51, P= 0.000).

To better understand these regional and ethnic differences observed by the models, we controlled for village. An in-depth look at soybean uptake by village showed villages in the Northwest region had the highest log odds of up-taking

soybeans compared to those in the Northeast and Central regions (see table 6.3). Households located in Manica village 5 had the lowest uptake probability across the nine villages examined. Households in Manica village 4 had a 5% less chances of up taking soybeans when compared to Mutore and the other eight villages. The regression models comparing each of the three villages by the region also show the village effect most pronounced in the Central region as the Pseudo R^2 is much higher (0.1205)

Table 6.3: Logistic regression output showing beta coefficient of 9 study villages located in Northwest, Northeast and Central Mozambique, based on WEAI+ Survey data

	Inter-village comparison			Regional
	Northwest	Northeast	Central	(FULL)
Variables	(n = 303)	(n=260)	(n=313)	(N=878)
Gender of decision maker (female)	-0.194	0.495	-0.281	-0.0168
	(0.267)	(0.311)	(0.271)	(0.157)
Age of respondents	0.0115	0.0673	0.0648	0.0515**
	(0.0455)	(0.0464)	(0.0419)	(0.0247)
Age squared	-0.00014	-0.000467	-0.0005	-0.000453*
	(0.0005)	(0.0005)	(0.0004)	(0.0003)
Type of household (ref. unmarried)				
Married	-0.272	0.251	0.622	0.0442
	(0.196)	(0.294)	(0.401)	(0.263)
Edu attainment (ref: no edu)				
Primary	-0.546	-0.573	1.037**	-0.124
	(0.496)	(0.449)	(0.509)	(0.267)
Sec pry	-0.534	-0.256	0.767	-0.351
	(0.899)	(0.734)	(0.614)	(0.373)
college/other			1.314	0.741
			(1.564)	(1.221)
Person speaks Portuguese	-0.792	-1.326***	-0.735	-0.966***
	(0.551)	(0.471)	(0.491)	(0.280)
Study village				
Namiepe (ref. Murriumu)	-			
Zomba village (ref. Murriumu)	-			
Nhamane village (ref. Bjango)		-		
Ntapo village (ref. Bjango)		-		
Manica village 4 (ref. Mutore)			-0.0571	
Muhhinga village (ref. Mutore)			-0.94***	
			(0.359)	
Region of Mozambique (ref. Northeast)				

Central				-0.412**
				(0.180)
Northwest				1.322***
				(0.203)
Intercept	2.668*	-0.612	-2.879*	-0.0772
	(1.595)	(1.387)	(1.630)	(0.807)
-2 Log Likelihood	4.27	14.75*	49.20***	97.75***
Pseudo R2	0.0112	0.0412	0.1205	0.0803

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance

Women's participation in decision-making of food crops and cash crops

Women in rural Mozambique participate in decision-making of food crops and cash crop farming. Our data showed that both men and women (N=866) were fully engaged in deciding what inputs were to be used in food crop farming. However, when it came to cash crop farming, only 78% of the women and 83% of the men, had some level of participation in deciding about the cash crop farming. The WEAI^{+} survey asked respondents who said they participated in food crop farming to rank their level of participation from "no input" to "all decisions". Results from a one-way ANOVA test examining if there were differences in the various decision-making level showed that there were statistically significant differences between men and women, F=54, p = 0.000. The Scheffee post-hoc test further showed that women participated 51.6% less compared to men in making decisions about cash crop farming. A previous test comparing both men and women's level of participation in food crop farming had also shown women participated 47.8% less compared to men.

Several models assessing effect of women's participation in decision making on soybean uptake were tested. Similar to our previous models, the

regional effect was positive in all of them and explained almost 14% of the uptake. When we tested uptake across the various age groups, based on region and their participation in decision making we found soybean uptake was statistically significant among women aged 26- 34 years old, 44- 52 years, and 53-61 years old. We also found that women who were not able to speak Portuguese were 82.8% less likely to participate in soybean uptake. Women from the Macua tribe were 2.5 times less likely to uptake soybean compared to those from the Lomue tribe.

The adopted decision-making model, on table 6.4, could explain 15.5% of the variation observed on soybean uptake in the three regions of Mozambique (see table 6.4). The results showed, women in the Northwest were 2.6 times more likely compared to women in the Central region to uptake soybeans. The model also showed a 36.8% increase in soybean uptake among women who participated in decision-making. When we tested the probability of soybean uptake among women based on their sociodemographic characteristics, region and level of participation in deciding what inputs should be purchased or used in food crops and cash crops, our model we found that there was a positive effect on soybean uptake based on age, region and level of participation as shown on table 6.4, and table D1 and D2 (in appendix D).

To gain a deeper understanding on the sociodemographic, cultural and productive capital factors that contributed to women's soybean uptake, a subset of 455 women only was first tested to see the effect of decision making on soybean uptake. The results, showed that sociodemographic characteristics of the women

alone could only explain about 3% of the variation observed in uptake. Educational attainment by women alone played a significant role in their participation in soybean uptake. Women with primary level education alone were 67.5% less likely to uptake soybeans compared to those who had no education. One's ability to speak Portuguese was also found to be a negative predictor to soybean uptake. When the model controlled for region and decision making, women who could not speak Portuguese were 94.4% less likely to uptake soybeans. Given that the Northwest region had the highest uptake, a closer examining on of the women located only in the Northwest region (n=181) showed that women who participated in all decision making regarding cash crops had the highest (61.69%) uptake rates while those who did not participate had less than a 30% chance as shown on table 6.5.

Table 6.5 Probability estimates of soybean uptake among female decision-makers in the Northwest region alone.

Level of decision-making in cash crop farming	Probability estimate based on Delta-method (n=181)					
	Margin	Std. Err.	z	P>|z|	[95% conf.	Interval]
None	0.2933	0.038025	7.71	0.00	0.2188	0.3678
Some	0.5862	0.03824	15.33	0.00	0.5112	0.6612
Most	0.5595	0.03464	16.15	0.00	0.4916	0.6274
All	0.6169	0.04111	15.01	0.00	0.5363	0.6974

The probability of a household with a female decision maker who participates in all levels of decision-making regarding cash crop farming compared to men is estimated at 62% in the Northwest region, 61% in the Central region and 60% in the Northeast region. This is statistically significant ($p=0.000<0.001$). To

get a better understanding on the role decision-making had on soybean uptake we tested a random sample of 181women from the Northwest region. Our estimates showed soybean uptake increased with each higher level of decision-making as illustrated on table 6.4.

Effect of productive capital, extension and social networks.

Studies of social networks and social capital note that access to physical capital such as land, cellphone, radio, and means of transportation are key to agricultural technology uptake. Having found that women's level of participation in deciding what inputs were used in cash crops as significant, the study used a random sample of 456 women to test the effect of productive capital, social capital and social networks on soybean uptake.

For the purposes of this study, the logistic regression models presented in table 6.6 were adopted to assess soybean uptake across the three regions. The productive capital model assessed uptake based on physical assets such as radio, cellphone and means of transportation (land was not assessed because everyone had access to land and there was no variability observed). The household labor index, access to extension officers, the number of times one had met an extension officer over the last year and if they had received any free seed from extension services, we also considered under our productive capital model. The model accessing credit took into consideration credit accessed by household members from NGOs, formal and informal lenders, friends and relatives and other sources. The last model examined uptake based on social networks, agricultural production and marketing groups.

Table 6.6: Logistic regression models estimating soybean uptake based on sociodemographic characteristics, region, and productive capital across 3 regions of Mozambique.

Variables	Model 1 Socio (N=875)	Model 2 Phy_cap. (N=874)	Model 3 Soc_cap. (N=872)
Gender of decision-maker (female)	0.0359	-0.00892	-0.0379
	(0.177)	(0.190)	(0.191)
Age of decision-maker (ref: 18-25 years)			
26 - 34 Years	0.619**	0.629**	0.652**
	(0.247)	(0.263)	(0.266)
35 -43 Years	0.222	0.0776	0.0441
	(0.246)	(0.267)	(0.272)
44 - 52 Years	0.626**	0.600**	0.585**
	(0.272)	(0.291)	(0.294)
53 -61 Years	0.854***	0.562	0.525
	(0.328)	(0.360)	(0.363)
62 - 99 Years	0.452	0.246	0.215
	(0.294)	(0.319)	(0.322)
Person speaks Portuguese	-0.721***	-0.661***	-0.647***
	(0.198)	(0.211)	(0.213)
Type of household (ref: Married)			
Female-only	0.0566	0.0749	-0.00350
	(0.298)	(0.334)	(0.338)
Male- only	-0.807	-1.404*	-1.382
	(0.761)	(0.834)	(0.842)
Ethnic group			
Macua	-2.523***	-3.121***	-3.124***
	(0.416)	(0.450)	(0.453)
Chechewa	-0.673	-1.129	-1.103
	(1.100)	(1.254)	(1.293)
Shona	1.209	0.964	1.112
	(1.164)	(1.277)	(1.308)
Chute	0.184	0.196	0.330
	(1.145)	(1.254)	(1.288)
Other	0.299	-0.0652	0.0239
	(1.101)	(1.212)	(1.241)
Region of Mozambique (ref: Northwest)			
Central	-2.647***	-2.694***	-2.833***
	(0.645)	(0.702)	(0.710)
Northeast	-1.163	-1.121	-1.126
	(1.097)	(1.248)	(1.286)
Level of decision-making on use of inputs on crops			
Some decisions in food crop inputs	-0.177	-0.748	-0.773
	(0.488)	(0.632)	(0.641)

Most decisions in food crop inputs	-0.172	-0.786	-0.668
	(0.494)	(0.636)	(0.646)
All decisions in food crop inputs	0.446	-0.0506	0.0368
	(0.519)	(0.654)	(0.662)
Some decisions in cash crop inputs	1.092***	0.908***	1.008***
	(0.291)	(0.305)	(0.310)
Most decisions in cash crop inputs	1.216***	0.980***	0.989***
	(0.306)	(0.322)	(0.326)
All decisions in cash crop inputs	0.693**	0.398	0.385
	(0.344)	(0.362)	(0.365)
Productive capital			
Access to land		-1.866*	-1.713*
		(1.012)	(1.011)
Access to nonfarm business equipment		0.697**	0.674**
		(0.326)	(0.327)
Access to radio		-0.524***	-0.535***
		(0.195)	(0.197)
Access to cellphone		-0.102	-0.0723
		(0.203)	(0.204)
Access to means of transportation		0.213	0.251
		(0.190)	(0.192)
Number of times met with extension in 1 year			
1 time		0.906***	0.860***
		(0.282)	(0.286)
2 times		0.251	0.190
		(0.366)	(0.377)
3 times		-0.136	-0.372
		(0.619)	(0.639)
4 + more times		1.507***	1.552***
		(0.526)	(0.531)
Received free seed from extension in last 12 months		-1.407***	-1.349***
		(0.255)	(0.259)
Social networks			
Belongs to agriculture group			-0.359
			(0.254)
Received NGO credit in last 12 months			0.257
			(0.734)
Received credit from informal lender in last 12 months			-0.818
			(0.865)
Received micro finance loan in last 12 months			-0.539
			(0.746)
Intercept.	1.328	5.772***	8.214***
	(1.233)	(2.034)	(2.232)

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance

Results from our logistic regression showed that increase in household labor index, access to radio, extension services and free seed had a significant effect on soybean uptake. Based on the variables assessed, our model on productive capital explained 16.13% of the variation observed among women in the three regions of Mozambique. Increase in household labor had a positive effect on soybean uptake, holding all other factors constant. Likewise, having access to a radio and free seed from extension services had a positive effect on soybean uptake, holding all other factors constant. Surprisingly, there was a negative effect on soybean uptake if one had met an extension service officer. This finding was statistically significant at p-value 0.001.

Our model controlling for access to credit could explain almost 17% of the variation observed on soybean uptake although none of the sources of credit had a significant effect on soybean uptake. When access to agricultural producer groups and marketing groups were further considered (see model 4 in table 6.7), our model explained 17.1% of the variation observed on soybean uptake across all three regions. While these were acceptable models, based on the goodness of fit measures observed (LR chi2 (18) = 107.79, $p<0.00$), access to social networks such as agricultural groups did not have a statistically significant effect on likelihood of uptake of soybeans. A more in-depth analysis of the effects of social network characteristics on soybean uptake is found in the next section that focuses on two villages in a single region.

Micro Level Results

The micro-level analysis method used in this study provided a way to measure the effect of social networks on soybean uptake in the Central region. The approach chosen provided a way to examine inter-village, intra-village and inter-household soybean uptake behavior. The results based on logit and logistic estimates on soybean uptake by men and women between Manica village 4 and Manica village 5. Corresponding to the macro-level estimates previously presented, the models used in this section test soybean uptake based on the decision makers socio-demographic characteristics as well as household access to productive and social capital. In addition to these variables, the effect of access to social network and soybean networks within the villages on uptake are assessed.

Our previous macro-level WEAI^{+} data on the Central region, had shown that 68% of the households surveyed (n=314) had previously tried growing soybeans. This response was based on 59% men and 40.7% women in the three villages surveyed in Manica province. When the same respondents were asked if they (themselves) had ever tried to grow soybeans in the past, fewer women (24.7%) compared to men (32%) said they had planted soybeans sometime in the past five years.

Soybean uptake

An independent t-test was run on a sample of 169 respondents from Manica village 4 and 255 respondents from Manica village 5 to test if there were statistically significant differences in soybean uptake between the two study villages. The results showed that respondents from Manica village 5 had a statistically lower soybean uptake rate (0.10588 ± .01931) compared to respondents from Manica village 4 (0.2367 ± 0.03279), t (422) = 3.6637, p = 0.0003. An independent t-test examining soybean uptake between men and women in our sample did not find any statistically significant differences between men and women's uptake, t (422) = -0.4125, p = 0.6802.

Effect of sociodemographic variables on soybean uptake at micro-level

We used several logistic regression models to estimate the effect of socio-demographic characteristics on soybean uptake. The adopted socio-demographic model controlled for gender, age, type of household and village. Educational attainment and marital status were excluded from our models since there was no variability across our sample.

Based on the logistic regression model presented on table 6.8, we could only explain 6.25% of the variation on soybean uptake based on the sociodemographic characteristics of decision makers. According to this model, female decision-makers had a greater (68.6%) chance to uptake soybeans compared to male decision-makers, holding all other factors constant. This finding was statistically significant at p-value 0.1. We also found a curvilinear relationship between age of decision-maker and soybean uptake. Based on our results, a one

year increase in the decision-maker's age increases the likelihood for soybean uptake by 15.3% holding all other factors constant. Hence there is a positive relationship observed up to the age of 53.36[15] years when uptake starts to decline. Hence there was an increasing- decreasing relationship between age and soybean uptake. Our model also notes that, households in Manica village 4 were 2.5 times more likely (0.920 log odds) to uptake soybeans compared to households in Manica village 5, holding all other factors constant. This finding was statistically significant at p-value 0.001.

Table 6.7: Logistic regression Model showing Socio-demographic characteristics contributing towards soybean uptake in Manica village 4 and Manica village 5

Variables	Sociodemographic (n=424)
Gender of decision maker (female)	0.523*
	(0.287)
Age of decision maker	0.143**
	(0.0600)
Age squared	-0.00134**
	(0.000622)
Type of household (ref: unmarried)	
Married (dual couple)	0.374
	(0.573)
Village (ref: MV5)	
Manica village 4	0.920***
	(0.280)
Intercept	-6.126***
	(1.478)
-2 Log Likelihood	23.14***
Pseudo R^2	0.0625

Note. *Standard errors in parentheses,* *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.

15 Turning point for the age quadratic term is based on: $X^* = \frac{0.0429}{2(-0.000377)}$

To ensure none of the socio-demographic characteristics were collinear, we tested our model for multi-collinearity. The results showed that none of our variables were highly correlated since none of the correlation values, as shown on table 6.8, were over 0.70.

Table 6.8: Correlation matrix for sociodemographic variables affecting soybean uptake in rural Mozambique

	Soy_up	fem	age	age_sq	dual_hh	MV4
Soy_up	1					
female	0.0633	1				
age	0.0969	-0.1753	1			
age_sq	0.0775	-0.1689	0.984	1		
dual_hh	0.0149	-0.149	0.0383	0.0342	1	
MV4	0.1756	-0.0452	0.2052	0.2022	-0.0847	1

Effect of productive capital and social capital on soybean uptake

To test our first hypothesis, which had hypothesized that households with access to extension services and agricultural groups would participate in soybean farming, we ran several productive capital and social capital models. Access to productive capital such as land and labor were considered as physical productive capital. Access to agricultural extension officers, number of times met with extension, number of relatives and friends in the village were considered as types of social capital. Knowledge on persons within the village who were often consulted on soybeans also was considered as social capital.

Our productive capital and social capital estimation model, explained 14.27% of the variation observed on soybean uptake. There was a positive effect of living in Manica village 4 and size of household and soybean uptake (see table

6.10). According to our productive and social capital model, households in Manica village 4 were almost four times more likely to uptake soybeans compared to households in Manica village 5, holding all other factors constant. This finding is statistically significant at p-value 0.001.

Table 6.9: Logistic regression models showing effect of socio-demographic characteristics, productive capital and social capital on soybean uptake between Manica village 4 and Manica village 5 of Manica Province.

VARIABLES	(model 1) Socio-demo.	(model 2) Prod. capital
	(n=424)	(n=424)
Gender of decision maker (female)	0.523*	0.442
	(0.287)	(0.303)
Age of decision maker	0.143**	0.0808
	(0.0600)	(0.0639)
Age squared	-0.00134**	-0.000629
	(0.000622)	(0.000666)
Type of household (ref: unmarried)		
Married (dual couple)	0.374	-0.142
	(0.573)	(0.612)
Village (ref: MV5)		
Manica village 4	0.920***	1.361***
	(0.280)	(0.439)
Productive capital		
Size of household		0.222***
		(0.0619)
Land (ha.) -total cultivated by household		0.0390
		(0.0816)
Social capital		
Number of relatives in village		0.154
		(0.212)
Number of friends in village		-0.636***
		(0.241)
Number of people consulted on soybean in village		0.831
		(0.795)
Number of times consult with extension		0.104
		(0.132)
Intercept	-6.126***	-7.368***

	(1.478)	(2.753)
-2 Log Likelihood	23.14***	52.79***
Pseudo R^2	0.0625	0.1427

Note. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.

The positive effect observed between size of household and soybean uptake showed households with more member had a 22% greater chance to uptake soybeans. Our results also show that having a large friendship network within the village had a negative effect on soybean uptake. The odds of households to uptake soybeans decreased by 63.4% with each one new friend gained. This finding was statistically significant at p-value 0.001.

Contrary to our first model and our previous macro-level estimates that had noted age as a significant predictor of soybean uptake, our logistic regression model controlling for the same socio-demographic characteristics along with the household productive capital did not find age to be a significant predictor. To better understand why this had happened, we subdivided our data by gender and re-ran the same models.

In-depth look at the Effects of productive capital and social capital on soybean uptake in Manica village 4 and Manica village 5

Using a sample of 235 females and 198 males from both Manica village 4 and Manica village 5, we estimated the effect of socio-demographic characteristics, productive capital, and social capital on soybean. The obtained Pseudo R^2 from both samples was higher and could explain 15.26% of the variation observed on soybean uptake among men and 18.72% of the variation observed in women (see table 6.11). Based on these findings, we concluded there were other

unique characteristics between the two sample populations that needed to be examined.

