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Abstract

Food and nutrition security have become an increasingly important area of policy debate in developing countries. Children in the semi-arid areas of Africa are most vulnerable because of the poor socio-economic status of their parents especially their mothers. In Zimbabwe, frequent droughts, the decreasing performance of the agricultural sector since the onset of the land reform program and severe economic underperformance have resulted in high levels of child malnutrition. Because legumes are protein and calorie rich, are cheap to produce (do not require heavy input use), are drought resistant and increase soil fertility through biological nitrogen fixation, they have often been considered as the best cropping innovation for increasing food and nutrition security for the most vulnerable children in the country. However, no comprehensive studies have been carried out in the country to estimate and ascertain this contribution. In this study, using household farming data from the Department of Agricultural and Extension Services (AGRITEX) and from community level health institutions, a two stage instrumental variable probit model was developed to establish the factors affecting the level of legume production at farm level and to estimate the contribution of legume cultivation to child nutrition in Zimbabwe. Results from the study show a significant positive increase in the chances of a household not having a malnourished child as the level of legume cultivation increases. By instrumenting legume production levels by the aggregated quantity of legume seed available for planting, the study found that a 1Kg increase in the quantity of legume seed cultivated was found to have an 11.6% marginal increase in the chances of a household not having a malnourished child. The results, backed by focus group discussions and key informant interviews also show that, lack of legume producing inputs especially seed and land heavily constrain the production of legumes at a larger scale. Formal education and agricultural extension (both government and private sector provided) generally discourage legume cultivation in favour of livestock and other crops. Markets were found to be week in driving legume production because legume markets are not well developed and organised in the study areas. Policies that seek to achieve better child nutrition through legumes should aim to increase availability of legume production inputs especially seed and land to women and to sensitize men, extension workers and school agricultural education curriculum developers on the value of legumes in reducing child malnutrition. Also, women empowerment projects that focus on agricultural resource allocation between men and women have a potential to improve legume production and thus child nutrition. Legume production can be stimulated by the creation and development of legume markets through a value chain system.

1. Introduction

Background

Over two billion people suffer from multiple micronutrient deficiencies worldwide, with high prevalence among young children in sub-Saharan Africa (Muthayya et al. 2013). More than one in three children under five years of age in sub-Saharan Africa are stunted (UNICEF et al. 2015). The majority of malnourished people live in rural areas and depend on agriculture as an important source of the food and income required for their nutrition and health (Pinstrup-Andersen 2012). Agricultural interventions have great potential to improve nutrition, but this potential is yet to be unleashed (Ruel and Alderman 2013). Boosting the production of grain legumes by smallholder farmers is a feasible option to improve nutrition in rural areas. The advantage of grain legumes like cowpea, groundnut and bambara nuts is twofold. First, legumes are unique in that they can fix nitrogen from the air in symbiosis with Rhizobium bacteria, increasing their production and enhancing soil fertility, thus increasing the production of other crops (Giller et al. 2013). Second, compared with maize, which is the most commonly produced and consumed staple in sub-Saharan Africa, legumes are better sources of high-quality protein and contain a larger variety and greater concentration of micronutrients (de Jager 2013; FAO, 2012).

The term malnutrition generally refers both to under nutrition and over nutrition (WHO, 1995), but in this study, it is used to refer solely to a deficiency of nutrition. Many factors can cause malnutrition, most of which relate to poor diet in underprivileged populations. Inadequate diet in turn, is closely linked to the general standard of living, the environmental conditions, and whether population is able to meet its basic needs such as food, housing and health care. Although malnutrition is rarely the direct cause of death (except in extreme situations, such as famine), child malnutrition was associated with 54% of child deaths (10.8 million children) in developing countries in 2006 (FAO, 2011). Malnutrition that is the direct cause of death is referred to as “protein-energy malnutrition” and it this form of malnutrition that is the main focus of this study.

There are a number of strategies that rural farmers can adopt to deal with climate change induced malnutrition. Some of these strategies have been scientifically proven to work well by a number of research institutes such as ICRISAT and CIMMYT. Among the most acclaimed nutrition security strategies are the adoption of drought resistant crops and crop varieties, the rearing of drought tolerant livestock types and breeds and the diversification of livelihoods to cushion farmers from welfare changes associated with fluctuations in climate.