A closer examination between the two sets of models show that the age of women, their village and size of friendship networks within their village affect soybean uptake. Soybean uptake among women increases by 14.8% each year of age. Women are more likely to uptake soybean as they get older. Similar to our general sample (previously estimated in table 6.8), the observed relationship between age and soybean uptake continues up to the age of 53.36 years and then declines. This finding is statistically significant at p-value 0.1. Women with larger friendship networks within the village are also the most unlikely to uptake soybeans. While location (village) remains a significant predictor to soybean uptake among females in both the socio-demographic and productive capital model, this is not the case for men. Instead, the size of household becomes a significant predictor to soybean uptake. Our model did not find access to extension services nor number of people consulted on soybeans as significant. Hence based on these findings we rejected our hypothesis and concluded that soybean uptake is not influenced by access to extension services and agricultural groups.

Table 6.10: Logistic regression models comparing effect of sociodemographic characteristics, productive capital and social capital on soybean uptake between male and female decision-makers in Manica village 4, Manica Province.

	Male -Only		Female only	
	(1)	(2)	(3)	(4)
Variables	Socio-dem. (n=198)	Productive capital (n=198)	Socio-dem. (n=235)	Productive capital (n=235)
Age of decision maker	0.132	0.0267	0.175**	0.148*
	(0.0959)	(0.104)	(0.078)	(0.0834)
Age squared	-0.00129	-0.00017	-0.001*	-0.00125
	(0.0009)	(0.00104)	(0.001)	(0.00087)
Married (dual couple)			0.134	-0.177
			(0.612)	(0.674)
Village				
Manica village 4	0.889**	0.926	1.477***	1.818***
	(0.408)	(0.629)	(0.377)	(0.592)
Productive capital				
Size of household		0.270**		0.0869
		(0.106)		(0.0799)
Size of land (ha.) cultivated by household		-0.00514		0.122
		(0.124)		(0.117)
Social capital in village				
Number of relatives in village		0.113		0.515
		(0.340)		(0.319)
Number of friends in village		-0.497		-0.960***
		(0.384)		(0.354)
Number of people consulted on soybean		1.773		1.758
		(1.279)		(1.104)
Number of times consult with extension		0.327		0.0490
		(0.204)		(0.182)
Intercept	-5.180**	-9.423**	-6.66***	-10.69***
	(2.278)	(4.424)	(1.844)	(3.839)
-2 Log Likelihood	7.59*	26.22***	29.76***	41.30***
Pseudo R2	0.0442	0.1526	0.1349	0.1872

Note. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.
(i) Reference groups not married (ii) village reference group Manica village 5

Effect of social networks on soybean uptake

Diversity in networks accessed for soybean information

Our second and third hypotheses predicted that decision-makers with diverse information networks would be more likely to uptake soybeans. To examine this, logistic regression models controlling for socio-demographic characteristics, productive capital, social capital and various types of social networks were examined. The types of information networks assessed by the model (presented in table 6.12) adopted to test our hypothesis included; kin, non-kin, agro-dealers, traders and extension agents. The kin network comprised relatives. The non-kin network comprised friends, community leaders and neighbors. The agro-dealer network comprised all persons that were identified as traders, aggregators and/or agro-dealers. The extension network was comprised only agricultural extension officers. For the purposes of this analysis, the full sample of 424 respondents was first examined.

The results obtained from our diversity model based on a sample of 424 respondents explained 18% of the variation observed on soybean uptake (see model D, table 6.11). The overall results suggested that decision makers with knowledge on who to consult regarding information on where to purchase soybean seed, what inputs to use, were more likely to uptake soybeans. The model also showed that the odds to uptake soybeans increased almost two times (1.933 log odds) among persons with more diverse networks. Households that consulted a larger proportion of extension agents on soybeans were 4.6 times more likely to uptake soybeans compared to households that did not consult extension. Although these results are convincing based on the statistical evidence observed,

it is worth noting that there are very small differences reported by the pseudo R^2 observed particularly between the non-kin and diverse network models. Based on these results, we cannot reject our hypothesis.

Table 6.11: Logistic regression models assessing effect of diverse soybean information networks on soybean uptake in MV4 and Manica village 5.

	Types and number of soybean networks accessed			
Variables	(Model A) Base (n=424)	(Model B) Kin (n=424)	(Model C) Non_kin (n=424)	(Model D) Diverse (n=424)
Gender of decision-maker (female)	0.420	0.420	0.265	0.332
	(0.302)	(0.302)	(0.312)	(0.313)
Age of decision- makers	0.0857	0.0877	0.0772	0.0791
	(0.0636)	(0.0646)	(0.0659)	(0.0664)
Age squared	-0.000676	-0.0007	-0.00053	-0.00059
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Married (ref: unmarried)	-0.239	-0.229	-0.113	-0.435
	(0.598)	(0.600)	(0.620)	(0.612)
Manica village 4	1.501***	1.495***	1.873***	1.612***
	(0.404)	(0.405)	(0.408)	(0.611)
Productive capital				
Size of household	0.224***	0.224***	0.231***	0.237***
	(0.0616)	(0.0617)	(0.0639)	(0.0645)
Size of land (ha.)	0.0560	0.0562	0.0231	0.0287
	(0.0780)	(0.0780)	(0.0817)	(0.0825)
Social capital in village				
Number of relatives in village	0.159	0.160	0.244	0.185
	(0.210)	(0.210)	(0.214)	(0.213)
Number of friends in village	-0.649***	-0.648***	-0.705***	-0.689***
	(0.239)	(0.238)	(0.241)	(0.243)
Village soybean network	0.723	0.716	2.168**	1.933**
	(0.773)	(0.774)	(0.873)	(0.869)
Networks consulted on soybeans				
Proportion of kin		0.489	2.298	1.572
		(2.510)	(2.633)	(2.544)
Proportion non-kin			5.779***	
			(1.776)	
Proportion agro/traders				2.218
				(1.636)
Proportion extension				4.561***
				(1.223)
intercept	-7.028***	-7.076***	-13.24***	-11.04***

	(2.696)	(2.708)	(3.257)	(3.187)
-2 Log Likelihood	52.17***	52.20***	66.18***	66.55***
Pseudo R^2	0.1410	0.1411	0.1789	0.1799

Note. *Standard errors in parentheses,* *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.

Network density

Comparisons between MV4 and Manica village 5 networks shows that networks in Manica village 4 have higher densities, compared to Manica village 5 (see figure 6.1). The identified and measured soybean networks were obtained using NodeXL which graphed responses obtained from our sample of 601 respondents using the NPS. There were four main influential networks identified in Manica village 4 and three main influential networks in Manica village 5 that affected the likelihood of adopting soybeans. See table 6.12.

Network R_401 had the highest density score (0.004508) followed by network R_6 (0.000986). Manica village 5 had the lowest network density (0.000290). Our data and SNA output had shown the MV4 soybean networks and agriculture information network Centralized around node R_401. Estimates using the Delta-method found the probability of soybean uptake was highest (60.7%) among actors linked to network M_61. The probability to uptake soybean among households linked to network M_65 was 24% and 25.3% for households connected to network R_401.

Figure 6.1: Comparison of network density scrores based on primary node identified as key informant for soybeans in the village

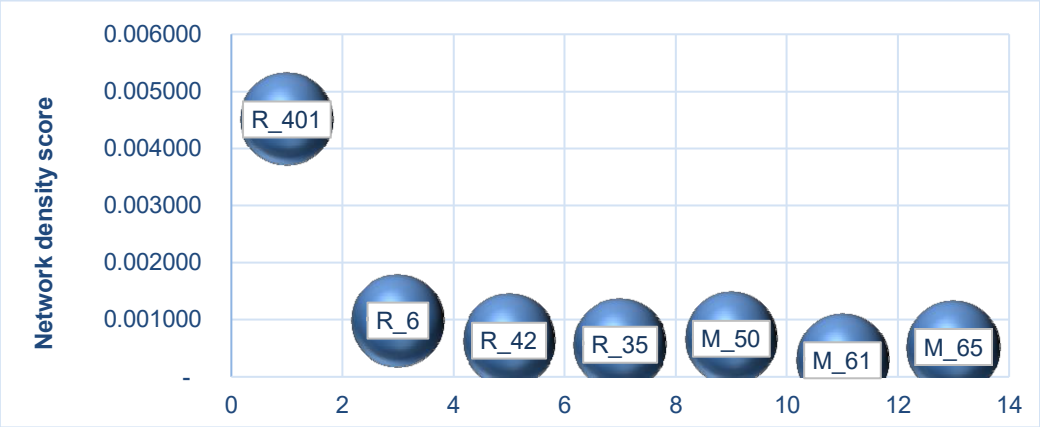


Table 6.12: Comparison of Manica village 4 and Manica village 5 uptake rates based on soybean network influencers

Village	N	Soybean network (Influencer)	# Links	% Uptake	Characteristics of Influencer
MV4	169	R_401	64	13.01	Agric. extension officer
MV4	169	R_6	14	14	Relative
MV4	169	R_42	9	12.5	Friend, neighbor
MV4	169	R_35	8	12.5	Community leaders, relative
MV5	255	M_50	36	5.5	Community leader, Agro-dealer
MV5	255	M_61	26	2	Community leader, relative
MV5	255	M_65	17	1.2	Community leader

Note: MV4 (Manica Village 4)
MV5 (Manica Village 5)

Our third hypothesis had hypothesized that younger female decision-makers were more likely to uptake soybeans due to more diverse information networks. Our results show a negative relationship between gender, land, income, size of friendship networks in the village, unique soybean networks in the village, intensity of ties and soybean uptake. We observed positive relationships between age, size of household, size of kin network in village, number of people one knew

in their village to consult on soybean (size of village soy network), access to demonstration plots and farmer field days.

We had also hypothesized that households with younger decision-makers were more likely to report higher income and subjective wellbeing for their households. The models assessed showed that older women were almost 3 times less likely compared to men to uptake soybeans. Similar to our previous models, larger friendship networks did not promote soybean uptake, however larger kin networks were four (4) times more likely to promote soybean uptake. We also found that larger households were more likely to provide access to labor needed for soybean farming. On the contrary access to more land and income have an inverse relationship with soybean uptake suggesting the more income and land a household has, the higher the propensity to not uptake soybean. Based on these findings we rejected the hypothesis that assumed younger women as more likely to uptake soybeans due to their diverse networks.

Strong/weak ties

To test our second and third hypothesis, we chose to estimate our models using a smaller sample size, for two reasons. First, our data comparing strength of ties (tie intensity) between the two villages had noted little variability within the Manica village 5 respondents. However, the Manica village 4 data on strength of ties had a normal distribution curve. Second, our previous models had shown that Manica village 4 had a higher propensity to adopt soybean compared to Manica village 5. Therefore, we assessed effect of strength of ties using a sample of 80 men and 89 women (n=169) from Manica village 4

The results obtained from our logistic regression model on table 6.15 could explain more than half (51.06%) of the variation observed on soybean uptake among households in Manica village 4. Interpretation of the model suggests women are almost three times less likely to uptake soybeans compared to men in Manica village 4. Access to productive capital, such as household labor, land and income have mixed results on soybean uptake. Households with more members have a 1% increase in soybean uptake with every extra member gained. The negative effect observed in the land variable suggests households with access to more land for farming are less likely to uptake soybeans. Similarly, households with high income are less likely to uptake soybeans.

Table 6.13: Logistic regression models assessing effect of relationships (intensity of ties) on soybean uptake in Manica village 4

	1	2	3	4	5
	Soc.demo	Prod capital	Soc.cap	Dense_SN	S/weak ties
VARIABLES	(n=169)	(n=169)	(n=169)	(n=169)	(n=118)
Gender of decision-maker (female)	1.131***	0.544	-0.125	-0.227	-2.744*
	-0.405	-0.47	-0.644	-0.752	-1.436
Age of decision-maker	0.0569	0.0106	-0.0979	-0.127	-0.446**
	-0.0767	-0.0813	-0.0982	-0.116	-0.205
age_sq	-0.000621	-0.000175	0.000936	0.00133	0.00445**
	-0.000788	-0.000841	-0.000998	-0.00123	-0.00224
Type of household (ref: unmarried)					
Married (dual couple)	0.552	0.00735	0.55	1.268	0.572
	-0.693	-0.794	-0.927	-1.145	-1.273
Productive capital					
size_hh		0.0755	0.254**	0.746***	1.010***
		-0.101	-0.129	-0.204	-0.256
Size of agric land (ha)		0.201	-0.0502	-0.383*	-0.458*
		-0.139	-0.166	-0.207	-0.245
Household income		-1.30e-05*	-2.99e-05**	-1.68E-05	-6.23e-05**
		-7.17E-06	-1.19E-05	-1.22E-05	-2.58E-05
Social capital					
Size of village kin network			1.627**	3.261***	4.039***
			-0.744	-1.03	-1.207
Size of village friendship network			-1.108*	-2.259***	-2.312**
			-0.594	-0.829	-0.913
Size of soy network accessed			3.004**	5.826***	9.194***
			-1.391	-1.974	-2.648
Participated in farmer field school			0.815	0.334	0.271
			-0.696	-0.764	-1.002
Access to demo plot & field visits			1.034	2.151**	4.211***
			-0.817	-0.972	-1.365

Kin consulted regarding soy			2.008	2.787*	-13.56
			-1.266	-1.454	-2,041
Non-kin consulted regarding soy			2.191***	4.565***	-14.59
			-0.749	-1.048	-2,041
Unique soy networks (ref: R_42)					
R_401				-1.977**	-5.339***
				-0.777	-1.593
R_6				-5.964***	-7.582***
				-1.635	-2.043
R_35				-4.209***	-7.729***
				-1.472	-2.65
Strength of tie (Intensity)					-2.910**
					-1.25
Constant	-3.520*	-2.328	-14.00***	-28.18***	-9.61
	-1.809	-1.92	-4.945	-7.35	-2,041
-2 Log Likelihood	10.05**	19.13**	56.50***	78.25***	75.73***
Pseudo R2	0.0545	0.1034	0.3055	0.4231	0.5106

Note. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.

Our model also shows types of networks and characteristics of those networks as affecting soybean uptake. There was a moderately negative correlation (-0.294[16]) noted between strength of tie and number of people known in the village that could be consulted on soybeans (size of village soybean network). Based on this relationship, households with weak (low intensity) ties were more likely to uptake soybeans compared to households with strong ties. Surprising we find a positive effect between kin networks and soybean uptake. This finding suggests that the propensity of soybean uptake increases by 4 times

[16] See correlation matrix in appendix 6 – figure 6.2

when there are more relatives in the village and decreases when there are more friends in the village.

Our logistic regression model 5 in table 6.13 also shows that decision-makers with access to demonstration plots, and those who have participated in farmer field schools over the last five years were also more likely to uptake soybeans compared to those who had not had the opportunity to do either. Surprisingly, this model also shows a negative relationship between the unique village soybean networks and soybean uptake. Upon, assessing the model for correlation, we find that the unique networks (nodes) have negative correlation (-0.3536). Hence based on these findings, further analysis to understand this effect is needed.

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[17] See correlation matrix in appendix 6 – figure 6.2

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Summary

The results obtained from all nine villages (macro-level analysis) show region and village as the most important predictors of soybean uptake among smallholder farmers. Although socio-demographic factors such as gender, age, ethnicity and one's ability to speak Portuguese were significant predictors to soybean uptake, they did not explain much of the variation observed in soybean uptake. Based on our models, women were less likely to uptake soybeans compared to men. However, when women were involved in deciding what inputs should be purchased and used in cash crop farming, their uptake increased. Access to non-farm business equipment, radio, and agricultural extension services were to some degree found to be significant predictors for soybean uptake among smallholder farmers.

The results obtained from the two study villages based in Manica province (micro-level analysis) suggested that gender and age were the main sociodemographic predictors of soybean uptake at the community level. Access to productive and social capital among men and women was also found to affect soybean uptake in differing ways. For example, access to more labor promoted soybean uptake among male decision-makers but not female decision-makers. Decision-makers with more relatives (larger kin networks) in their village were also more likely to uptake soybeans. Finally, our models suggested that even though men and women with access to agricultural extension officers and diverse

information networks had the highest propensity to uptake soybeans, women with large friendship networks are the least likely to uptake soybeans.

CHAPTER 7: DISCUSSION

The results obtained from both the macro and micro level analysis show that there are significant regional differences in the soybean uptake rates; that women are less likely, compared to men to uptake soybeans; and that the types of networks accessed affect soybean uptake in rural Mozambique. Villages in the Northwest region of Mozambique were the most likely to uptake soybeans followed by those in the Northeast region. Villages in the Central region however, were the least likely to uptake soybeans despite having favorable agro-climatic conditions for the beans.

Mozambique's soybean production has increased dramatically following the government's economic development agenda, multilateral organizations and NGO promotion of soybeans in the region. The Mozambique government's effort to promote agricultural development and alleviate poverty have led to various programs expected to promote technology transfer. Soybeans are also presumed to provide smallholder farmers income diversification opportunities as well as address food security concerns. However, despite these benefits, majority of the smallholder farmers lack access to seed, fertilizer, credit and markets.

Previous studies on Mozambique smallholder farmers by Smith and Findeis (2013) noted that women in rural Mozambique often struggle to grow crops for their home consumption due to poor agricultural soils, limited access to improved seed, limited access to credit, assets, and market among other reasons. The researchers also noted that most of the women did not have access to agricultural

extension services. Although majority of the women decision-makers in our study noted having joint ownership on land cultivated by the household, there were differences on soybean uptake.

Smart and Hanlon (2014) noted that one fifth of Mozambique's soybean producers are in located in Gurue district (Northeast region). This success was attributed mainly to the region's long history (almost 30 years) of soybean farming and NGO support. Compared to the Central region where SIL has been working, soybeans were first introduced in the Lioma state farm (a government owned farming community in Gurue), by Brazilians in the 1980 and later by World vision in 2002. Most recently, IITA and Technoserve have played a significant role in the development of soybean value chain through improved seed varieties and promotion of cooperatives that link farmers to the market (Smart & Hanlon, 2014; Walker and Cunguara, 2016).

TechnoServe and the Cooperative League of the USA (CLUSA) can be argued to have led the big-push in the Northeast region of Mozambique. The majority of the smallholder farmers in Gurue district are registered in cooperatives (farmer groups) that provide access to farm inputs such as seed, fertilizer, credit and market (Smart & Hanlon, 2014). Although majority of the respondents interviewed in this study said they did not belong to agricultural groups, nor received credit from NGOs nor formal organizations, we did find that decision-makers who had access to diverse sources of information within the village, as well as those who had participated in farmer field days and demonstration plots were more likely to uptake soybeans. Likewise, farmers who knew where to market

soybeans or persons within their village who could market their soybeans were also more likely to participate in soybean farming.

Majority of women in Mozambique perceive their primary role as one of care giving and providing labor at the family farm (Mubichi, Field notes 2015). Women are also culturally expected to participate in planting, weeding and harvesting of crops. Marketing of crops as well as decision-making on types of cash crops to be grown are assumed to be men's role. Although this custom is not unique to Mozambique, it does to some extent hinder women's participation in the formal economy as many depend on their spouses or male members of the family to market their crops.

Karamba and Winters (2015) noted that competing social and economic interests between men and women affect cropping choices between men and women. Soybeans in Mozambique are assumed to be a cash crop rather than food crop (Walker & Cunguara, 2016). Hence it could be argued that women interested in provisioning for their households would be reluctant to allocate their limited resources, primarily land and labor to soybeans which are not typically consumed at the household level.

Older decision-makers are more likely to have access to more productive capital and social capital that promotes their participation in soybeans. Our study found a moderately strong /positive relationship between age, participation in farmer field schools and participation in demonstration plots. This suggested that older decision-makers with more experience, more diverse networks and access to labor might be more willing to try new agricultural innovations.

Although farmers might be interested in trying the soybeans, the current market infrastructure is lacking. The qualitative and quantitative data obtained in this study shows, that majority of Mozambicans have limited access to credit and markets. Many also lack collateral needed to access formal credit. The focus group discussions conducted in Manica village 4 and Manica village 5 showed that there was very little collaboration/ collective action at the village level. Many of the farmers did not trust each other and therefore were not engaged in farmer groups that provided credit or access markets outside their immediate communities.

The role of agricultural extension officers in Mozambique is to disseminate information. Therefore, agricultural extension officers do not provide seed nor fertilizer needed to promote soybean uptake. Extension services in Mozambique are limited primarily by lack of human resources and budgetary constraints. For example, according to the director of agricultural development in the Central region, there were only 16 extension officers instead of the recommended minimum of 24 available to serve a population estimated at 119,000[18] Majority of these extension officers lack transportation while others are unable to access rural communities due to lack of roads. Many of the government agricultural extension officers are also men and often lack access to continued training due to constrained government budgets.

18 Estimate of population obtained from the Mozambique population census data provided at: http://knoema.com/MNSORS2012Nov/regional-statistics-of-mozambique-2015

Social capital provides bonding and bridging ties that promote agricultural technology adoption. This study found that the number of friends, relatives and persons' one consulted on soybeans influenced their uptake. Similar to previous agricultural technology adoption studies in the region, we also found that kin networks promoted technology adoption (Bandiera & Rasul, 2006; Van de Broeck & Dercon's, 2011). On the contrary, large friendship networks as well as strong relationship ties hindered women's participation in soybean uptake.

Policy implications

This study found that agricultural information networks within rural Mozambique are highly Centralized and as such access to information limited. Women make up 60-80 % of the labor force in Mozambique's agricultural production, yet majority of the agricultural extension officers and community leaders are men (Palacios-Lopez, Christiaensen et al. 2017). Women also lack access to productive and social capital such as credit, improved seed and access to groups which might improve access to agricultural innovations. Recognizing that majority of the women lack access to agricultural technology information due to existing social norms, capacity building programs that encourage mentorship and appointment of women in leadership positions might facilitate access to information and improved farm management systems.

Women's participation in decision-making regarding agricultural production has been linked to improved nutrition and food security (Olivier & Heinecken, 2017; Mason et al, 2017). These improvements are often as a result of women allocating more resources towards food, health, clothing and education for their children

(Kristjanson, et al, 2017; Mason, et al, 2017; Quisumbing et al, 2014). Previously, Smith and Findeis (2013) found that majority of the late adopters of improved legume seeds among Mozambicans lacked security and wanted to see others successfully grow and market the new crop before they could adopt. Faced with a fast growing population and declining soil fertility, an agricultural development policy that promotes development of market infrastructure which would promote access to improved seed varieties, farm input such as fertilizers, credit and markets could mitigate poverty.

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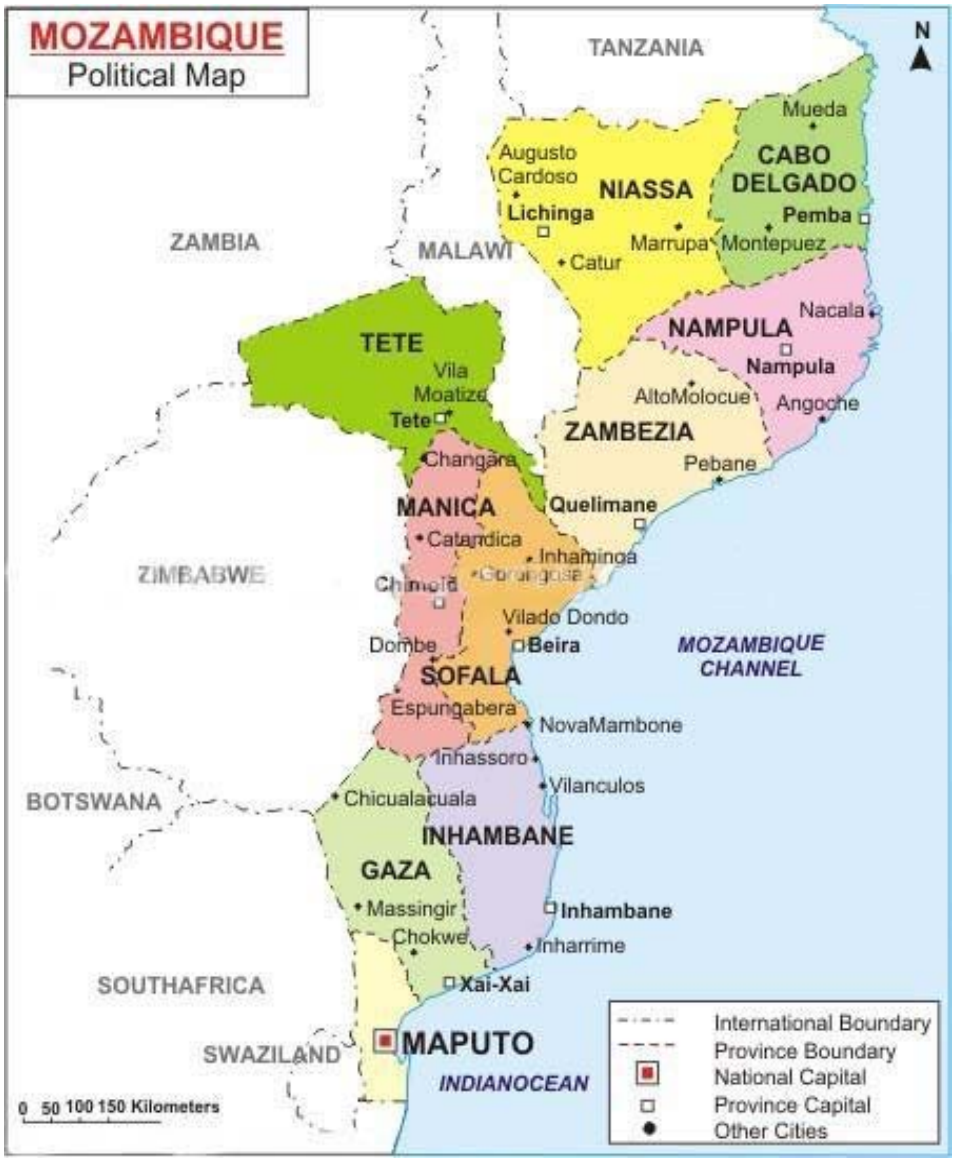
APPENDICES

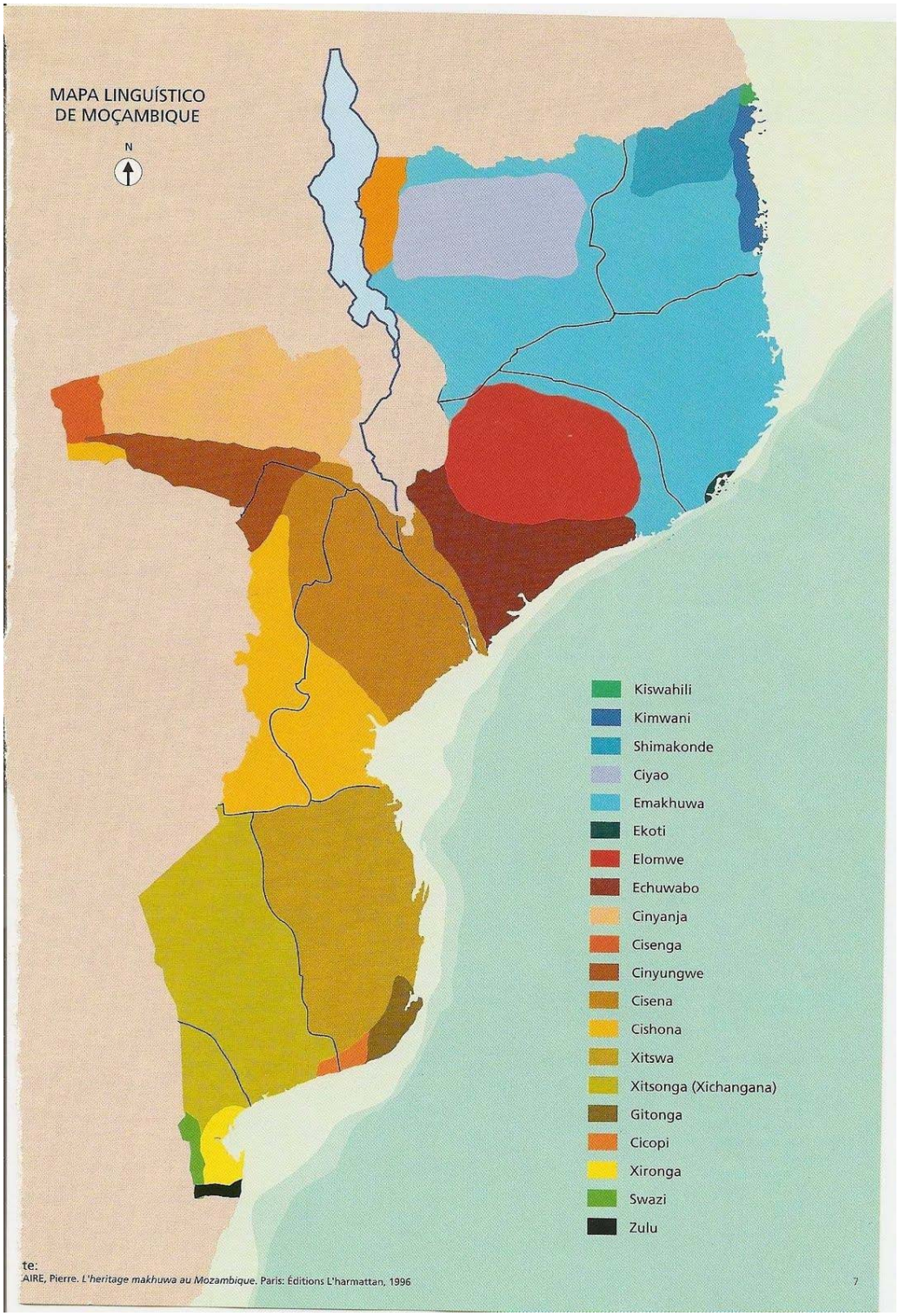
Appendix A: Chapter 1

Figure A1: Administrative provinces of Mozambique



Source: https://goo.gl/images/IAkRO9

Figure A2: Linguistic and Ethnic group map of Mozambique



Appendix B: Chapter 3

Data collection instruments

B1 - Mozambique WEAI+

WEAI+/Mozambique Survey YR1

MODULE A. Enumerator: This survey is administered to individuals who self-report that they are: 1) 18 years or older, 2) are a decision-maker in the household, and 3) reside in this village. Check each box to indicate:

- ☐ You have gained informed consent from participant.
- ☐ You have noted the correct RESEARCH IDENTIFICATION NUMBER – RIN – on EVERY PAGE of this survey.
- ☐ You have asked to interview the participant in an area where other members of the household cannot overhear or contribute answers.

MODULE A. DEMOGRAPHICS	Code
A1. District ID Number……	
Angonia…….....….2	
Gurue…….…….3	
Lichinga…...…….4	
Malema……...5	
A2. Research ID Number ……..→	
A3. Date of interview (dd/mm/yyyy) ……....……→	/ /
A4. START TIME of interview (24 hh : mm)……..…→	:
A5. Sex of participant	
Male……...1	
Female……...2	
A6. Type of household…… Married couple……..……..…1	
Female-only head of household... 2	Specify:
Male-only head of household.....3	
A7. Language spoken at home by participant……..….	
A8. Marital status of participant	
Never married……..….1	
Married…….…..2	
Separated……...……3	
Divorced…….…….4	
Widowed…...……5	

	Code
household…….	
Muslim……..……..1	
Christian……..……...2	Specify:
Traditionalist……..……..3	
Other (specify) ……..…….4	
A10. Ethnic group of participant……Yao……..……...…1	
Nhanja…… 2	Specify:
Lomue...…….3	
Macua……...…4	
Chechewa.……5	
Shona……..…..6	
Chiute……7	
Other (specify) 8	
A11. End TIME of interview (24 hh : mm)……..…→	: - -
A12. ENUMERATOR: Your Individual enumerator code…→	
A13. ENUMERTOR: Your PAIR enumerator code.....…→	
A14. Interview Outcome…	
Completed…..…….1	
Incomplete……2	
No eligible adult at home……3	

MODULE B.1. DWELLING CHARACTERISTICS	Enumerator: For B1—B4, OBSERVE ONLY...DO NOT ASK participant to respond
B1. Roof's material	
Thatch.....…1	
Corrugated metal sheets….2	Specify:
Asbestos…….…..3	
Other (specify) ……..…….4	
B3. Exterior wall material Mud plaster…….……..1	
brick……..……..... 2	
Cement/concrete block……...…3	
Other (specify) ……..……..…4	

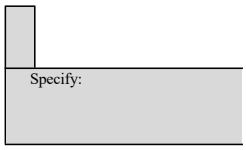
B2. Floor's material

Earth……..……1

Cement/concrete……2

Vinyl tiles……..3

Other (specify) …….…….4



B4. State of dwelling repair…… Excellent ..1

Good repair……..... 2

Moderate wear…… .. 3

Poor repair……..4

Very bad repair……..……..5

B5. Is your compound shared with other households?……..…… Yes…1 No….2

B6. If YES: Total number of households that share your compound (including yours)…….……

B7. Is your house shared with other households?..... Yes…1 No….2

B8. If YES: Total number of households that share your house (including yours)……..……..……

B9. Is your house…….. Rented……..……..…1
Self / spouse owned…..2
Other family owned…. ..3
Other (specify) …….…4

B10. How many rooms are in your house? (Do not count toilet, kitchen, hallways)…… # Rooms

B11. How many rooms are used JUST for sleeping?..... # Rooms

B12. Is there a water source (tap) inside your house? Yes…1 No….2

B13. What is household's main source of water for general use?
Borehole……..…1
River, pond, stream, dam, spring…….…..2
Well……..…3
Public tap (someone else's private tap…..4
Piped into your compound……..……5
Piped into your dwelling……...6
Other (specify) ……..……7

B14. What is your household's main source of drinking water?
Borehole……..…1
River, pond, stream, dam, spring…….…..2
Well……..…3
Public tap (someone else's private tap…..4
Piped into your compound……..……5
Piped into your dwelling……...6
Other (specify) ……..……7

B15. Do you use a process to prepare water used for drinking?

Yes…1 No….2
→ If NO, skip to B17

B16. What process do you use to prepare water for drinking?
……...1
Filtered……..2
Filtered & boiled……..……3
Natural treatment (with herbs, charcoal, stones, etc) 4
Other (specify)……..5

B17. Does your dwelling have access to electricity? Yes…1 No….2

B18. What is the main lighting source for your household?
Electricity via national grid…..1
Lanterns, candles, paraffin….2
Fire lit sticks, grass, or pit…...3
Liquid petroleum……..4

B19. What type of kitchen does your household use?
External kitchen 1
Internal kitchen……...2

B20. What is the main cooking fuel your household uses?
Firewood…….... 1
Charcoal……..…2
Liquid petroleum ……3
Kerosene……..……..4
Other (specify) ……..…..5

B21. What is the main destination of household waste for your household?
Collected by local authority 1
Own garbage pit or heap...……....2
Own burned or buried…….3
Public garbage……4
Dumped in vacant land, property…….……5
Dumped in river, pond, stream, dam, spring…..6
Other (specify) ……..……..7

B22. Main type of toilet your household uses?

Pit latrine……..…… 1
Public toilet (flush / bucket / KVIP)……..…2
Bush (no toilet)……..……..……3
Toilet in anther house..... 4
Other (specify) ……..……..…….5

Module C. DEFINITION OF A "HOUSEHOLD"

Enumerator: Read this section to the participant: In our survey, a member of your household is ANYONE who has lived in your household for at least 3 months of the past 6 months and takes food from the "same pot" as other members of your household most of the time.