In addition to these, legumes and legume-based cropping systems have been highly acclaimed as potential remedies to food and nutrition insecurity in resource constrained rural communities. Efforts have been made in most African countries to promote the incorporation of legumes and legume-based cropping systems into smallholder agriculture (Peterson et al., 2010). Smallholder farmers, especially women have been growing legumes as sole crops or intercropped with staple cereals mainly maize for many years. But however, because most leguminous crops have limited markets resulting in low market values and are not considered as strategic food security and commercial crops by smallholder farmers, their production has mainly been the preoccupation of women farmers and children.

Because of limitations in land and other resources, women farmers often grow legumes as intercrops with cereals. By doing this, these farmers also benefit from the symbiotic biological commensalism between the two crop types such as nitrogen fixation by legumes which improves soil fertility resulting in increased drought resistance by the cereal crop. Legumes naturally fix nitrogen in the soil (biological nitrogen fixation -BNF). Biological nitrogen fixation increases soil fertility and reduces the amount of fertilizer that women farmers need to buy for their cereal crops. This is desirable since most women farmers especially widows are located on the lower levels of community income spectrums. Experiments have also shown that the soil fertility enhancement benefits of legumes also result in cereal crop tolerance to drought (Nellemann, 2011) and thus a lower threat of protein carbohydrate malnutrition. Legumes are highly nutritious and are rich in healthy plant protein and unsaturated fats and if intercropped with cereals which are rich in carbohydrates, the chances of improving household nutrition are highly enhanced. However, Zimbabwe's agricultural extension system (both public and private) has ignored the production of legumes in favour of more commercially lucrative crops such as cotton, tobacco and maize. Zimbabwe's agricultural education and extension system therefore needs to consider their role played by legumes in nutrition.

The semi-arid areas of Zimbabwe are characterized by low, often erratic and unreliable rainfall. This makes dry land crop farming in these areas a nightmare. Farmers in these areas who are mostly women have responded to this by diversifying their farm enterprises through intercropping cereals with legumes. By doing this, they increase their chances of getting some return on their investment from one crop should the other one fail due to poor climatic conditions. Inter-cropping, the growing (or mixing) of more than one crop on one piece of land in the same season is also particularly of immense benefit to these farmers because they do not own large pieces of land like their male counterparts and thus it helps them to get more than one crop type on one piece of land. It is also less labour and capital intensive since it maximizes returns per unit area and labour unit - a desirable feature since women farmers have only usufruct rights to land and thus they do not make major decisions on household land use unless the husband is not available.

Problem statement

Zimbabwe, a Southern African country of about 14.8 million people has faced political and economic upheaval that disrupted its previous standing as a relatively prosperous and resilient country (World Bank, 2017; ZIMSTAT, 2015; USAID, 2018). About 76 percent of the rural households are considered poor and 23 percent extremely poor. On average, households spend over 70% of their income on food. Ninety-two percent of Zimbabwean rural households practice agriculture as their primary livelihood. However, frequent droughts, decreasing performance of the agricultural sector since the onset of the land reform program and severe economic underperformance have resulted in high levels of child malnutrition. Around 650,000 children under 5 years (27 percent) suffer from chronic malnutrition (stunting or low height-for-age) (USAID, 2016). This coupled with the slaughtering of breeding stock (mainly cattle) have resulted in acute shortages of animal-based protein sources (meat and milk) compounding the problem of child malnutrition in all but the richest households in the rural areas.

Legumes are cheap to produce (they require relatively low levels of input use due to their nitrogen fixing ability and pest resistance), they are drought resistant and tolerant, and also because of their soil fertility benefits through biological nitrogen fixation, they help to improve the drought resistance of the crop they are either intercropped or rotated with (Munier - Jolan et al, 2010). This implies that they are excellent food and nutrition crops for they maintain yield (and therefore household nutrition) across years and places of fluctuating and changing climatic and socio-economic circumstances.

Unlike the many other measures that have been proffered to maintain household nutrition and security in Zimbabwe that are either out of step with normal farmer practice or are too expensive, complicated or too labour intensive to the mostly women and children dominated agricultural systems of the country's rural areas, legumes and legume based agricultural systems have a potential to either maintain or improve nutrition levels of communities in a cheaper and affordable manner.

Notwithstanding the enormity of the contribution of legumes to women farming systems in Zimbabwe, a trawl through Zimbabwean literature reveals worrying trends. The most obtrusive of these trends is the lack of comprehensive studies on the actual contribution of legumes to household nutrition security in the country and on how to incorporate legumes into semi-arid agricultural systems in a way that will secure child nutritional statuses under varying agro-ecological conditions and socio-economic circumstances. Except for some disjointed studies that have been conducted here and there, there is no lucid or consolidated work that shows a direct link between legumes and child nutrition.

This study determines the contribution of legume production to child nutrition in the semi-arid areas of Zimbabwe. It reveals the potential prime movers to the increased integration of legumes into rural area farming systems and point at the policy interventions that can help the marginalized communities (mostly women and children) to attain sustainable nutritional security through legumes.

Justification

Women and children nutritional status is of paramount importance because it is through women and their children that the malicious effects of malnutrition are propagated from generation to generation. A malnourished mother has a high likelihood of giving birth to a malnourished baby susceptible to death prematurely, which further undermines economic development of the society and continues the poverty and malnutrition cycle. Considering the position of rural women farmers at the lower levels of community income spectrums, and their vulnerability to malnutrition either directly or through their unborn and young babies, a study that seeks to investigate cheaper ways of improving nutritional security is invaluable. Malnutrition related child mortality and morbidity, although on a decline in the country, the rates are still worrisome in the semi-arid areas among the poor communities.

The results from this study are expected to enlighten policy makers in government agricultural and health departments on how inexpensive agricultural systems such as the inclusion of legumes into rural cropping systems can contribute to the attainment of increased levels of nutrition and thus in formulating sound and appropriate nutrition security policies that are in line with community pedo-climatic conditions and socio-economic circumstances. The study will especially benefit the women and children who, in most cases cannot afford more expensive ways of attaining acceptable levels of nutrition due to poverty. This, in turn, will result in the attainment of greater levels of productivity from a well-nourished citizenry and a further improvement in household nutrition.

Research objectives

- To examine the factors affecting the increased integration of legumes into Zimbabwe's semi-arid farming systems.
- To determine the contribution of legumes to child nutrition in the semi-arid areas of Zimbabwe.

Hypotheses

- The growing of legumes by semi-arid area farmers is not affected by household socio-economic characteristics, pedo-climatic conditions and institutional factors.
- Growing legumes has no significant impact on child nutrition in the semi-arid areas of Zimbabwe.

2. Literature review and conceptual framework

Literature review

Agriculture nutrition nexus

Literature describes a number of potential pathways through which agricultural policies may affect nutrition outcomes positively, but also negatively (Du et al. 2015; Hoddinott 2011). This study is mainly interested in 3 of these pathways: crop production for own consumption (the production-own consumption pathway), crop production for income used to purchase food (the income-food purchase pathway) and improvement of women's status in crop production and nutrition (the women's empowerment pathway). The production-own consumption pathway assumes that increased production of nutritious foods increases consumption of these foods and adds to diversity of the household's diet (Du et al. 2015; Masset 2012). Greater dietary diversity results in improved nutrient adequacy of the diet, which is especially important for vulnerable groups like young children (Kennedy et al. 2007; Moursi et al. 2008). Increased legume production may lead to increased consumption of legumes, adding to dietary intake of energy, proteins, minerals and B vitamins, and improved dietary diversity.

In Malawi, for example, an agriculture and nutrition education project that offered different legume intercrops (including groundnut and soybean) to farmers, resulted in increased cultivation of legumes, increased the frequency of legume consumption by children and improved their nutritional status in villages that were most intensely or longest involved in the project (Bezner Kerr, 2010). The authors did not report on the impact on children's dietary diversity. The income-food purchase pathway assumes that increased agricultural income through increased production is used for immediate or future household needs, including food and non-food purchases to support improved nutrition outcomes (Du et al. 2015). As noted by Keats and Wiggins 2014, results of studies on effects of increased income on dietary intake are inconsistent and vary per country. Some studies found positive effects (Muhammad et al. 2011; Monteiro 2009) and others found no effects (World Bank 2007; Masset et al. 2012) or suggested negative effects as diets tend to shift from cereals and tubers to meat, fats and sugar (Keats and Wiggins 2014).