MODULE C.1. HOUSEHOLD DEMOGRAPHICS | C1. Based on this definition: How many TOTAL # of people are members of your household……..…. Number →

	(Relationship of household member to SELF) Self..……..1 Spouse……..2 Father ……3 Father-in-law…….4 Mother……..5 Mother-in-law.……6 Brother..……7 (7A, 7B, 7C, etc) Brother-in-law..… 8 (8A, 8B, 8C, etc) Sister……..9 (9A, etc) Sister-in-law …...10 (10A, etc) Son……11 (11A, etc) Son-in-law……12 (12A, etc)	(Relationship: Continued) Daughter……13 (13A, etc) Daughter-in-law…14 (14A, etc) Grandson……..15 (15A, etc) Granddaughter….16 (16A, etc) Nephew……..17 (17A, etc) Niece……..18 (18A, etc) Foster boy……..19 (19A, etc) Foster girl……...20 (20A, etc) Male lodger, non-laborer…..21 (21A, etc) Female lodger, non-laborer…22 (22A, etc) Male Agric Laborer……..23 (23A, etc) Female Agric Laborer…….24 (24A, etc)	Person's age in years (# yrs old)	Person's marital status: Married monogamous Married polygamous Single/never married.....7 Divorced.....8 Widowed.....9 Separated.....10	Person's local language Yao……1 Nyanja……2 Lomue……3 Macua……4 Chechewa…… 5 Shona……6 Chiute……7 Others……8	Person currently attends school Yes…1 No….2	Person can speak Portuguese Yes…1 No….2 [SKIP TO Ch]	Person can read and write Portuguese Yes…1 No….2	Highest grade of education completed by person Less than primary (or no school)…1 Primary……..2 Secondary……..3 College……4 Vocational School……..5 Technical School……..6 Other (specify)……..7
	Ca		Cb	Cc	Cd	Ce	Cf	Cg	Ch
C1	1 [that is, you (yourself)]								
C2									
C3									
C4									
C5									
C6									
C7									
C8									
C9									
C10									
C11									
C12									
C13									
C14									
C15									

Module c.2. Household Hunger Scale		Code
C16	In the past 4 weeks, was there ever NO FOOD to eat of any kind in your dwelling because of lack of resources to get food? ……..…... Yes…1 No….2	

C17	How often did this happen in the past 4 weeks? ……... Never……1 Rarely (1-2 times)……..……2 Sometimes (3-10 times) …..……3 Often (more than 10 times) …….4	
C18	In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food? …….. Yes…1 No….2	
C19	How often did this happen in the past 4 weeks? ……... Never……1 Rarely (1-2 times)……..……2 Sometimes (3-10 times) …..…3 Often (more than 10 times) …….4	
C20	In the past 4 weeks, did you or any household member go a whole day and night without eating anything at all because there was NOT enough food? Yes…1 No….2	
C21	How often did this happen in the past 4 weeks? ……... Never……1 Rarely (1-2 times)……..……2 Sometimes (3-10 times) ……..…3 Often (more than 10 times) …….4	

MODULE D. KEY CROP CULTIVATION: Enumerator: All questions refer to the immediate past cropping season.

	cROP	In the immediate past cropping season, did any member of your household cultivate [CROP]? Yes 1 No 2 [If NO, skip to next CROP]	If YES, what was the approximate size of the [CROP] plot in acres? Less than 1/4 acre……1 1/4 acre……..……2 1/2 acre…..……3 1 acre ……4 If more than 1 acre of [CROP] was cultivated, specify # of acres	If YES, what was the quantity of [CROP] produced? I do not know……. 98 Specify # of bags of [CROP] (bag size: 50 or 100Kg)	If YES, what was the income from [CROP] produced? I do not know……. 98 MT (Meticais)	If YES, was [CROP] also consumed by your household? Yes 1 No 2
		Da	Db	Dc	Dd	De
D1	Maize					
D2	Rice					
D3	Soybean					
D4	Cassava					
D5	Sorghum					
D6	Groundnut					
D7	Cowpea					
D8	Beans					
D9	Millet					
D10	Pigeonpea					
D11	Vegetables					

MODULE E.1. HOUSEHOLD DECISION-MAKING

Activity	In the immediate past cropping season, did you (yourself) participate in [ACTIVITY]? Yes 1 No 2	If YES: How much input did you have in making decisions about [ACTIVITY]? No input ..... 1 Input into very FEW decisions..... 2 Input into SOME decisions ..... 3 Input into MOST decisions ..... 4 Input into ALL decisions..... 5 No decision made..... 6	If YES: How much input did you have in decisions on the use of income generated from [ACTIVITY]? No input ..... 1 Input into very FEW decisions..... 2 Input into SOME decisions ..... 3 Input into MOST decisions 4

				Input into ALL decisions..... 5 No decision made.....6
		Ea	Eb	Ec
E1	Food crop farming (Crops that are grown primarily for household food consumption)			
E2	Cash crop farming (Crops that are grown primary for sale in the market)			
E3	Livestock raising			
E4	Non-farm economic activities (Small business, self-employment, buy-and-sell)			
E5	Wage and salary employment (In-kind or monetary work—including agriculture work & other wage work)			
E6	Fishing or fishpond culture			
E7	Handcraft			

MODULE E.2. HOUSEHOLD DECISION-MAKING IN PRODUCTION & INCOME GENERATION

Activity		Do you (yourself) have relatives—other than those listed for your household—who help your household out? [They can live locally or somewhere else] Yes 1 No 2 [If NO, skip to Ef]	If YES: How much input did they have in your decisions about [ACTIVITY]? No input ..... 1 Input into very FEW decisions.....2 Input into SOME decisions.....3 Input into MOST decisions.....4 Input into ALL decisions.....5 No decision made..... 6	Does (spouse / other HH decision-maker) have relatives—other than those listed for your household—who help your household out? [They can live locally or somewhere else] Yes 1 No 2	If YES: How much input did they have in your decisions about [ACTIVITY]? No input ..... 1 Input into very FEW decisions ..... 2 Input into SOME decisions.....3 Input into MOST decisions.....4 Input into ALL decisions.....5 No decision made..... 6
		Ed	Ee	Ef	Eg
E7	Food crop farming (Crops that are grown primarily for household food consumption)				
E8	Cash crop farming (Crops that are grown primary for sale in the market)				
E9	Livestock raising				
E10	Non-farm economic activities (Small business, self-employment, buy-and-sell)		ĵ		
E11	Wage and salary employment (In-kind or monetary work—including agriculture work & other wage work)				
E12	Fishing or fishpond culture				

MODULE F.1. Access to productive capital & Credit

	Does anyone in your HH currently have any [ITEM]? Self……1 Spouse…… 2 Self & spouse jointly... 3 Other HH member…. .4	How many of [ITEM] does your HH currently have? # of each	Who would you say owns most of the [ITEM]? Self…… 1 Spouse…… 2 Self & spouse jointly…… 3 Other HH member…… 4 Self & other HH member(s)…… 5 Spouse & other HH member(s)…… 6 Someone/group outside HH…… 7	Who would you say can decide whether to sell [ITEM] most of the time? Self…… 1 Spouse…… 2 Self & spouse jointly…… 3 Other HH member…… 4 Self & other HH member(s)……5 Spouse & other HH member(s)…… 6 Someone/group outside HH…… 7	Who would you say can decide whether to give away [ITEM] most of the time? Self…… 1 Spouse…… 2 Self & spouse jointly…… 3 Other HH member…… 4 Self & other HH member(s)……5 Spouse & other HH member(s)…… 6 Someone/group outside HH…… 7	Who would you say can decide to mortgage or rent out [ITEM] most of the time? Self…… 1 Spouse…… 2 Self & spouse jointly…… 3 Other HH member…… 4 Self & other HH member(s)…… 5 Spouse & other HH member(s)…… 6 Someone/group outside HH…… 7
Productive Capital					

			ITEM	Self & other outside people……..... 8 Spouse & other outside people……. 9 Self, spouse & other outside people... 10	Self & other outside people……..... 8 Spouse & other outside people……. 9 Self, spouse & other outside people… 10	Self & other outside people……..... 8 Spouse & other outside people……. 9 Self, spouse & other outside people... 10	Self & other outside people……..... 8 Spouse & other outside people……. 9 Self, spouse & other outside people... 10
		Fa	Fb	Fc	Fd	Fe	Ff
F1	Agricultural land for farming (pieces/plots)						
F2	Land for grazing						
F3	Large livestock (oxen, cattle, donkeys)						
F4	Small livestock (goats, pigs, sheep)						
F5	Chickens, guinea fowl, ducks, turkeys						
F6	Fish pond or fishing equipment						
F7	Farm equipment (non-mechanized)						
F8	Farm equipment (mechanized)						
F9	Nonfarm business equipment						
F10	House (and other structures)						
F11	Small consumer durables (radio, cookware)						
F12	Cell phone						
F13	Means of transportation (bicycle, motorcycle, car)						

MODULE F.2. Access to productive capital & Credit								
Lending Sources		In past 12 months, has anyone in your HH taken any loans or borrowed cash / in-kind from [SOURCE]? Yes, cash…….. 1 Yes, in-kind……2 Yes, cash and in-kind..3 No……4 → If 4, SKIP TO Fe Don't know……5 →If 5, SKIP TO Ff	Who made decision to borrow from [SOURCE]? Self…… 1 Spouse…… 2 Self & spouse jointly……. 3 Other HH member……..…... 4 Self & other HH member(s)……...5 Spouse & other HH member(s)…… 6 Someone/group outside HH…… 7 Self & other outside people…….. 8 Spouse & other outside people……. 9 Self, spouse & other outside people...10	Who makes the decision about what to do with the money / item borrowed from [SOURCE]? Self…… 1 Spouse…… 2 Self & spouse jointly……. 3 Other HH member……..…... 4 Self & other HH member(s)……...5 Spouse & other HH member(s)…… 6 Someone/group outside HH…… 7 Self & other outside people…….. 8 Spouse & other outside people……. 9 Self, spouse & other outside people... 10	If more credit had been available from [SOURCE] would you have used it? Yes 1 No 2	Why would you not have borrowed more from [SOURCE]? Have enough money…….. 1 Afraid of losing collateral…….. 2 Don't have enough collateral/ did not qualify for loan…….. 3 Afraid cannot pay back loan…. 4 Interest rate/other costs too high..…….....5 Not allowed to borrow/family dispute in borrowing decision…6 Place of lender is too far…….. 7 Other, specify…….. 8	In past 12 months, did you want to borrow or get a loan from [SOURCE]? Yes 1 No 2	Why were you not able to borrow from [SOURCE]? Have enough money…….. 1 Afraid of losing collateral…….. 2 Don't have enough collateral/ did not qualify for loan…….. 3 Afraid cannot pay back loan…. 4 Interest rate/other costs too high..…….....5 Not allowed to borrow/family dispute in borrowing decision…6 Place of lender is too far…….. 7 Other, specify…….. 8
		Fa	Fb	Fc	Fd	Fe	Ff	Fg
F14	Non-governmental organization (NGO)							
F15	Informal lender							
F16	Formal lender (bank/financial institution)							
F17	Friends or relatives							
F18	Group based micro-finance or lending**							

[** Including VSLAs (Village Savings & Loans), SACCOs (Savings & Credit Cooperatives), merry-go-rounds (rotating savings and credit associations that do not charge interest)]

MODULE G. Access to Agriculture / livestock / fisheries extensioN		Code
G1	In the past 12 months, have you (yourself) ever met with an Agricultural Extension Agents or livestock / fisheries Extension Agent?..... Yes……1 No……..……..2	
G2	In the past 12 months, how many times did you meet with an Agricultural Extension Agents or livestock / fisheries Extension Agent? ……..…… # of TIMES (specify)…….. →	
G3	In the past 12 months, have you ever been given soybean or other seed by an Agricultural Extension Agent?..... Yes……1 No……..2	
G4	In the past 12 months, when you met with an Agricultural Extension Agents, were they a male or female?..... Male……..……..…..…….. 1 Female……...……..…….. 2 Both male and female……3	

MODULE H.1. Individual leadership & influence in the community		Code	
H1	Do you feel comfortable speaking up in public to help decide on infrastructure (like small wells, roads, water supplies) to be built in your community?		No, not at all comfortable…… 1 Yes, but with a great deal of difficulty… 2 Yes, but with a little difficulty…….. 3 Yes, fairly comfortable……..... 4 Yes, very comfortable……..... 5
H2	Do you feel comfortable speaking up in public to ensure proper payment of wages for public works or other similar programs?		
H3	Do you feel comfortable speaking up in public to protest the misbehavior of authorities or elected officials?		
H4	Do you feel comfortable speaking up in public to ask Agricultural Extension Agents questions about agricultural practices, policies or decisions that affect you?		

MODULE H.2. Group membership

		How many [GROUP] are in your community? Yes 1 No 2 Don't know…..98	Are you an active member of [GROUP]? Yes 1 No 2 [Skip to Hg]	How much input do you have in making decisions in [GROUP]? No input ..... 1 Input into FEW decisions ..... 2 Input into SOME decisions ..... 3 Input into MOST decisions ..... 4 Input into ALL decisions 5	To your knowledge, is [GROUP] open to anyone who wants to join? Yes 1 No 2 Don't know…..98	To your knowledge, does [GROUP] require dues, fee, etc, from members? Yes 1 No 2 Don't know .98	To your knowledge, does someone who wants to join [GROUP] need a personal recommendation from someone already in the group? Yes 1 No 2 Don't know…..98	Why are you not a member of [GROUP]? Not interested……..1 No time ……. …2 Unable to raise entrance fees …3 Unable to raise reoccurring fees …4 Group meeting location not convenient. …….5 Family dispute/unable to join …6 Not allowed because of sex …7 Not allowed because of other reason…8 Other (specify)……...……..9
	Groups	Ha	Hb	Hc	Hd	He	Hf	Hg
H5	Agricultural / livestock / fisheries producer's group (including marketing groups)							
H6	Water users' group							
H7	Forest users' group							
H8	Credit or microfinance group (including VSLAs (Village Savings & Loans), SACCOs (Savings & Credit Cooperatives), merry-go-rounds (rotating savings and credit associations that do not charge interest)							
H9	Mutual help or insurance group (including burial societies)							
H10	Trade and business association							
H11	Civic groups (improving community) or charitable group (helping others)							
H12	Local government							
H13	Religious group							
H14	Other women's group (only if it does not fit into one of the other categories)							
H15	Other (specify)							

MODULE I.1. Decision-making

ENUMERATOR: Ask Question Ia for ALL activities below BEFORE proceeding to Question Ib. If HH does not engage in that particular activity, enter code for "Decision not made" (98) and proceed to next category.	When decisions are made regarding the following [ACTIVITIY], who is it that normally makes the decision? Main male or husband 1 Main female or wife 2 Husband and wife jointly 3 Someone else in HH 4 Jointly with someone else in HH 5 Jointly with someone else outside HH 6 Someone outside HH/other 7 Decision not made …… 98	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
Activity	Ia (Ask about EVERY activity first)	Ib

I1	Agricultural production		
I2	What inputs to buy for agricultural production		
I3	What types of crops to grow for agricultural production		
I4	When or who would take crops to the market		
I5	Livestock raising		
I6	Non-farm business activity		
I7	Your own (singular) wage or salary employment		
I8	Minor household expenditures (such food for daily consumption or other household needs)		
I9	What to do if you (yourself) has a serious health problem		
I10	Whether or not to use family planning to space or limit births		
I11	How to protect yourself from violence		
I12	Whether and how to express religious faith		
I13	What kind of tasks household members will do on a particular day		

MODULE I.2. Decision-making					
ENUMERATOR: This set of questions is very important. I am going to give you some reasons why people act as they do in the activities I just mentioned. You might have several reasons for doing what you do and there is no right or wrong answer. Please tell me how true it would be to say: [If HH does not engage in that particular activity, enter 98]		My actions in [DOMAIN] are determined by the situation. I don't really have an option. Never true…… 1 Not very true…… 2 Somewhat true…… 3 Always true…….. 4 Decision not made …… 98	My actions in [DOMAIN] are partly because I will get in trouble with someone if I act differently. Never true…… 1 Not very true…… 2 Somewhat true…… 3 Always true…….. 4 Decision not made …… 98	Regarding [DOMAIN], I do what I do so others don't think poorly of me. Never true…… 1 Not very true…… 2 Somewhat true…… 3 Always true…….. 4 Decision not made …… 98	Regarding [DOMAIN], I do what I do because I personally think it is the right thing to do. Never true…… 1 Not very true…… 2 Somewhat true…… 3 Always true…….. 4 Decision not made …… 98
	Activity	Ic	Id	Ie	If
I14	Agricultural production				
I15	Getting inputs for agricultural production				
I16	The types of crops to grow for agricultural production				
I17	Taking crops to the market (or not)				
I18	Livestock raising				
I19	Nonfarm business activity				
I20	Your own (singular) wage or salary employment				
I21	Minor household expenditures (such food for daily consumption or other household needs)				
I22	What to do if you (yourself) has a serious health problem				
I23	Whether or not to use family planning to space or limit births				
I24	How to protect yourself from violence				
I25	Whether and how to express religious faith				
I26	What kind of tasks household members will do on a particular day				

MODULE J.1. Time Allocation			Code	
J1	During the last four weeks, how many days of your primary daily activities did you miss because of poor health?	Enter # of days [between 1-30 days]		
J2	Do you suffer from a chronic disability?	Yes…… 1 No ……..2		

MODULE J.1. Time Allocation			Code	
J3	Are you or your spouse currently doing something or using any method to delay or avoid getting pregnant?	Yes…… 1 No ……..2		
J4	If YES: How satisfied are you with the method you or your spouse are currently using to delay or avoid getting pregnant?	Instructions: Please give your opinion 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 nor dissatisfied this would be in the middle or 5.		1 2 3 4 5 6 7 8 9 10 [Circle ONE number]
J5	How satisfied are you with your available time for leisure activities like just relaxing, listening to the radio, visiting or socializing with friends or neighbors, playing sports or games?			1 2 3 4 5 6 7 8 9 10 [Circle ONE number]

MODULE J.2. Time Allocation: 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.			
J6	Was yesterday a holiday or nonworking day for you (yourself)?..... Yes…….1 No……..……..…2		
J7 A	IF NO: I'm going to ask you to walk me through all the activities you engaged in during the last 24 hours—starting yesterday morning when you woke up.		
J7 B	IF YES: Please think back on the very last day that was a regular or normal work day for you. I'm going to ask you to walk me through all the activities you engaged in during the last 24 hours—starting yesterday morning when you woke up.		
J8	OK, let's start with the time you woke up yesterday morning. I am going to ask you to recall what you did for each half hour after you woke up. Just take me through your day from the time you woke up to the time you went to sleep, and try not to leave out any details.	Code: For each half hour, record the CODE corresponding to the appropriate activity category:	

1	Sleeping: Night-time sleep (not resting briefly during the day)
2	Self-Care: Resting (not sleeping at night), eating and drinking, other personal care (bathing, fixing your hair, etc)
3	Non-Domestic Work: Farming, caring for livestock, fishing, repairing tools and other farming equipment, making repairs on your house, working at your own business, such as harvesting / processing shea (self-employed), work for a wage (employed by someone else)
4	Domestic Work: Cooking, cleaning, fetching wood, fetching water, caring for others (including children, adults, elderly), doing laundry, sewing, mending clothes, weaving, shopping in the market, getting services (including health services)
5	Traveling: Traveling and commuting for ANY reason (EX: To go to your farm plot, to go to market on market day)
6	School: Attending school, doing homework
7	Leisure: Just relaxing, listening to the radio, visiting or socializing with friends or neighbors, participating in religious activities, playing sports or games (soccer, cards, draught, chess, ludo, oware etc, etc), reading, hobbies
8	Other: Other activities that do not fit into any of the categories listed above. [ENUMERATOR: USE THIS CATEGORY ONLY AS A LAST RESORT]: Please Specify:

Time you woke up																							
H1:		H2:		H3:		H4:		H5:		H6:		H7:		H8:		H9:		H10:		H11:		H12:	

H13:		H14:		H15:		H16:		H17:		H18:		H19:		H20:		H21:		H22:		H23:		H24:	

MODULE K.1. soybean & other seed access	Code

K1	Has any member of your household EVER tried to grow soybean—even if it was several years ago?..... Yes……1 No……2	
K2	Have you (yourself) EVER tried to grow soybean—even if it was several years ago?..... Yes……1	
K3	Would you (yourself) have to be shown how to better grow soybean by an Agricultural Extension Agent or other trained person before you would try it? …..... Yes……1 No……2	
K4	Would you have to see others (relatives, neighbors, friends, etc) grow soybean successfully before you would try soybean yourself? …..... Yes……1	
K5	Does any group or organization ever give out FREE soybean seed locally? ..... Yes……1 No……2	
K6	Do you know where to buy soybean seed that grows well in your area? ..... Yes……1 No……2	
K7	Do you know where to buy BEAN seed that grows well in your area? ..... Yes……1	
K8	Have you (yourself) EVER been given—FREE OF CHARGE—any kind of improved seed (soybean, bean, etc) from ……..Yes……1	
	K8A Relative in your village……1	
	K8B Relative in another village……..…… 2	
	K8C Relative living/working in urban areas…….3	
	K8D Friend, neighbor in your village……..4	
	K8E Friend in another village……5	
	K8F Friend living in urban areas…….. 6	
	K8G Agricultural extension Agent……..7	
	K8H Farmers Association…… 8	
	K8I Local market……..…….. 9	
	K8J Aggregator……..10	
	K8K Seed Company Agent (Ghana Nuts, etc)……..11	
	K8L NGO…….12	
K9	Have you (yourself) EVER purchased any kind of improved seed (soybean, bean, etc) from …… ……Yes……1	
	K9A Relative in your village……1	
	K9B Relative in another village……..……. …2	
	K9C Relative living/working in urban areas…..……..3	
	K9D Friend, neighbor in your village……4	
	K9E Friend in another village..……..……..5	

	K9F Friend living in urban areas…….6	
	K9G Agricultural extension Agent……7	
	K9H Farmers Association…… . 8	
	K9I Local market……..…….…… 9	
	K9J Aggregator……10	
	K9K Seed Company Agent (Ghana Nuts, etc)……11	
	K9L NGO…….12	
K10	If you were offered a new and improved soybean variety to try for free, how interested would you be in trying it?..... Not at all interested...……1 Not very interested…….…2 Somewhat interested…..…3	
K11	If you were offered a new and improved soybean variety to purchase, how interested would you be in trying it?..... Not at all interested...……1 Not very interested…….…2 Somewhat interested…..…3	
K12	Imagine a new and improved soybean variety is introduced to your village that you are interested in purchasing: How likely is that you will be able to get the seed in the first year?..... Very unlikely...……1 Somewhat unlikely…….…2 Somewhat likely…….....…3 Very likely …….. 4	
K13	Imagine a new and improved soybean variety is introduced to your village that you are interested in purchasing: How likely is that you will have to wait for others to try the seed before you are able to get it? Very unlikely...…….....…1 …… Somewhat unlikely…....…2 Somewhat likely…….....…3 Very likely …….. 4	
K14	Imagine a new and improved soybean variety is introduced to your village that you are interested in purchasing: What is the one (1) factor MOST likely to prevent you from getting the seed in the first year?..... Lack of money to purchase the seed…….1 Lack of info about where to buy the seed…..2 Specify: Other: 3	
	MODULE k.2. soybean CULTIVATION: Enumerator: All questions refer to immediate past cropping season	
K15	In the immediate past cropping season, list ALL soybean varieties you (yourself) cultivated: 1. _____ 2. _____ 3. _____	
K16	In the immediate past cropping season, did you use an inoculum on your soybeans at planting time? ..... Yes……1 No…….2	
K17	If YES, where did you obtain the inoculum? …… Yes…….……1	
	K17A Relative in your village……..1	
	K17B Relative in another village…….....… 2	
	K17C Relative living/working in urban areas…....…3	
	K17D Friend, neighbor in your village……4	

	K17E Friend in another village..……..……...5	
	K17F Friend living in urban areas…..……..6	
	K17G Agricultural extension Agent……7	
	K17H Farmers Association…… 8	
	K17L Local market……..…… 9	
	K17J Aggregator……..10	
	K17K Seed Company Agent (Ghana Nuts, etc)….11	
	K17L NGO…….……12	
K18	In the immediate past cropping season, did you use Phosphorus fertilizer on your soybeans at any time before harvest?..... Yes……1	
K19	In the immediate past cropping season, list ALL pesticides you used on your soybeans at any time before harvest: 1. _____ 2. _____ 3. _____ I don't	
K20	In the immediate past cropping season, how did you plant your soybean?..... By hand……..…..1 Push planter……..……2	
K21	If you planted in HILLS: How far apart did you plant each hill of soybeans (in meters)?..... Fill in blank with METER PER HILL→	
K22	If you planted in HILLS: How many soybean seeds per HILL did you plant?..... Fill in blank with # SEEDS PER HILL →	
K23	If you planted in ROWS: How far apart did you plant each row of soybeans (in meters)?..... Fill in blank with DISTANCE BETWEEN ROWS (meters) →	
K24	If you planted in ROWS: how many soybean seeds per FOOT of row did you plant?..... Fill in blank with # seeds per FOOT of ROW →	

MODULE l.1. cultivation months: Enumerator: Participant can X more than one box for each activity.													
ENUMERATOR: For each activity below, put an X in each box of the month(s) in which the activity typically occurs.		Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
		La	Lb	Lc	Ld	Le	Lf	Lg	Lh	Li	Lj	Lk	Ll
L1	Preparing your fields for planting (Soybean only)												
L2	Planting (Soybean only)												
L3	Working on your farm between planting and harvesting (Soybean only)												
L4	Harvesting (Soybean only)												
L5	Marketing/selling (Soybean only)												
L6	Working on a relative's farm to plant, grow or harvest												
L7	Working on a non-relative's farm to grow or harvest Soybean												
L8	Preparing your fields for planting (Any other crops)												
L9	Planting (Any other crops)												
L10	Working on your farm between planting and harvesting												
L11	Harvesting (Any other crops)												
L12	Marketing/selling (Any other crops)												
L13	Working on a relative's farm to plant, grow or harvest Any												
L14	Working on a non-relative's farm to grow or harvest Any												
MODULE l.2. income-generation months: Enumerator: Participant can X more than one box for each activity.													

ENUMERATOR: For each income source below, put an X in each box of the month(s) in which the income is typically earned or received.		Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
		Lm	Ln	Lo	Lp	Lq	Lr	Ls	Lt	Lu	Lv	Lw	Lx
L15	Soybean sales												
L16	Maize sales												
L17	Rice sales												
L18	Other legume sales (Ex: cowpea, groundnuts, Bambara beans)												
L19	Sales of all other crops												
L20	Sales of livestock or livestock products												
L21	Work on others' farms												
L22	Nonfarm employment												
L23	Natural product sales (EX: Shea butter production)												
L24	Income from other self-owned small business												
L25	Remittances (money sent or given to you or your household by relatives)												

END SURVEY: thank You for your valuable time!

B2: Mozambique SUNS

ENUMERATOR: This survey is administered to persons who self-report that they are: 1) 18 years or older, 2) are a decision-maker in their household, and 3) reside in this village. CHECK EACH BOX TO INDICATE: ☐ You gained informed consent from participant. ☐ You asked to interview participant in area where other HH members cannot overhear or contribute answers.

A1. Household # in village: (*From map*)		A2. Village name:	

A. Read to participant: In our survey, a member of your household is ANYONE who has lived in your household for at least 3 months during the past 6 months and takes food from the "same pot" as other members of your household most of the time.

District # = Angonia = Gurue = Sussundenga	Participant gender? = Male = Female	Participant age (in years)? (write # below)	Participant religion? = Muslim = Christian = Other	Participant marital status? 1 = Never married 2 = Married = Separated = Divorced = Widow	Household (HH) type? = Married couple = Female-only head of HH = Male-only head of HH	# of HH members (write # below)	In past 12 months was there ever NO FOOD to eat of any kind in your HH because of lack of resources to get food? = yes = no	How often did this happen in past 12 months? = never = 1-2 times = 3-10 times = 11+ times	In past 12 months, did you or any HH member go to sleep at night hungry because there was not enough food? = yes = no	How often did this happen in past 12 mnths? = never = 1-2 times = 3-10 times = 11+ times	In past 12 months, did you or any HH member go a whole day and night without eating anything at all because there was not enough food? = yes = no	How often did this happen in past 12 months? = never = 1-2 times = 3-10 times = 11+ times
A 3	A 4	A 5	A 6	A 7	A 8	A 9	A 10	A 11	A 12	A 13	A 14	A 15

A.16. Approximately how much land/ size of plot does your household cultivate _____ _ _ _ _ _ (ha.)

B. CROPS GROWN BY YOUR HOUSEHOLD (HH) TO EAT LAST YEAR

List the FIVE most important crops your HH grew to EAT LAST YEAR?	Did YOU participate in growing [CROP] in the past 12 months? = yes = no	WHERE was [CROP] grown LAST YEAR? (*Have participant show* Enumerator on map) = next to house = near (less than 15 min walk) = far (15-30 min walk) = VERY far (31+ min walk) 98 = Don't know	Who OWNS the land on which [CROP] was grown? = self = spouse = self & spouse jointly = other HH member = non-HH member 98 = Don't know	Did your HH save enough [CROP] to PLANT until your NEXT HARVEST? = yes = no	Did your HH SAVE any [CROP] to EAT Until NEXT HARVEST? = yes = no 98 = I don't know	Did HH SELL any [CROP] in past 12 months? = yes = no 98 = Don't know	If YES, who BOUGHT [CROP] from HH? = aggregator/ trader = farmers assoc./ cooperative = relative in village who sells for you = friend in village who sells for you = directly to consumer in village market = other (specify) 98 = Don't know LIST ALL BUYERS THAT APPLY

B a		B b	B c	B d	B e	B f	Bg	Bh
B1								
B2								
B3								
B4								
B5								

C. CROPS GROWN BY YOUR HOUSEHOLD (HH) TO SELL LAST YEAR								
List the FIVE most important crops your HH grew to SELL in past 12 months? If none, write NONE	Did YOU participate in growing [CROP] in past 12 months? = yes = no	WHERE was location of land on which [CROP] was grown? 1 = next to house 2 = near (less than 15 min walk) = far (15-30 min walk) = VERY far (31+ min walk) 98 = Don't know	Who OWNS the land on which [CROP] was grown? = self = spouse = self & spouse jointly = other HH member = non-HH member 98 = Don't know LIST ALL THAT APPLY	WHO participated in SELLING [CROP] in past 12 months? = self = spouse = self & spouse jointly = other HH member = non-HH member 98 = Don't know LIST ALL SELLERS THAT APPLY	WHERE was [CROP] sold in past 12 months? self's house = self's farm plot = local market = non-local market 6 = other (specify) 98 = Don't know LIST ALL THAT APPLY	TO WHOM was [CROP] sold in past 12 months? = Trader = FBO / cooperative = relative in village who sells for me = friend in village who sells for me 5 = directly to consumer at local market 6 = other (specify) 98 = Don't know LIST ALL THAT APPLY	Did your HH save any [CROP] to EAT in past 12 months? = yes = no 98 = Don't know	Did your HH SAVE any [CROP] to PLANT at NEXT PLANTING time? = yes = no 98 = Don't know
C a	C b	C c	Cd	C e	Cf	Cg	Ch	C i
C1								
C2								
C3								
C4								
C5								

D. SELF—KNOWLEDGE OF SOYBEAN CULTIVATION & SOY MARKETS		Strongly disagree	Somewhat Disagree	Somewhat Agree	Strongly agree
D1	YOU know how to cultivate soybeans.	☐	☐	☐	☐

D2	YOU know how to identify problems with pests or other problems of soybean crops.	☐	☐	☐	☐
D3	YOU know how to market soybeans.	☐	☐	☐	☐
D4	YOU know where there are good markets nearby for soybeans.	☐	☐	☐	☐
D5	YOU know where there are good markets far away for soybeans.	☐	☐	☐	☐
D6	YOU know buyers / aggregators who come to your village to buy soybeans.	☐	☐	☐	☐
D7	YOU know how to sell your soybean crop yourself.	☐	☐	☐	☐
D8	YOU know how to work with Extension Agents to grow better soybean plants.	☐	☐	☐	☐

E. FARMERS ASSOCIATIONS		Yes	No	Don't know
E1	Are any farmers' associations in your village CURRENTLY involved in GROWING soybean?	☐	☐	☐
E2	Are any farmers' associations in your village CURRENTLY involved in LEARNING TO PREPARE soybean for the family to eat?	☐	☐	☐
E3	Are any farmers' associations in your village CURRENTLY involved in SAVING soybean seed for next planting season?	☐	☐	☐
E4	Are any farmers' associations in your village CURRENTLY involved in SELLING soybean?	☐	☐	☐
E5	Are YOU (yourself) a member of one or more farmers' association? (if NO, go to E 16)	☐	☐	☐
E6	Are any of these farmers' associations involved in GROWING soybean?	☐	☐	☐
E7	Are any of these farmers' associations involved in LEARNING TO PREPARE soybean for the family to eat?	☐	☐	☐
E8	Are any of these farmers' associations involved in SAVING soybean seed for next planting season?	☐	☐	☐
E9	Are any of these farmers' associations involved in SELLING soybean?	☐	☐	☐
E10	Do any of these farmers' associations include members living IN OTHER VILLAGES?	☐	☐	☐
E11	Do other HH members belong to farmers' associations to which you are NOT a member? (if NO, go to F) 1	☐	☐	☐
E12	Are any of these farmers' associations involved in GROWING soybean?	☐	☐	☐
E13	Are any of these farmers' associations involved in LEARNING TO PREPARE soybean for the family to eat?	☐	☐	☐
E14	Are any of these farmers' associations involved in SAVING soybean seed for next planting season?	☐	☐	☐
E15	Are any of these farmers' associations involved in SELLING soybean?	☐	☐	☐
E16	Do any of these farmers' associations include members living IN OTHER VILLAGES?	☐	☐	☐

F. SOYBEAN CULTIVATION (ENUMERATOR: THESE QUESTIONS REFER TO IMMEDIATE PAST CROPPING SEASON)								
In IMMEDIATE PAST cropping season, did YOU PLANT SOYBEAN? = yes = no (go to I 1)	WHAT WAS PLOT SIZE OF SOYBEAN YOU PLANTED (IN HECTARES)? = < than 1/4 Ha. = 1/4 Ha. = 1/2 Ha. = 1 Ha.	What was the QUANTITY of SHELLED soybean your plot produced (in 25kg bags)? (Specify # of 25kg bags of SHELLED soy	Did the QUANTITY of SHELLED soybean produced MEET expectations? QUANTITY was: = far below expectations	What was the INCOME you produced from the SHELLED soybean? Specify in MZ (Metical)	Did the INCOME produced from your soybeans MEET your expectations? INCOME was: = far below expectations	Was any soy YOU grew EATEN by your HH? = yes	What soy products did your HH EAT? = khebabs = tofu = soy milk soy porridge = other(specify)	Was any soy YOU grew SAVED to plant next year? = yes = no 98 =

	(>1 Ha., specify #.0 EX: 2.0 = 2 Hectares, 3.0 = 3 Hectares, etc)	produced) 98 = Don't know	= below expectations = met expectations = exceeded expectations 5 = greatly exceeded expectations	98 = Don't know	= below expectations = met expectations = exceeded expectations 5 = greatly exceeded expectations	= no (go to G 1)	LIST ALL THAT APPLY	Don't know
F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8	F 9

(Enumerator – Please ask the following set of questions if respondent answered YES in F1.)

F.10. We would like your opinion on some of the reasons why your household participates in soybean farming. On a scale of 1 to 4, with 1 being not important at all and 4 being very important, how important are each of the following reasons to your participation in soybean cultivation.

a	Household had access to demonstration plot	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
b	Household had access to agriculture extension officer OR agriculture technician	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
c	Soybeans might improve my household income	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
d	Soybeans reduce my time and cost for transport..	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
e	Soybeans reduce my time in bargaining with sellers	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
f	Soybeans have a reliable market	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
g	My relatives are participating in soybean farming	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐

(Enumerator – Please ask the following set of questions if respondent answered NO in F.1.)

F.11. We would like your opinion on some of the reasons why your household does not participate in soybean farming. On a scale of 1 to 4, with 1 being not important at all and 4 being very important, how important are each of the following reasons to your participation in soybean cultivation.

a	Household had no access to demonstration plot	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
b	Household had n access to agriculture extension officer OR agriculture technician	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
c	Soybeans might not improve my household income	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
d	Soybeans increase my time and cost for transport.	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
e	Soybeans increase my time in bargaining with sellers	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐
f	Soybeans have no reliable market	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐

g	None of my relatives are participating in soybean farming	Strongly Disagree ☐	Disagree ☐	Agree ☐	Strongly Agree ☐

G. SOYBEAN CULTIVATION (ENUMERATOR: THESE QUESTIONS REFER TO IMMEDIATE PAST CROPPING SEASON)

In IMMEDIATE PAST cropping season, what were the top THREE soybean VARIETIES YOU cultivated?	In IMMEDIATE PAST cropping season, how did you plant your soybean crop? = by hand = push planter = mechanical planter	In IMMEDIATE PAST cropping season, did you plant your soybean seeds in hills, rows, or by hand-broadcasting? = hills = rows = hand-broadcast seed	(IF THEY PLANTED IN HILLS) How far apart did you plant each hill (mound) of soybeans (in feet)? (Fill in # FEET PER HILL)	(IF THEY PLANTED IN HILLS) How many soybean seeds per hill did you plant? (Fill in number of SEEDS PER HILL)	(IF THEY PLANTED IN ROWS) How far apart did you plant each row (in feet)? (Fill in DISTANCE BETWEEN ROWS (in feet)	(IF THEY PLANTED IN ROWS) How many soybean seeds per FOOT of row did you plant? (Fill in number SEEDS PER FOOT OF ROW)
G 1	G 2	G 3	G 4	G 5	G 6	G 7
1.						
2.						
3.						

H. USE OF INPUTS (ENUMERATOR: THESE QUESTIONS REFER TO IMMEDIATE PAST CROPPING SEASON)

In IMMEDIATE PAST cropping season, did you use FERTILIZER on your soy crop? = yes (go to H 2) = no (go to H 3)	If YES, was the FERTILIZER used on your soybean crop FREE? = yes = no (go to H 3)	If NO, did you have decision-making input on PURCHASING the fertilizer used on your soy crop? = yes = no	In IMMEDIATE PAST cropping season, did you use INOCULANT on your soy crop? = yes H (go to 5) = no (go H to 6)	IF YES Was INOCULANT used on your soybean crop FREE? = yes = no (go to H 6)	IF NO, Did you have decision-making input over purchasing INOCULANT used on your soy crop? = yes = no	In IMMEDIATE PAST cropping season, did you use PESTICIDE on your soycrop? = yes (go to H 8) = no (go to H 9)	(IF YES Was PESTICIDE used on your soy crop FREE? = yes = no (go to H 9)	IF NO) Did you have decision-making input over purchasing PESTICIDE for your soy crop? = yes = no	In IMMEDIATE PAST cropping season, did you plant less CO of other crops to grow soybean? IF YES, LIST ALL THAT APPLY: = maize = rice = common beans 4=cassava = groundnut = other (specify) LIST ALL THAT APPLY	T ho do yo u me pla soy EA = Ha = = = (I 1 h #.0 ha = 3
H 1	H 2	H 3	H 4	H 5	H 6	H 7	H 8	H 9	H 10	H

IA. SELF—FREE SOYBEAN SEED RECEIVED IN 24 MONTHS		Yes	No
I 1	Did YOU (yourself) receive free soybean seed in the 24 Months? (if NO or DON'T KNOW, go to N a)	☐	☐
I 2	(IF YES) From whom did YOU rreceive free soybean seed in the 24 Months? (CHECK ALL THAT APPLY) →		
I 3	(IF YES) How much free soybean seed did YOU receive in the 24Months? (TOTAL IN KILOS) →		

☐ Relative in your village
☐ Relative in another village
☐ Relative living/working in urban area
☐ Friend in your village
☐ Friend in another village
☐ Friend living/working in urban area
☐ Extension Agent
☐ Farmers association
☐ Local market
☐ Trader/Aggregator
☐ Private Seed Company Agent
☐ NGO

IB. SELF—DISPOSITION OF CROP GROWN FROM FREE SOYBEAN SEED RECEIVED IN THE PAST 12 MONTHS		Yes	No
I 4	In the past 24 months, did YOU SELL OR TRADE soybeans grown from 'free seed' to others in your village?	☐	☐
I 5	In the past 24 months, did YOU SELL OR TRADE soybeans grown from 'free seed' at your village's local market?	☐	☐
I 6	In the past 24 months, did YOU SELL OR TRADE soybeans grown from 'free seed' at a non-local market?	☐	☐
I 7	In the past 24 months, did YOU SELL OR TRADE soybeans grown from 'free seed' to soybean aggregators?	☐	☐