The women's empowerment pathway is a cross-cutting pathway interacting with the production-own consumption and the income-food purchase pathways. Women's status in the household is often related to children's dietary intake. In the case of increased legume production, a greater status of women may lead to increased control over resources related to legume production and more income from the sale of legume produce. In turn, women's greater control over resources may result in the channeling of nutritious foods within households to the advantage of children, and to more income spent on nutritious food and health care, particularly for children (Smith et al. 2003; UNICEF 2011). However, the increase of female participation in agriculture may trade off with time spent on care practices, negatively influencing child nutrition (Barrios 2012). For example, the effect of increased legume production on children's dietary diversity may depend on the household's landholding influencing all three pathways. The landholding of households is associated with the quantity of household crop production and the household's agricultural income. To better understand the effect of boosting food production on children's dietary diversity, quantitative assessments of the production-own consumption and the income food purchase pathways are needed, while taking into account the role of women and the food environment. More rigorous and better designed studies are needed in agriculture and nutrition evaluations (Masset et al. 2012) but these have methodological challenges such as with establishing proper comparison groups, lacking baseline data and matching the project implementation process with rigorous study designs.

In much of southern Africa, smallholder arable farming is dominated by maize production. Agricultural productivity in the region is poor, with annual national average grain yields varying between 0.3 and 2.2 Mg ha−1 in 2008–2012 in Malawi, Mozambique and Zimbabwe (FAOSTAT, 2014). In Malawi, poor crop productivity has partly been addressed by the Farm Input Subsidy Programme (FISP) (Dorward and Chirwa, 2011; Chibwana et al., 2012). The FISP has contributed to raising national maize productivity and reducing rural poverty but is not without controversy. Households participating in the FISP have been found to simplify crop rotations by allocating more land to maize and tobacco at the expense of other crops such as groundnut, soybean and bean (Chibwana et al., 2012). The over-reliance on maize has led to repeated recommendations for crop diversification using legumes. Grain legumes, such as groundnut (Arachishypogaea L.), soybean (Glycine max (L.) Merrill), cowpea (Vignaunguiculata (L.) Walp.), common bean (Phaseolus vulgaris L.) and pigeonpea (Cajanuscajan (L.) Millsp.), provide more promising entry points to diversify cropping systems and enhance soil fertility management due to their multiple benefits.

Throughout Africa there is a wide diversity of farms and farming strategies, which determine the opportunities for uptake of different technologies (Giller et al., 2011). Since it is impossible to develop unique recommendations for each household, farm diversity has been categorized to define recommendation domains (Kamanga et al., 2010a; Tittonell et al., 2010b).

But what are gegumes?

Legumes are plants belonging to the family Leguminosae that produce seeds within a pod (MacColl, 1989). Leguminosae is a large family with over 18,000 species but only a limited number is used as human food. Common legumes used for human consumption include peas, broad beans, lentils, soybeans, lupins, lotus, sprouts, mung bean, green beans and peanuts and are referred to as grain legumes or food legumes.

Food legumes are divided into two groups, namely oil seeds and pulses. The former being legumes with high oil content such as soybean and peanuts and the latter being all dry seeds of cultivated legumes used as traditional food (Franke et al., 2008). Legumes are believed to be one of the first crops cultivated by mankind and have remained a staple food for many cultures all over the world (Yusuf et al., 2009). These seeds are valued worldwide as an inexpensive meat alternative and are considered the second most important food source after cereals (Mugwe et al., 2009). Legumes are nutritionally valuable, providing proteins with essential amino acids, complex carbohydrates, dietary fibre, unsaturated fats, vitamins and essential minerals for the human diet. In addition to their nutritional superiority, legumes have also been ascribed economical, cultural, physiological and medicinal roles owing to their possession of beneficial bioactive compounds.

The consumption of legumes has also been reported to be associated with numerous beneficial health attributes such as hypocholesterolemic, antiatherogenic, anticarcinogenic and hypoglycemic properties (Yusuf et al, 2009). Legumes have proven to be a cheap source of nutrients as well as a potential source of income for subsistence farmers who cultivate legumes at household level. They are excellent crops for energy malnutrition (PEM) which is a major nutritional syndrome affecting over 170 million preschool children and lactating women in developing African and Asian countries (Rogers,1995). The prevalence of PEM can be attributed to many factors such as the high price of animal protein (eggs, meat and milk), the staple cereal-based diet and the ever-increasing price of food commodities becoming unaffordable to the lower income groups. Although, high protein legumes such as soybean and cowpea are available to consumers, their consumption rate surpasses their production rate; thus, an ever-increasing demand has been observed (Kadam and Chavan, 1991).

The nutritional demand of legumes is increasing worldwide because of increased consumer awareness of their nutritional and health benefits. Furthermore, recent years have seen more people substituting animal protein with vegetable protein; thus, further increasing the demand for legumes as they are the chief source of plant proteins. To meet this demand, there is a need to direct attention to the nutritional profiling of various legumes, increase the utilization of underutilized legumes, produce cheap, innovative value-added products from legumes, educate consumers on the nutritional value of legumes as well as find new ways of encouraging the use of existing legumes.

Utilization of legumes in Zimbabwe

The major edible grain legumes grown and consumed in Zimbabwe are groundnuts, cowpeas, beans and bambara nuts.

Groundnuts

Groundnuts can be used as freshly harvested seeds or dry kernels. Fresh harvested pods may be boiled or roasted with or without salt and served as a snack. Postharvest technologies in dry groundnut are very fundamental to value addition of the crop. The processing of dry groundnuts begins with shelling and can be done by hand or machinery; it also adds value to the crop. Nutritive groundnut haulm from shelling can be used to feed livestock while the hulls can be used to make compost manure. Shelled groundnuts can also be boiled or roasted with or without salt and served as a snack (Singh and Diwakar, 1993). The most popular value-added product from groundnuts in Zimbabwe is peanut butter. The butter is used as an additive to porridge for feeding children or can be used instead of cooking oil for cooking vegetables and other dishes (Kadam and Chavan, 1991).

Bambara nut

Bambara nuts can be eaten while it is fresh by boiling the seeds. Dried seeds can be milled into flour which is used to make flat cakes, biscuits and porridge when mixed with other cereals. In Zimbabwe, the nuts are pounded and mixed with onions, tomatoes and oil to make a relish. In order to improve protein content of traditional weaning foods, the legume grain can be used to make bambara- fortified high protein fermented maize dough (Mbata et al., 2009). Grain legumes that include bambara nuts can be used to make fortified wheat flours that are nutritive (Abu-salem and Abou-Arab, 2011). Similar to soybeans, bambara nuts can be used to produce milk by soaking overnight, dry frying the seeds, homogenizing and removal of insoluble material (Brough et al., 2003). Despite the high nutritional value of bambara nuts, antinutritional factors have been reported that include tannins, trypsin inhibitors and also poor dehulling properties. Fermentation reduced anti-nutritional factors while hot soaking improved dehulling properties (Barimalaa and Anoghalu, 1997).

Cowpea

Cowpea is predominantly grown in Zimbabwe as the crop can tolerate dry environments than other legumes like soybeans. Therefore, its utilization is important in the country. This legume crop can be grown for fodder or grain purposes. When the crop is grown under stressful conditions, the foliage may be used to feed livestock as few pods will be produced. Fresh green cowpea pods can be used in the same way as snap beans while tender cowpea leaves can be served as a vegetable. Dry mature seeds can be boiled and eaten by children and adults alike.

Conceptual and analytical frameworks

Conceptual framework

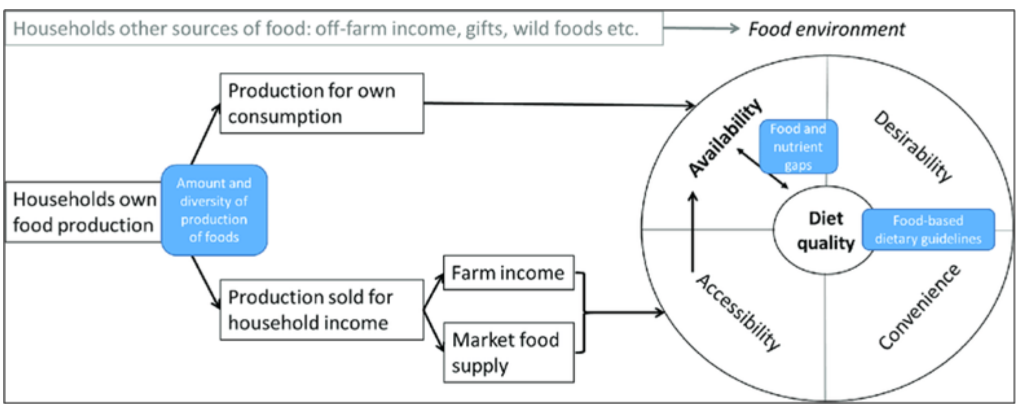
Crop production - Nutrition pathways

The aim of agricultural interventions is to increase food availability and assume this will result in improved nutrition outcomes. In literature, there are many different potential pathways through which agricultural interventions may affect nutrition outcomes positively, but also negatively (Du et al. 2015; Herforth and Harris 2014).