J. SELF—DISPOSITION OF FREE SOYBEAN SEED RECEIVED IN THE PAST 24 MONTHS

J 1	J 2	J 3	J 4	J 5	J 6	J 7	J 8	J 9	J 10	J 11	J 24
Did YOU PLANT any of the free soybean seed YOU received in the past 24 months? = yes = no	Did YOU SELL any of the free soybean seed YOU received in the past 24 months? = yes = no	Did YOU GIVE any of the free soybean seed to others WITHIN your household? 1 = yes 2 = no (go to J 8)	Did THEY PLANT any of YOUR free soybean seed? = yes = no 98 = Don't know	Did THEY SELL any of YOUR free soybean seed? = yes = no 98 = Don't know	Did THEY EAT any of YOUR free soybean seed? = yes = no 98 = Don't know	Did THEY GIVE any of YOUR free soybean seed to others? = yes = no 98 = Don't know	Did YOU GIVE any of YOUR free soybean seed to nonhousehold members? = yes = no K (go to 1)	Did THEY PLANT any of YOUR free soybean seed? = yes = no 98 = Don't know	Did THEY SELL any of YOUR free soybean seed? = yes = no 98 = Don't know	Did THEY EAT any of YOUR free soybean seed? = yes = no 98 = Don't know	Did THEY GIVE any of YOUR free soybean seed to others? = yes = no 98 = Don't know

K. SELF—ASSESSMENT OF FREE SOYBEAN SEED RECEIVED IN 24 MONTHS (ENUMERATOR: ASK PARTICIPANT: "TELL ME HOW MUCH YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENTS")			Strongly disagree	Somewhat Disagree	Somewhat Agree	Strongly agree
K1	Most of the free soybean seed YOU received in the 24 Months sprouted from the ground (i.e., germinated).		☐	☐	☐	☐
K2	Most of the 'free seed' soybean plants YOU grew had healthy leaves.		☐	☐	☐	☐
K3	Most of the 'free seed' soybean plants YOU grew had healthy pods that contained many soybeans.		☐	☐	☐	☐
K4	Based on YOUR experience, do you agree or disagree that YOU will grow soybeans again next planting season?		☐	☐	☐	☐
K5	Why or why not? (WRITE THEIR ANSWER HERE) →					

N. HOUSEHOLD (HH) INCOME IN 12 MONTHS (ENUMERATOR: THESE QUESTIONS REFER TO 12 MONTHS)						
		How much income did YOU yourself earn from [SOURCE] in the past 12 months? Specify in MZN (Metical) 98 = Don't know	How much income did other household members earn from [SOURCE] in the past 12 months (not counting your earnings)? Specify in MZN (Metical) 98 = Don't know	In what months did YOU (yourself) earn income from [SOURCE]? 1 = January 2= February = March = April = May = June = July = August = September = October = November = December LIST ALL MONTHS THAT APPLY FOR EACH [SOURCE]	Is [SOURCE] a source of income that your household depends on every year? = yes = no 98 = Don't know	Which household members have decisionmaking input on how income from [SOURCE] is spent? = Self = Spouse = Self & spouse jointly = Other HH member (specify) LIST ALL HH MEMBERS THAT APPLY, INCLUDING SELF
		N a	N b	N c	N d	N e
N 1	Soybean sales					
N 2	Maize sales					
N 3	Rice sales					
N 4	Bean sales (cowpea, groundnuts, etc)					
N 5	Sales of all other crops					
N 6	Livestock/livestock products					
N 7	Work on others' farms					
N 8	Nonfarm employment					
N 9	Charcoal production / other wood products					
N 10	Shea production/other forest products					
N 11	Self-owned small business					
N 12	Remittances					
N 13	Other income (specify):					

B3: Network Pilot Survey (NPS)

A Collaborative Survey conducted by the University of Missouri, and IIAM-Mozambique

Project funded by USAID Soybean Innovation Laboratory (USAID SIL)

We are conducting a project that we hope will help farm households in rural Mozambique. We are very interested in learning more from you about the people, groups, and media from which you obtain information and resources for your livelihood. If you have any questions regarding this survey, please feel free to ask us questions. We very much thank you for being part of this project.

A. Survey Respondent Identification Particulars

1.1. Village name: (a) Rotanda_____(b) Munhinga____

1.2.a. Interviewer name: _____ _ _ _ _ _ _ _ _ _ _ _____ _ __

1.2.b. Date of interview: _____ _ _ _ _ _ _ _ _ _ _ _____ _ __

1.3.a. Household number in village (from map): _____ _ _ _ _ __ _ __

1.3.b. Name of respondent (first, Last)_____ _ _ ____ _ _ _ _____ _ __

1.4 Gender of respondent: ☐ Male ☐ Female

1.5. Age of respondent: _____ _ ____ _ _ _ _ _ _ _ _ __ _

1.6. Years of schooling: _____ _ _ _ _ (yrs)

1.7. Marital status (please check one)

Married	Widow/er	Single female	Single male
☐	☐	☐	☐

2.0. INFORMATION & SHARING NETWORKS

Enumerator – for the following set of questions, please work with the participant to identify houses on the map and list the respective house # in the response section.

2.1. In this village, where do YOUR friends live?	**Hse # :**
2.2. In this village, where do YOUR relatives live?	**Hse # :**
2.3. In this village,WHO DO PEOPLE USUALLY GO TO FOR ADVICE ON AGRICULTURAL PROBLEMS ?	**Hse # :**
2.4.a. In this village, WHO DO PEOPLE USUALLY GO TO FOR INFORMATION ON WHERE TO GET SOYBEAN SEED?	**Hse # :**
2.4.b. In this village, WHO DO PEOPLE USUALLY GO TO FOR INFORMATION ON WHERE TO GET BEAN SEED?	**Hse # :**
2.5.a In this village, WHO DO PEOPLE USUALLY GO TO FOR INFORMATION ON WHERE TO SELL SOYBEAN	**Hse # :**
2.5.b. In this village, WHO DO PEOPLE USUALLY GO TO FOR INFORMATION ON WHERE TO SELL BEANS?	

2.6. HOW OFTEN DO YOU TALK TO AN AGRICULTURE EXTENSION AGENT?	Never ☐	Once a year ☐	Several times a year ☐	Once a month ☐	More than once a month ☐
2.7. In the last 5 years have you ever participated in farmer field school ?	YES ☐		NO ☐		
2.8. In the last 5 years, have you ever participated in a demonstration plot/ field day vist/ farmer exchange visits?	YES ☐		NO ☐		
2.9.a In the last 5 years have YOU traded ANY KIND OF SEEDS with any households in this village? Show me which ones .	Hse # :				
2.9.b In the last 5 years have YOU traded SOYBEAN SEEDS with any households in this village? Show me which ones.	Hse # :				
2.9.c In the last 5 years have YOU traded BEAN SEEDS with any households in this village? Show me which ones	Hse # :				
2.10.a In the last 5 years have YOU shared ANY KIND OF SEEDS with any households /anyone in this village? Show me which ones .	Hse # :				
2.10.b. In the last 5 years have YOU shared SOYBEAN SEEDS with any households in this village? Show me which ones	Hse # :				
2.10.c In the last 5 years have YOU shared BEAN SEEDS with any households in this village? Show me which ones	Hse # :				

3.0 EGO & NETWORK TIES

People often obtain information on new seeds, market prices and farming knowledge from friends, family, agro dealers, extension and other people.

We have some questions about where YOU obtain different kinds of information such as agriculture inputs, trading" (Enumerator for the following questions, please present respondent with map and list house numbers of identified individuals)

3.1. Who do you go to for any information regarding SOYBEANS? (this question captures general info e.g. purchase, planting, markets etc)

3.1.a House Number	3.1.b. Gender of person consulted 1= Male 2= Female	3.1.c. Which of the following identify the individual relationship to you 1 = relative 2= neighbor 3= friend 4= community leader 5= extension officer 6= agro dealer 7= trader	3.1.d. How long have you known individual in House # (list # of years)	3.1.e How close are you? 1= distant, 2= middle, 3 = very close
i.				
ii.				
iii.				
iv.				
v.				

3.1.f. Who else (outside your village) can you go to for information on SOYBEANS?	3.1.g. Gender of person consulted 1= Male 2= Female	3.1.h. Where is this contact located? 1= Neighboring village 2= Distant village 3= Market 4 = Urban center	3.1.i. Which of the following identify the individual relationship to you 1 = relative 2= neighbor 3= friend 4= community leader 5= extension officer 6= agro dealer 7= trader	3.1.j. How long have you known individual (list # of years)	3.1.k. How close are you? 1= distant, 2= middle, 3 = very close
i.					
ii.					
iii.					
iv.					
v.					

3.2. Who do you go to for any information regarding BEANS? (this question captures general info e.g. purchasing, planting, markets etc)

3.2.a House Number	3.2.b. Gender of person consulted 1= male 2= female	3.1.c Which of the following identify the individual relationship to you 1 = relative 2= neighbor 3= friend 4= community leader 5= extension officer 6= agro dealer 7= trader	3.1.d. How long have you known individual in House # (list # of years)	3.1.e. How close are you? 1= distant, 2= middle, 3 = very close
i.				
ii.				
iii.				
iv.				
v.				

3.2.f. Who else (outside your village) can you go to for information on BEANS?	3.2.g. Gender of person consulted 1= male 2= female	3.2.h. Where is this contact located? 1= neighboring village 2= distant village 3= market 4 = urban center	3.2.i. Which of the following identify the individual relationship to you 1 = relative 2= neighbor 3= friend 4= community leader 5= extension officer 6= agro dealer	3.2.j. How long have you known individual (list # of years)	3.2.k. How close are you? 1= distant, 2= middle, 3 = very close

			7= trader		
i.					
ii.					
iii.					
iv.					
v.					

3.3. Who do you go to for information regarding where to sell your crops?

3.3.a House number	3.3.b. Gender of person consulted 1= male 2= female	3.3.c. Which of the following identify the individual relationship to you? 1 = relative 2= neighbor 3= friend 4= community leader 5= extension officer 6= agro dealer 7= trader	3.3.d How long have you known him/her? (list # of years)	3.3. e. How close are you? 1= distant, 2= middle, 3 = very close
i.				
ii.				
iii.				
iv.				
v.				

3.3.f. Who else (outside your village) can you go to for information on where to sell your crops?	3.3.g. Gender of person consulted 1= male 2= female	3.3.h. Where is this contact located? 1= neighboring village 2= distant village 3= market 4 = urban center	3.3.i. Which of the following identify the individual relationship to you 1 = relative 2= neighbor 3= friend 4= community leader 5= extension officer 6= agro dealer 7= trader	3.3.j. How long have you known individual (list # of years)	3.3.k. How close are you? 1= distant, 2= middle, 3 = very close
i.					
ii.					
iii.					
iv.					
v.					

4.1 . COMMUNITY GROUPS

4.1.a. In the last 5 years, have you ever participated in farmer field? YES _____NO__ _ _

4.1.b. Have you ever participated in a demonstration plot, field days, or exchange visits in the last five years? YES ___ _NO _ _

(Enumerator, please use the following codes to answer question 4.1 – regarding farmer group participation by individual and household)

CODE A, GROUP MEMBERSHIP: 1. YES - I, myself, am a member 2. Yes – Someone else in household is a member. 3.No, no one in my household is a member 4. I don't know
CODE B, TYPE OF GROUP : 1. Men only 2. Women only 3. Mixed gender (both men & women) 4. Includes members outside my village.
CODE C, GROUP PARTICPATION IN SOYBEAN or COMMON BEAN VALUE CHAIN: 1. YES – group involved in input distribution. 2. Yes- group involved in training 3. Yes – group involved in selling/marketing 4.Yes – group involved in storage 5. No- group not involved in soybeans/Beans. 6. I'don't know.

4.1. COMMUNITY GROUP Farmer group	4.1.a Do you or anyone in your HH belong to a farmers' group/ association? CODE A	4.1.b. How would you describe this group's membership? CODE B	4.1.c Is this group involved in soybeans [ACTIVITY]? CODE C	4.1.d Is this group involved in common bean [ACTIVITY]? CODE C
Akodo de Roma				
Badza Rotanda				
Chinyamukwenga				
Kugara hakuna chako				
Kugara hakunachako				
Kugarika Tangnhamo				
Kupfuma Ishungu				
Moyo Umwe				
Nhabricari				
Nyagonzwa				
Simba Murimi				
Simukai Kwaedza				
Zona Felidhe				
Other *(specify)*				

4.2. Are YOU or anyone else in your household a member of a micro credit group, education group or health group in your community? (Enumerator please tick all that apply and list names of any group mentioned that is not on this list).

4.2. Are YOU or anyone else in your household a member of a micro credit group, education group or health group in your community? (Enumerator please check all that apply and list names of any group mentioned that is not on this list).

4.2.a. COMMUNITY GROUP Micro-credit/Lending	4.2.a Do you or anyone in your HH belong to a micro-credit group? CODE A	4.2.b. How would you describe this group's membership? CODE B	4.2.c Is this group involved in soybeans/ Common Beans CODE C
Agro Dealers Ass-Sussundenga			
Ass.dos comerciantes - Munhinga			

Ifloma (Euculyptus plantation)			
Nhama Ngapere			
Poposa/ Chitike			
Other *(specify)*			

4.2.b. Community Group

Health	CODE A
Africare group	
HIV/ AIDS	
Other *(specify)*	
Education	**CODE A**
PTA- Primary	
PTA- Secondary	
Other *(specify)*	

4.3. Religious affiliation

4.3.a What is your religious affiliation? (If respondent identifies as Christian ask 4.3.b)

Christian ☐ Muslim ☐ Traditionalist ☐ Other (specify) _____ _

4.3.b. Church
(Enumerator please check name of church one attends regularly/ write name of church if not on the list).

7th Day Adventist Church		Nazareth Church	
Apostolic Mission		Nova Vida church	
Batanica Church		Tsoko Dzamwai	
Catholic Church		Z.C.C	
Chitedeerano		Z.C.C. Samuel Mutendi	
Djacknision church		Zion	
Mugodhi		Other (specify)	

5.0 Subjective well being

On a scale of 1 to 5, with 1 being very dissatisfied and 5 being very satisfied how would you rank each of the following statements?

5.1. How satisfied would you say you are with your financial situation?	Very dissatisfied ☐	Dissatisfied ☐	Neither satisfied or dissatisfied	Satisfied ☐	Very satisfied ☐
5.2. How satisfied are you with your life as a whole these days?	Very dissatisfied ☐	Dissatisfied ☐	Neither satisfied or dissatisfied	Satisfied ☐	Very satisfied ☐
5.3. When you consider today and the last few days would you say you are	In a worse mood than usual ☐	Normal ☐	In a better mood than usual ☐	I don't know ☐	
5.4. When you compare your wellbeing with that of other people around you?	Very dissatisfied ☐	Dissatisfied ☐	Neither satisfied or dissatisfied	Satisfied ☐	Very satisfied ☐
5.5 Some people feel they have complete control over their lives, others, that they have no control. How satisfied would you say you are with your life?	Very dissatisfied ☐	Dissatisfied ☐	Neither satisfied or dissatisfied	Satisfied ☐	Very satisfied ☐

6.0. Cultural awareness

(Enumerator for the following two questions please present respondent with the following visual aids- if one identifies differently as "other" please record name of location).

When you look at your self , Which of the following categories of people do you feel like you identify with the most and least?

6.1. a. I feel that I BELONG TO

___________________ MOST

6.1.b Briefly describe why you feel most connect to this group.

_____
_

6.2.a I feel that I BELONG TO

_____LEAST

6.2.b. Briefly describe why you feel least connected to this group.

_____
_

Visual aid: Your village, Province, county- Mozambique, the world, I don't know

a) My current village

b) Manica Province

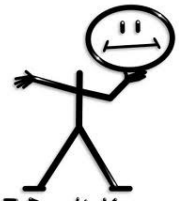
c) Mozambique

d) Africa

e) OTHER

(*write name of*

F) I don't know



7.0. Based on your experience in the last five years, how would you respond/ rank each of the following statuses listed below for your household (circle response based on the provided scale of 1-5)

7.1. Feelings towards household status	Scale 1= Strongly disagree 2= Disagree 3= Neutral 4 = Agree 5= Strongly agree				
Household has access to more income	1	2	3	4	5
Household has more food to eat	1	2	3	4	5
Household diet has improved	1	2	3	4	5
Household members are not sick as often as before	1	2	3	4	5
Household can afford medical care/ going to the hospital	1	2	3	4	5
Others in the community depend on me for farming advice	1	2	3	4	5
Children can afford to attend school more comfortably	1	2	3	4	5
I can afford to hire others to help me on my farm	1	2	3	4	5
I feel less stressed about my financial situation?	1	2	3	4	5
I am able to participate in more community dev. projects	1	2	3	4	5
I feel very good about my farming practice	1	2	3	4	5
I participate more in deciding how income raised is spent	1	2	3	4	5

This is the end of our survey, thank you for your participation and cooperation. Do you have any questions for me?

B4: Focus Group Interview Protocol

Title: Farmers Voices: Insights, attitudes and preferences on common bean & soy bean adoption among rural smallholder farmers in rural Mozambique

Investigators: Dunaway A.; Mubichi, M.F.; Findeis, J.F.; O'Brien, J.D.; Furstenau, N.M

Goal: To learn about the attitudes, preferences, practices, and resource networks of rural farmers in rural Mozambique; by exploring issues related to farming common beans and soy beans; access and barriers to new seed; and media usage in obtaining information on the same. These findings will be used to inform a pilot social marketing campaign in Mozambique, promote consumption of low-phosphorus common beans.

Specifically: To first identify information needs/ gaps women have. Second, to understand attitudes and behaviors towards beans as food and income generators so as to determine effective marketing strategies that might be adopted to improve bean consumption.

Target audience: Small scale farmers living in Rotunda village and Manica village 5 both located in Manica Provence, Central Mozambique.

Sample size: 36 participants from Rotunda & Manica village 5s will be selected using convenient sampling technique. The participants will be both male and female and of **varying**

ages, educational attainment, religious background and family status.

Section 1.01 Study Design

This is a descriptive study seeking to understand attitudes, preferences, practices, and resource networks of smallholder rural farmers in Central Mozambique. The study seeks to specifically explore access and barriers to new bean seeds; existing social and distribution networks; access and media usage in obtaining information on the same.

This study will adopt a focus group methodology. Focus groups provide multiple advantages. Unlike surveys, they are economical as they allow one to collect a lot of information from multiple respondents at the same time. Focus groups, unlike interviews provide an opportunity for group interaction between members of the target population providing the researcher to capture a deeper and more meaningful understanding of the phenomena through the participant's verbal and non-verbal communication. Participants in focus groups will often make connections to various concepts they might otherwise have not thought about as they listen to others (Nagle & Williams, 2013:2). For the purposes of this study, we seek to carry out 4 focus group meetings within two rural villages in Mozambique. The selected villages for this study are MV4 and Manica village 5s located in the Manica region, Central Mozambique. The focus groups will comprise, 2 women and 2 men groups. All four will be conducted over a period of 4 days starting March16-19, 2015. Each focus group interview will last approximately 60 to 75 minutes.

Section 1.02 Participants

A total of 36 participants, both men and women, from both villages will be selected and interviewed.

A. Recruitment of Subjects

The Mozambique Institute for Agricultural Research (IIIAM, Mozambique) will recruit subjects for the focus groups from a list of bean and soybean farmers in the local villages in the study. All participants will be at least eighteen years of age or older. Participants for the focus groups will be identified 3-4 weeks ahead of the interview dates. The in-country researcher based with IIAM (Mozambique) will travel to both villages to obtain permission from the chief/local authority. Once local authority consent is obtained, recruitment of participants will follow based on the following primary criteria:

i. Participants must be residents in the particular village of interest

ii. Participants maybe self-appointed or nominated for the study by the chief/ local authority, or other community members.

iii. Marital status – participant maybe be married, single, widowed, widower or divorced

iv. Eighteen women and eighteen men will be selected from each of the villages to participate in the focus groups. There will be separate focus groups for men and women.

v. Must be a farmer and have engaged in farming for at least 2 years in the village.