Two of these pathways are: crop production for own consumption (the production-own consumption pathway), crop production for income used to purchase food (the income-food purchase pathway) and improvement of women's status in crop production and nutrition (the women's empowerment pathway). These pathways are shown in Fig 2.1.

The first pathway assumes that increased production of nutritious foods increases consumption of these foods and adds to improved nutrition of the households (Du et al. 2015; Masset et al. 2012). Increased legume production may lead to increased consumption of legumes, adding to dietary intake of energy, proteins, minerals and B vitamins, and improved dietary diversity. This is exemplified by what happened in Malawi where an agriculture and nutrition education project offering different legume intercrops (including groundnut and soybean) to farmers, resulted in increased cultivation of legumes, increased the frequency of legume consumption by children and improved nutritional status in villages that were most intensely or longest involved in the project (Bezner Kerr et al. 2007; Bezner Kerr et al. 2010).

Fig 2.1: The production-own consumption and the income-food purchase pathways are two pathways that contribute to the availability and accessibility of food: A key condition for the adoption of food-based dietary guidelines to improve diet quality https://doi.org/10.1371/journal.pone.0204014.g001



The income-food purchase pathway assumes that increased agricultural income through increased production is used for immediate or future household food and non-food purchases to support improved nutrition outcomes (Du et al. 2015). Studies of this pathway yield varied and often conflicting results (Keats and Wiggins 2014). Some studies found positive effects (Muhammad et al. 2011; Monteiro 2009) and others found no effects (World Bank 2007; Masset et al. 2012) or suggested negative effects as diets tend to shift from cereals and tubers to meat, fats and sugar (Keats and Wiggins 2014).

Factors affecting adoption of innovations

Ndiritu et al., 2014:118 assert that increasing the speed of technology adoption is a key requirement for enhancing food security, agricultural productivity, economic growth and reduction of poverty in economically vulnerable communities. Feder, Just &Zilberman (1985:256) defined adoption as "the degree of use of a new technology in long-run equilibrium when the farmer has full information about the new technology and its potential". Wilkinson (1989) as cited in (Siziba, 2007:27) views adoption as an ongoing process occurring in a stepwise fashion. An early conceptualization of adoption of technologies as a process was coined by (Rogers, 1962) through the so called "Diffusion of Innovations" theory. Rogers (1995:20) avows that adoption occurs through a process of five key stages which are: knowledge, persuasion, decision, implementation, and confirmation. Knowledge stage is where potential adopters need to learn about the new technology while persuasion refers to the stage where adopters have to be convinced to accept the new technology. Decision phase is when farmers decide to take up the technology. During implementation the technology is put into practice and finally confirmation phase refers to the stage where the adopter has to reaffirm or reject his decision to adopt the technology.

Various studies on agricultural adoption including (Mwangi et al., 2015:4; Mugwe, 2009:66; Moser and Barrett, 2003:1097; De Souza Filho et al., 1999:99) have often categorized farmers as adopters or non-adopters. An adopter can simply be regarded as a person who consistently uses a technology.

Measurement of the rate of technology adoption can be done through different ways such as time needed for a particular group of people to adopt a technology, the number of technologies adopted when studying adoption of composite technologies or the percentage of technology adopters (Bonabana-Wabbi, 2002:25). Regarding the adoption of legume-based multiple cropping systems, the number of adopters can be useful in establishing the extent of adoption. Several factors influence the adoption of technologies and these can be categorized into biophysical, socio-economic, technology and institutional factors. Recent studies established that socio-economic factors have a significant effect on the adoption of soil fertility management practices (Mwase et al., 2015:148; Lambrecht et al., 2014:20; Mugwe et al., 2009:73). Once the biophysical environment has been fully understood, socio-economic factors and their interactions must be factored in the process of developing legume-based technologies (Ojiem et al., 2006:80).

Numerous households, economic and farm-related variables have been reported to influence the adoption of technologies (Jariko et al., 2011:194). The factors included in this study are; age of the respondent, farming experience, labour availability, farm size, gender, number of years in formal education, family size, number of extension contacts, off-farm income, agricultural extension income and other resource endowments. Age has been reported to affect adoption of technologies negatively. Mbugua (2011:34) for example asserted that younger farmers adopt technologies faster because they are willing to try out new things. Age can also influence adoption positively because older farmers have accumulated a lot of knowledge through experimentation. Farming experience, a factor that is closely related to age was reported to have a negative influence on adoption of ISFM technologies in Western Kenya (Mugwe et al., 2009:70). In this study, however experience in legume production was hypothesized to have a positive influence on adoption because the farmer has gained knowledge regarding the type of cropping system that can maintain soil fertility.