Benefits

vi. There will be no direct monetary gifts or in kind gift, provided to the participants.

vii. However, information obtained from the focus groups is expected to help improve seed distribution and farming technology within the region.

viii. Information obtained from this study will help the researcher gain a better understanding of attitudes, preferences, and resources that affect social networks and socioeconomic status in rural Mozambique.

Section 1.03 Environment

- Discussion will be held in a community designated public meeting space.
- Circle seating will be used within groups
- Women will be interviewed separately from men and vice-versa
- Although no perceived risk (nothing out of the ordinary) is expected, every reasonable measure to protect participant privacy will be taken.

Section 1.04 Moderators

1. Moderators will comprise of both University of Missouri (MU) researchers and IIAM research team members. The MU researchers will include a PhD student in Rural Sociology and faculty members from the Division of Applied Sciences and the School of Journalism.
2. Given that participants do not speak English, IIAM team members will serve as translators and moderators for the focus groups. The IIAM team members will be responsible for introductions, setting ground rules, guiding discussions and ensuring responses are accurately captured and recorded. For example, IIAM representatives will serve as moderators and recorders (i.e., recording responses/ providing an oral summary of responses and providing further clarification to the MU team members and focus group participants).

3. Discussion responses will be recorded using note books and audio recording. Note taking in this particular exercise will capture both participant verbal and non-verbal responses to questions.
4. Ground rules for moderators:
5. Be aware of your intentions – Be clear about your intentions, questions and responses.
6. Build shared meaning – avoid misunderstanding by asking what people mean when they use specific words or phrases.
7. Use self-awareness as a resource – continually ask yourself what you are thinking, feeling or want when you feel frustrated, confused or angry.
8. Explore impasse – try and pin point the source of disagreement by asking participants what they agree on and disagree on.

Section 1.05 Reporting and analysis

Systematic note taking and analysis of responses will be used to ensure information is correctly captured using the following two steps:

a. Restating response to participant to cross checking for accuracy
b. Summarize response from participant – to triangulate and verify response

Section 1.06 Participant record

Village Name: _____

Focus group #_____

Participant ID # _____

Date_____/_____/_____

Focus group participant demographic data:

Please take a few minutes to provide us with the following information.

1. Gender of participant (Sex) _____

2. Age_____Marital status _____

3. Religion _____

4. What is your highest level of education _____

5. Do you hold any community leadership position? (Yes) or (No) If Yes,

list position/s

_____

_____

_____

_____

_____

_____

6. Please list names of groups you belong to (including religious groups)

_____

Section 1.07 Focus group Introduction script

Welcome! My name is_____, and I work with IIAM and am from the University of Missouri. Thank you very much for coming today. Your presence is very important.

We are here today to learn from you. We want to understand your farm and family needs and how we might help your families and other families in Mozambique like yours. We would like to know where you get farming information on soy and bean. We would like to learn where you get your seed and information from. This project is directed by IIAM and funded by USAID.

There are no right or wrong answers. We want to know your ideas and suggestions; both positive and negative comments, are welcome. Please feel to disagree with one another. Everyone's opinion matters. No one will be able to identify you with any comments made in this meeting. Everything you say will remain confidential. Your participation today is voluntary and you are free to leave at any time.

This discussion should take approximately 1 hour. Remember, this is a group discussion, you do not need to wait to be called on. Please speak one at a time, though, so we can record your comments correctly on the flip chat. No identifying information will be saved with your comments.

Do you agree to participate in this focus group? (Yes or No/verbal consent)

Does anyone have any questions before we get started?

Section 1.08 Focus group discussion questions

What is grown in the village/planting decisions.

First we would like to hear from you. Please talk to the person next to you, say hello and then introduce your partner by name (it can be real or made up).

1. What are the top 5 crops that have been most successful in a good year here? Why?

2. What are the top 5 crops that have been successful in a bad year here? Why?

Awareness of the new beans

3. Have you heard about improved common beans or soybeans?

a. What have you heard about the new beans? [Probe for look, taste, yield, how much fertilizer it needs etc.]

b. Have you seen the beans before? If yes, where did you see them?

c. Have you planted these beans before? If yes, where did you buy or get them? How well did they grow/what was the yield like?

d. Who in the village started or introduced the new beans first?

e. How many people in the village would you say have adopted these new beans?

f. What are the advantages of growing these new beans?

g. What are the disadvantages?

Changing weather, changing practices

5. How has the weather been over the last few years? The last 10-15? What has been the same? What has changed?

6. What do you do to help improve your soil? (Would you all want to know this, like crop rotation, live fencing, tree planting?, cover cropping?)

7. How does this change what you seeds you buy or what you plant?

Facilitators/Access to the beans

8. Where do you get your seed and technical information? [Probe for distributors, IIAM, Extension—NOTE WHAT WORD DO THEY USE FOR EXTENSION, etc.]

9. How hard or easy is it to get new seed or any bean or soybean seed? [Probe for how this experience is, is it hard or easy, far away/close by, do they trust the seed folks/don't trust the seed folks, do they have to have the cash to buy the seed or is it possible to get on credit? If credit is possible, what is that like? What does good seed look like?]

10. How do you usually pay for your seed and fertilizer? (establish if there is a credit /loan system).

    a. Are you able to borrow money or pay later for seeds and other farm materials that you need? How well do these options serve your needs? [Do they work? Are they reliable for you?]

    b. What do you have to do to get one of these loans, or to be able to pay later? (use this question to determine: (i) if source offers formal/ informal credit (ii) the requirements for one to access this credit?(iii) if there is training involved and who is most likely to be trained).

BUSINESS DECISIONS

11. Do you sell all of your beans? [If keep some of beans, how much do you keep to eat? How much do you keep as seed?]

Networks, MESSENGERS AND PARTNERSHIPS

12. If you had a problem or questions about your farm, where would you go for information or for help?

Media access

13. Do you have access to a cell phone?

a. If so, is it yours or someone else's?

a. If so, which carrier? (maybe also ask if this is the only or most popular carrier)

b. What do you use the phone for? (Probe for calls, texting, photos, Internet, music, weather information, planting information, bean selling/information,

c. How reliable is the cell phone service like here? (probe for good or bad, works all the time, most of the time, etc.

14. Do you have access to a radio? If so, is it yours or someone else's?

a. What do you listen to on the radio? (Probe for shows, weather information, planting information, community radio, music, etc.)

b. What times do you most listen to it? (Probe for radio stations, community radio vs. national radio, reception, when like to listen to it?)

c. What information do you receive by radio everyday? Every 10 days? Every season?

15. Do you have access to TV?

What do you watch? (Probe for shows, weather information, planting information, telenovellas, etc.)

a. When do you most watch it?

Community Exercise (if time allows/ needed)

16. What do you use your income for? [Probe for children's schooling, health, more crops/food, etc]

WRAP UP

1. Is there anything we missed that you would like to talk about?
2. What is 1 thing we could do to help you or your farm?

THANK YOU

Google images of study villages

Image B1: Manica village 4

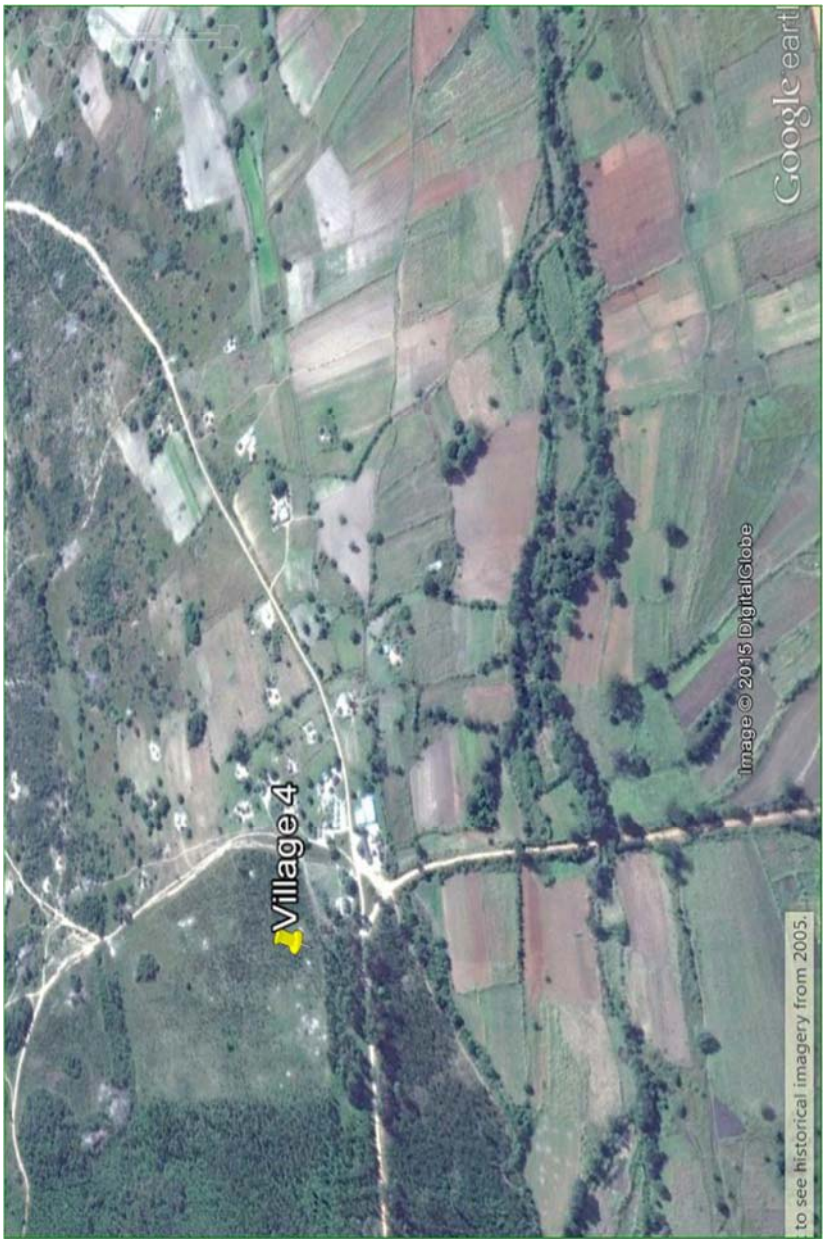
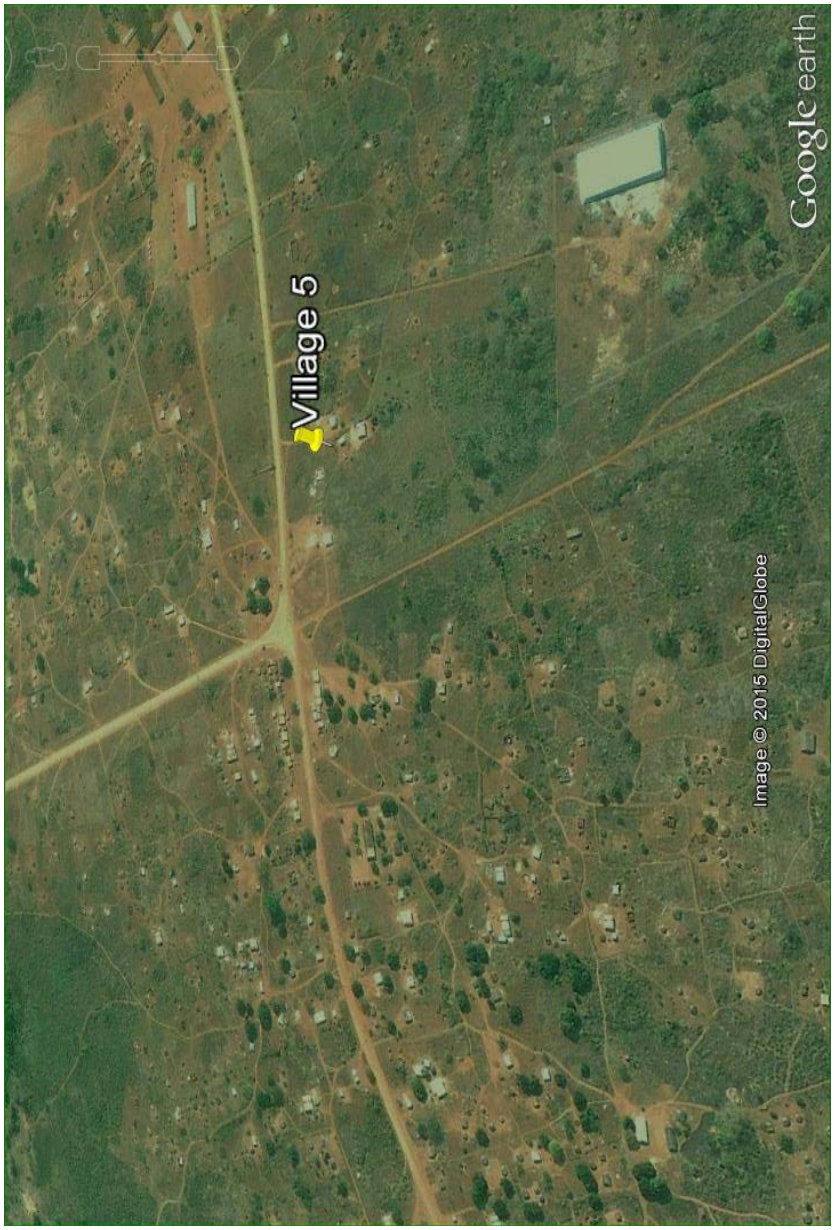


Image B2: Manica village 5



Appendix C: Chapters 4

Table C1: Summary statistics of study variables based on WEAI+ Mozambique data

Study variable	Obs (N)	Female (%)	Male (%)	Total %
Total respondents surveyed by region	882	percent	percent	percent
Central	316	33.55	38.44	35.8
Northeast	259	28.03	30.90	29.37
Northwest	307	38.43	30.66	34.81
Reported age of main decision maker in HH	880			
% aged below 25yrs		21.91	13.66	18.07
% aged 25-45yrs		47.66	24.26	49.55
% aged 46 and over		30.43	57.31	32.38
Types of households:	883			
% Married couple household		82.59	97.09	89.35
% Female-only household		17.2	0.97	9.63
% Male-only household		0.21	1.94	1.02
Education attained by main decision maker	882			
% Less than primary school		59.24	34.31	47.62
% Primary school		35.03	53.04	43.42
% Secondary school		5.1	12.41	8.5
% College, vocation or technical		0.63	0.24	0.87
Ability to speak/ write Portuguese				
% able to speak Portuguese	882	38.30	66.26	51.36
% able to write Portuguese	691	44.13	72.81	58.32

Table C2: Reported religious affiliation across Central, Northeast and Northwest Mozambique based on WEAI+ Baseline Survey 2014-2015

Religious affiliation	Central % (n=309)	Northeast % (n=258)	Northwest % (n=294)	Total % (N=861)
Muslim	9.06	0.78	0.68	3.72
Christian	79.61	93.02	89.12	86.86
Traditionalist/ Other	11.33	6.2	9.52	9.42
Pearson Chi2 = 44.37 (P =0.000<0.05)				

Figure C1: Reported household age distribution across all surveyed households based on WEAI+ age by age group

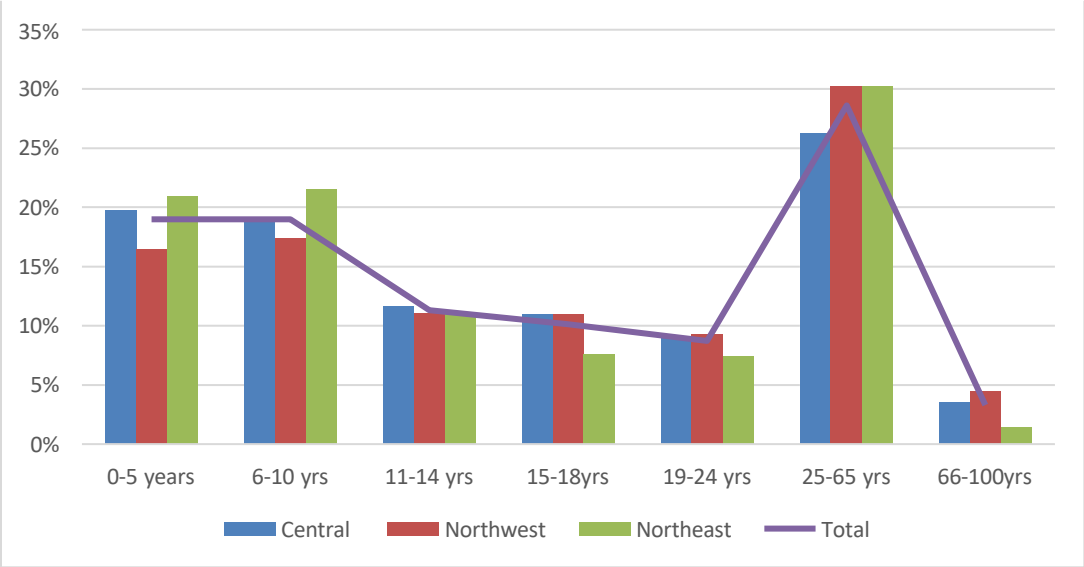


Figure C2: Highest level of education attained by men and women in rural Mozambique based on WEAI+ baseline survey