Hired labour is another factor which was expected to have positive influence on adoption of legume-based systems. This is because hired labour increases labour availability in the farmstead (Mugwe et al., 2009:70). Farm size is expected to have a positive influence because farmers with large land holdings are less risk averse, thus more likely to adopt legume-based cropping systems. Gender is critical to the adoption of technologies. Males are hypothesized to easily adopt technologies because they own and control resources and decision making on the farm. Number of years in formal education is another factor, which has been hypothesized to negatively affect technology adoption because highly educated farmers consider legume-based cropping as a primitive way of maintaining soil fertility. Family size is another factor that affects adoption because it increases the availability of labour on the farm. The number of extension contacts influences adoption because extension is a source of information regarding good farming practices. Off-farm income for the farmer can provide extra financial resources to purchase legume seeds. Access to credit is also an important factor in adoption of technologies because farmers with adequate capital have leverage over financial constraints. Membership to farmer group positively influences technology adoption because farmers in groups can be privileged to have access to technical information regarding legume-based multiple cropping.

3. Methodology

Introduction

This chapter presents the research methodology for the study. It begins by giving the background setting of Zimbabwe and the semi-arid areas of the country that were chosen for this study. Then data collection procedures are described culminating in an overview of the empirical analytical methods and modeling techniques that were employed to analyse the data.

The study setting

The study was carried out in Zimbabwe, a country that is divided into 5 major climatic zones basing on rainfall and agricultural potential. Region I receives the highest amounts of rainfall, exceeding 1000mm per annum in good years while the arid and semi-arid regions IV and V receive less than 300mm on average with the rainfall being erratic and poorly distributed temporally. This study was carried out in regions IV and V of the country which are the most arid regions and in which issues of food and nutrition security are conspicuous. It was carried out in the Masvingo and Matabeleland provinces which both lie in the Southern parts of the country bordering South Africa.

Data

Data collection was carried out through a number of methods and techniques namely key informant interviews, focus group discussions and using household child nutrition data available from the Ministry of Health and Child Welfare data basis available at local clinics and hospitals. Data on agricultural practices including the growing of legumes was obtained from a survey carried out by the department of Agricultural and Extension services (AGRITEX). Instrumental Variable Probit (IV Probit) regression analysis was used as the main data analytical model.

The first encounter with the research participants was in the form of key informant interviews. These provided the general setting and the initial direction of the study. The first group of key informants were health and nutrition professionals in the study area. These gave a general overview of the nutritional situation in the study areas including any efforts being made to deal with cases of malnutrition. Detailed information on malnutrition parameters and measurement were elicited from this group. The extent and sources of malnutrition in the study areas were established. They also provided direction on where and how to obtain the data that was used in the study.

The second group of key informants were agricultural extension specialists in the area and farmer representatives and farmer group leaders. These provided information on agricultural policy issues and practices in the communities and any problems, constraints and opportunities that farmers face in the production of different crops and livestock with special reference to legumes. Local units of measurement and calibration were established from this group and compared with standard units.

Six focus group discussions then followed using open ended questions drafted from knowledge gathered from key informant interviews. Besides obtaining aggregate group information from farmers, these focus group discussions also served to confirm the information given buy key informants and form the basis for triangulation. Approximately equal numbers of males and females participated in the discussions. Group sizes of 15 to 20 were considered adequate to elicit group information about all the basic and vital aspects about community nutritional status and agricultural systems including legume farming. Information on group attitude and perceptions about legume farming and malnutrition was also obtained from these discussions including the roles played by different age and gender groups in household food and nutrition security.

For farm level legume production, the Department of Agricultural Extension (AGRITEX) carries out household surveys on farming household demographic, socio-economic and farming characteristics from input use to harvest and yields. The surveys also include socio-economic and other household characteristics and is mainly intended for use by the department of research and specialist services and other researchers upon a written request. The data is kept for all farming households but for the purposes of this study, simple random sampling techniques were used to select 620 households from 12 wards using the sampling frame from AGRITEX extension workers.