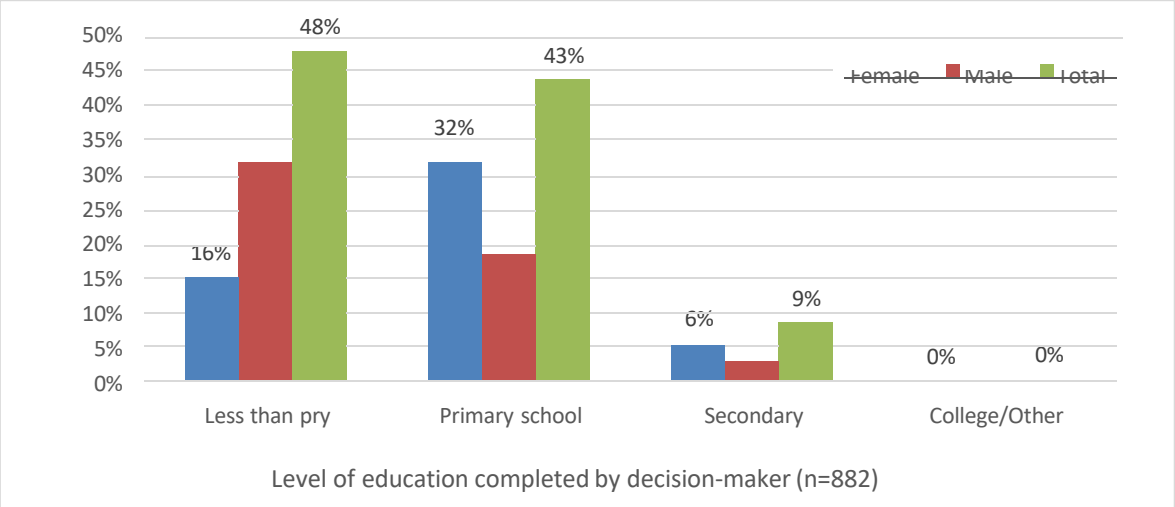
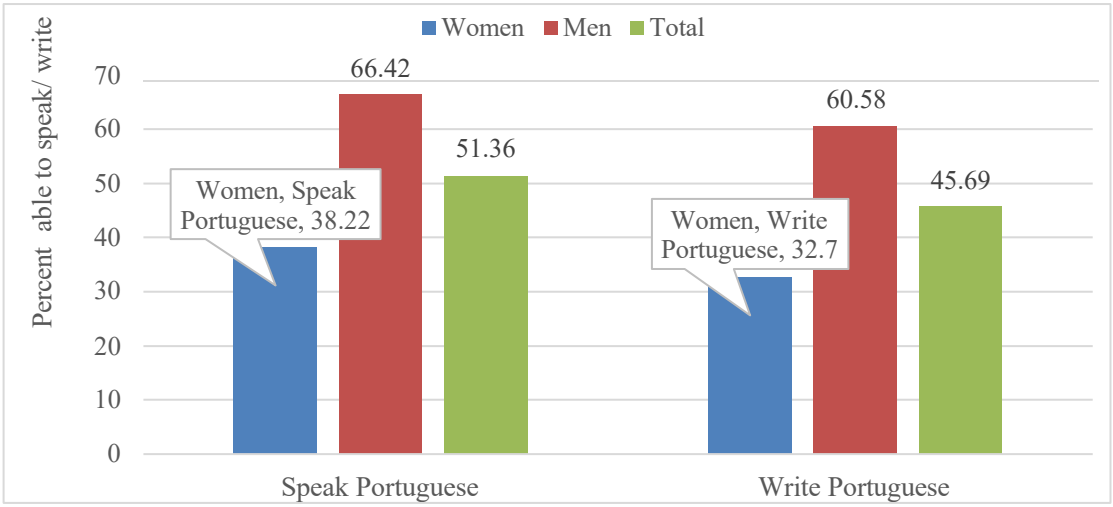


Figure C3: Comparison between men and women's ability to speak and write Portuguese in rural Mozambique (n=882)



t (611)=-8.1060, *P* (T<t) =0.000

Table C4: Language spoken at home by male and females across Central, Northeast and Northwest rural Mozambique based on WEAI+ Baseline Survey 2014-2015

Language spoken at home by respondent	Central		Northeast		Northwest	
	% Female (n=158)	% Male (n= 58)	% Females (n = 132)	% Male (n= 127)	%Females (n= 182)	% Male (n= 126)
Chimanhica	25.95	20.89	0	0	0	0
Chindau	1.27	1.27	0	0	0	0
Chiute	56.33	59.49	0.76	0	0	0
Chechewa	0	0	0	0	91.8	98.44
Lomue	0	0.63	65.91	70.87	0	0
Macua	0	0	33.33	29.13	0	0
Ngoni	0	0	0	0	6.56	0
Nhanja	0	0	0	0	1.09	0
Shona	16.46	17.72	0	0	0	0
Other	0	0	0	0	0.55	1.56

Table C5: List of study village located in Central, Northeast and Northwest Mozambique

VIN	Village name	Region	Male	Female	Total
1	MV4	Central	60	63	123
3	MV5	Central	42	38	80
4	Namiepe	Northeast	42	39	81
5	Zomba B	Northeast	39	38	77
6	Murrimu	Northeast	48	55	103
7	Mutore	Central	54	57	111
8	Nhamane	Northwest	41	64	105
9	Ntapo	Northwest	37	61	98
10	Bjango	Northwest	48	56	104
Total sample			411	471	882

Appendix D: Chapter 5

Figure D1: Comparison of decision-makers' age by gender and village

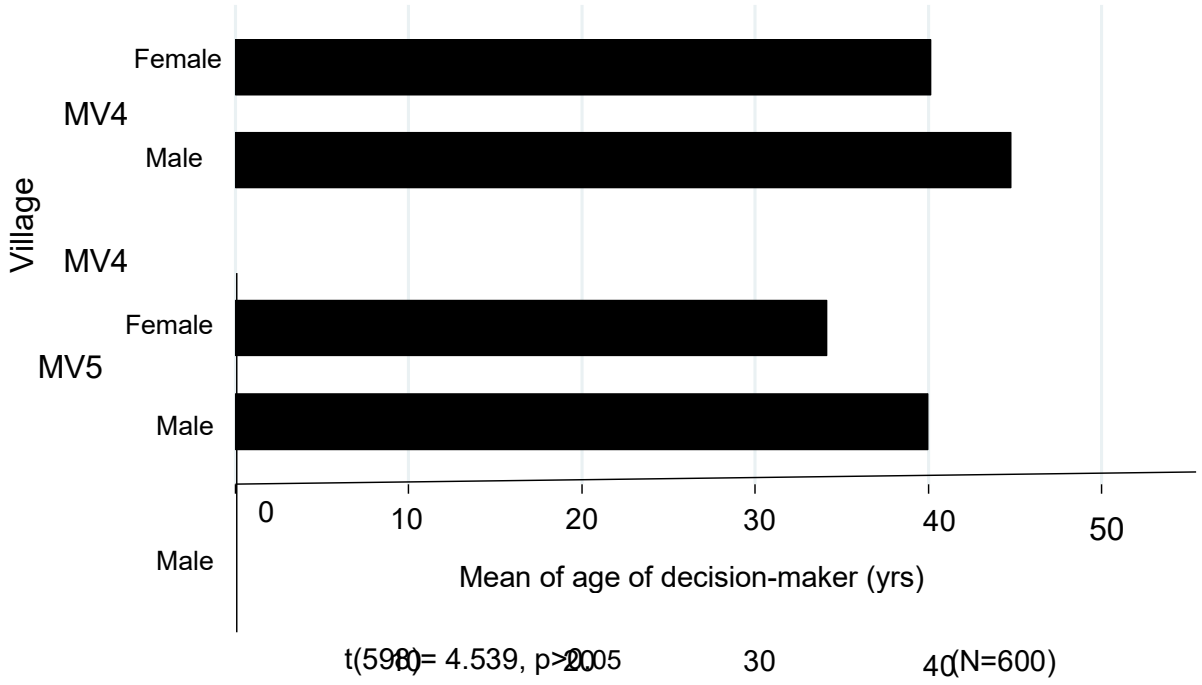


Table D1: Age comparison of decision-makers by village

Age of decision maker	N	Manica village 4	Manica village 5	% Total
18-25 Yrs	60	10.2	16.07	14.05
26-34 Yrs	112	19.73	29.64	26.23
35-43 Yrs	124	28.57	29.29	29.04
44-52 Yrs	56	16.33	11.43	13.11
53-61 Yrs	35	11.56	6.43	8.2
62-99 Yrs	40	13.61	7.14	9.37
Total (n)	427			

Figure D2: Size of agricultural land accessed by household

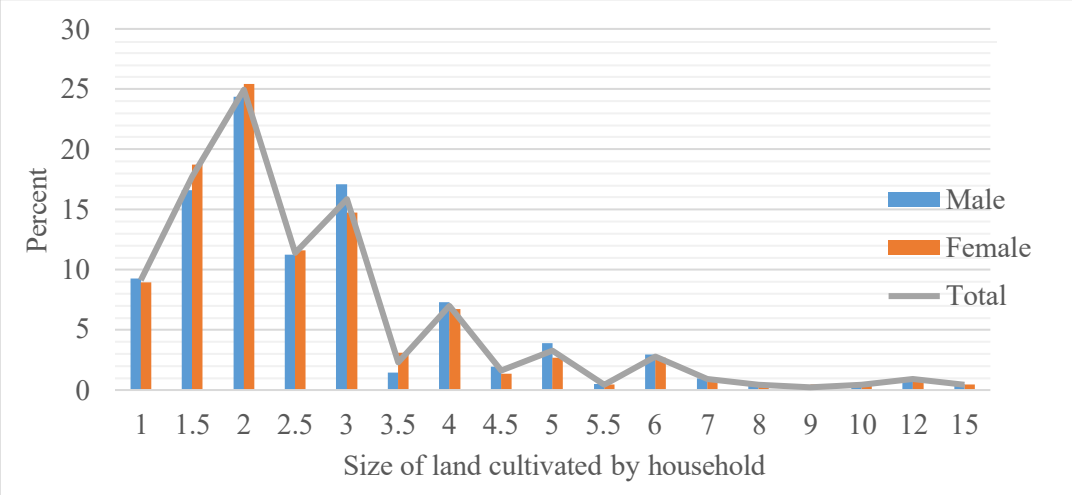


Table D2 Descriptive statistics on access to extension services and agricultural demonstration plots reported by MV4 and Manica village 5.

Access to agricultural extension	Study village	N	Mean	Std. Dev.	Std. Err. Mean
How often do you talk to agriculture extension agent?	MV4	249	2.80	1.355	0.086
	MV5	352	1.42	0.921	0.049
Have you participated in farmer field school in the last 5 years?	MV4	249	1.51	0.501	0.032
	MV5	352	1.87	0.334	0.018
Have you participated in demonstration plot or field day visit in the last 5 years?	MV4	249	1.45	0.498	0.032
	MV5	352	1.82	0.381	0.020

Table D3: Comparison by gender on access to agriculture extension and demonstration plots.

Access to extension services		N	F	Sig.	t	df	Sig. (2-tail)	Mean Diff.
How often do you talk to agriculture extension agent?	Male	287	2.21	0.138	1.428	599	0.154	0.153
	Female	314			1.427	591.8	0.154	0.153
Have you participated in farmer field school in the last 5 years?	Male	287	6.01	0.014	-1.23	599	0.218	-0.045
	Female	314			-1.23	587.6	0.219	-0.045
Have you participated in demonstration plot or field day visit in the last 5 years	Male	287	17.86	0.000	-2.17	599	0.030	-0.083
	Female	314			-2.16	585.4	0.031	-0.083

APPENDIX E: CHAPTER 6

Table E1: Logistic regression output on macro-level factors that affect soybean uptake among female decision-makers in the Northwest, Northeast and Central region of Mozambique based on their level of participation in decision-making of cash crop farming inputs

Variables	Sociodemographic (n=455)	Decision-making (n=455)
Age of decision-maker	0.0821**	0.0727*
	(0.0363)	(0.0393)
Age of head of household squared	-0.000892**	-0.000768*
	(0.000388)	(0.000422)
Educational attainment (ref: no school)		
Primary school	-0.675**	-0.436
	(0.338)	(0.374)
Secondary & above	-0.807	-0.364
	(0.531)	(0.578)
Person can speak Portuguese	-0.578*	-0.944**
	(0.343)	(0.386)
Type of household (ref: unmarried)		
Married (dual)	0.0350	-0.144
	(0.265)	(0.297)
Production capital		
Size of household	-0.0410	0.0638
	(0.0625)	(0.0691)
Household labor index	-0.177	-0.254**
	(0.110)	(0.121)
Level decisions in cash crops (ref: no input)		
Some input		1.136***
		(0.302)
Most input		1.220***
		(0.293)
All input		0.951**
		(0.388)
Region of Mozambique (ref. Central)		
Northwest		1.743***
		(0.300)
Northeast		0.699**
		(0.287)
Intercept	0.208	-1.121
	(1.016)	(1.121)
-2 Log Likelihood		
Pseudo R2	0.0276	0.1327

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.

Table E2: Logistic regression testing macro-level factors on soybean uptake across various age groups and women's participation in decision-making of inputs used in food and cash crop

Variable	Socio.dem. (n=878)	Region (n=878)	Crop_decision (n=878)
Gender of decision maker (female)	-0.0288	-0.0211	0.0981
	(0.161)	(0.163)	(0.172)
Age of decision maker (ref. 18-25 years)			
26 - 34 Yrs	0.494**	0.518**	0.484**
	(0.238)	(0.242)	(0.245)
35 -43 Yrs	0.168	0.227	0.143
	(0.240)	(0.243)	(0.248)
44 - 52 Yrs	0.500*	0.586**	0.515*
	(0.266)	(0.269)	(0.274)
53 -61 Yrs	0.748**	0.741**	0.777**
	(0.317)	(0.322)	(0.326)
62 - 99 Yrs	0.365	0.418	0.328
	(0.287)	(0.292)	(0.295)
Marital status of decision maker (ref. unmarried)			
Married	0.0489	0.295	0.211
	(0.265)	(0.275)	(0.289)
Education attainment (ref. no school)			
Primary	-0.167	-0.0861	-0.120
	(0.273)	(0.278)	(0.283)
Secondary	-0.495	-0.299	-0.353
	(0.381)	(0.388)	(0.395)
College &other	0.520	0.555	0.638
	(1.222)	(1.224)	(1.194)
Person speaks Portuguese	-0.819***	-0.902***	-0.828***
	(0.283)	(0.289)	(0.293)
Ethnicity (ref. Lomue)			
Macua	-2.503***	-2.521***	-2.497***
	(0.408)	(0.409)	(0.414)
Chechewa	0.614***	-0.332	-0.342
	(0.219)	(1.131)	(1.119)
Shona	-0.221	1.372	1.483
	(0.311)	(1.179)	(1.180)
Chute	-1.192***	0.386	0.513
	(0.227)	(1.157)	(1.158)
Other	-0.491*	0.553	0.701
	(0.274)	(1.118)	(1.117)
Region (ref: Central)			
Northwest		2.656***	2.603***

		(0.625)	(0.638)
Northeast		1.614	1.725
		(1.139)	(1.138)
Level decision-making (ref: no input)			
Level of participation in food crop inputs			-0.0715
			(0.125)
Level of participation in cash crop inputs			0.368***
			(0.0985)
Intercept	1.226*	-0.606	-1.137
	(0.628)	(1.300)	(1.322)
-2 Log Likelihood	146.94	168.79***	188.73***
Pseudo R2	0.1207	0.1387	0.1551

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.

Table E3: Logistic regression testing micro-level factors that affect soybean uptake between Manica village 4 and Manica village 5 based on productive capital and social capital

VARIABLES	(model 1) Socio-demo. (n=235)	(model 2) Prod. capital (n=235)
Age of decision maker	0.175**	0.148*
	(0.0785)	(0.0834)
Age squared	-0.00154*	-0.00125
	(0.000822)	(0.000875)
Type of household (ref: Unmarried)		
Married	0.134	-0.177
	(0.612)	(0.674)
Village (ref: MV5)		
Manica village 4	1.477***	1.818***
	(0.377)	(0.592)
Productive capital		
Size of household		0.0869
		(0.0799)
Land (ha.) -total cultivated by household		0.122
		(0.117)
Social capital		
Number of relatives in village		0.515
		(0.319)
Number of friends in village		-0.960***
		(0.354)
Number of people consulted on soybean in village		1.758
		(1.104)
Number of times consult with extension		0.0490
		(0.182)
Intercept	-6.655***	-10.69***
	(1.844)	(3.839)
-2 Log Likelihood	29.76***	41.30***
Pseudo R^2	0.1349	0.1872

Note. *Standard errors in parentheses,* *** p<0.01, ** p<0.05, * p<0.1 levels for one-tailed test of significance.

Figure E1: Stata output of correlation matrix based on variables adopted to test effect of intensity of ties and soybean uptake

	Soy_up	fem	age	age_sq	dual_hh	size_hh	land	inc	T_kin	T_vf	T_soy	farm_sch	demo	kin	non_kin	R_401	R_6	R_35	SW
Soy_up	1.0000																		
fem	0.2273	1.0000																	
age	0.0302	-0.1260	1.0000																
age_sq	0.0191	-0.1418	0.9834	1.0000															
dual_hh	0.0519	-0.2738	0.1966	0.1749	1.0000														
size_hh	0.1786	0.1634	-0.0329	-0.0683	0.3596	1.0000													
land	0.1437	0.1447	0.0926	0.0713	0.2211	0.5262	1.0000												
inc	-0.2604	-0.4681	-0.2388	-0.2176	0.1293	-0.1959	-0.1521	1.0000											
T_kin	0.1914	0.1104	0.0798	0.0824	-0.0436	-0.0881	0.1006	0.0192	1.0000										
T_vf	0.0041	0.0809	-0.0698	-0.0857	0.0037	0.1203	-0.1351	-0.0129	0.0713	1.0000									
T_soy	0.0962	-0.0227	-0.1165	-0.1375	-0.1079	-0.0037	-0.1936	-0.0099	-0.1001	0.5731	1.0000								
farm_sch	0.2204	0.0314	0.0634	0.0053	0.0948	0.0658	0.1208	0.1741	0.0648	-0.2343	-0.1216	1.0000							
demo	0.2033	-0.0050	0.1520	0.0852	0.0681	-0.0652	0.1144	0.1729	0.1587	-0.2133	-0.0962	0.7595	1.0000						
kin	-0.0614	-0.0271	-0.3056	-0.2596	-0.2202	-0.2042	-0.2135	0.5181	0.0757	-0.0338	0.0921	0.0186	-0.0753	1.0000					
non_kin	0.0195	0.0888	0.2304	0.2070	0.0342	0.1551	0.1854	-0.6122	-0.0469	0.0602	-0.0805	-0.1156	-0.0195	-0.8739	1.0000				
R_401	0.0506	0.0171	-0.1203	-0.1420	0.1412	-0.0383	-0.0068	0.1115	0.0452	0.2715	0.2906	0.1528	0.1678	0.0076	-0.0867	1.0000			
R_6	-0.1407	-0.2368	0.1538	0.1402	0.1234	0.2341	-0.0682	-0.0133	0.0054	-0.0376	0.1176	-0.0489	-0.0276	-0.1054	0.0921	-0.3468	1.0000		
R_35	-0.1137	-0.1249	0.0795	0.0761	0.0907	0.1946	0.0870	0.0273	0.1434	-0.1109	-0.1454	0.0641	0.1137	-0.0775	0.0677	-0.2259	-0.0989	1.0000	
SW	-0.1916	0.0040	0.0362	0.0417	-0.0856	0.0170	-0.1068	-0.1991	-0.1429	-0.2680	-0.2941	-0.1735	-0.1616	-0.0035	0.1471	-0.3536	0.1254	0.1954	1.0000

VITA

Mary Fridah Karwirwa Mubichi was born in Meru, Kenya to Florence and Stephen Mubichi. She spent her early childhood years at the Maua Methodist hospital where her mother served as the first African nurse matron. In 1984, she and her family moved to Oklahoma City as her mother pursued her bachelor's degree in Nursing. Upon returning to Kenya in 1987, she joined a local boarding school in Meru, and later attended the Kenya High School for her high school education. She joined the United States International University-Nairobi where she earned a BSc. in International Business Administration and later a Msc. in Management and Organizational Development. She also holds an MBA in International Marketing and an MA. in Sociology. An avid scholar, Fridah has received various international scholarships and fellowship awards including the International Peace Scholar (IPS) award by PEO, and the International Comparative Rural Policy study (ICRPS) fellowships among others. As an interdisciplinary scholar Fridah has taught various business and community development courses in Kenya and in the United States. A stout believer in grassroots development, she helped found the Miriam Kanana Mubichi Foundation, a nationally recognized NGO in Kenya that partners with various international partners to promote access to education, health and resource management.

Fridah’s vision is for a poverty free Africa. Having grown up in rural Kenya and later worked in Mozambique where she witnessed extensive malnutrition and poverty among women and children, her research focus has been on agricultural technology adoption, women empowerment and sustainable development in Africa.