In Zimbabwe, malnutrition in children is assessed using anthropometry. Common anthropometric indicators of child malnutrition are combinations of body measurements and age, because the short-term response of a child's body to inadequate food intake is to slow or stop growth. This results in low height-for-age (stunting) and low weight-for-height (wasting). The indicators recommended for international use are: stunting, wasting and underweight (a measure of both stunting and wasting). To assess the level of malnutrition, a child's age and weight are compared with the NCHS/WHO reference curves of weight-for-age. Records of cases of malnutrition kept at health Centres were used in this study to determine if a household had a case of child malnutrition from the period June 2017 to May 2018. This is the data reported in this study for the same households that were sampled using AGRITEX extension worker sampling frame.

The empirical strategy: The IV Probit Model

The Instrumental Variable Probit model (IVProbit) fits models with dichotomous dependent variables and endogenous regressors. It can be used to fit a probit model when one or more of the regressors are correlated with the error term. The ivprobit is to probit modeling what ivregress is to linear regression analysis.

Formally, the model is:

$$Y^*_{1i} = \beta Y_{2i} + \gamma X_{1i} + U_i \quad (1)$$

$$Y^*_{2i} = \Pi_1 X_{1i} + \Pi_2 X_{2i} + V_i \quad (2)$$

Where i = 1, ..., N

Y_{2i} = a 1×k1 vector of exogenous variables

X_{1i} = a 1×p vector of endogenous variables

X_{2i} = a 1 × k2 vector of additional instruments

The equation for Y_{2i} is written in reduced form. By assumption, $(u_i, v_i) \sim N(0, \Sigma)$, where σ_{11} is normalized to one to identify the model.

β and γ are vectors of structural parameters, and Π_1 and $\Pi_2$are matrices of reduced-form parameters.

This is a recursive model: Y_{2i} appears in the equation for Y^*_{1i}, but Y^*_{1i} does not appear in the equation for Y^*_{2i}. We do not observe Y^*_{1i}; instead, we observe:

$$Y_{1i} = 0 \text{ if } Y^*_{1i} < 0 \text{ and } 1 \text{ if } Y^*_{1i} \geq 0 \quad (3)$$

The order condition for identification of the structural parameters requires that $k_2 \geq p$. Presumably, Σ is not block diagonal between u_i and v_i; otherwise, Y_{2i} would not be endogenous.

The Instrumental Variable Probit (IVProbit) Model described above was used in the study to find out the contribution of growing legumes to household child nutrition and also as a way to find out the determinants of farm level production of legumes.

Legume seed availability (measured by the aggregate quantities of legume seed available to the farmer) was used to instrument the level of legume production at the farm (area of land allocated to legumes). This is because legume seed availability was found to be highly correlated with the levels of legume production (results from FDGs and KIIs also support this). The dependent variable is whether or not a household is child nutrition secure (1, meaning it had no child under 5 years who suffered any form of malnutrition during the study period) or is not child nutrition secure (0, meaning that the household had at least one child who suffered from any form of malnutrition during the study period). Table 3.1 shows the variables that were used in the IV Tobit

Model. The rationale for including these variables is given in section 2.2.1.1 and 2.2.1.2.

We attempt to take care of endogeneity of level of legume production using the amount of legume seed available on the farm as a credible instrumental variable (IV), and estimate a binary instrumental variable model of child nutrition. We specifically estimate the instrumental variables probit model using the ivprobit command in Stata. This estimator identifies the parameters of a model with a binary dependent variable and an endogenous explanatory variable (or variables). As in the linear instrumental variables estimator, the instrumental variables probit model is estimated in a two-stage process. Consistent estimation is based on the assumption that the error terms of the two equations (in both the first and second-stage) are independently and identically distributed multivariate normal. If this assumption is not fulfilled, one could use clustered standard errors to control for the lack of independence (Maddala, 1983).

Table 3.1: The Empirical IV Tobit Model – hypotheses about the variables

Factor	Variable type	Hypothesized Effect
Whether or not household is child nutrition secure	Categorical (1 = Yes, 0 = No)	Dependent variable
Quantity of legume seed available*	Continuous	Positive
Age of household head (years)	Continuous	Positive
Number of years of schooling of head	Continuous	Positive
Gender of Household Head	Categorical (1 = Female 0 =Male	Positive
Married	Categorical (1 = yes, 0 = no)	Negative
Widowed	Categorical (1 = yes, 0 = no)	Positive
Divorced	Categorical (1 = yes, 0 = no)	Positive
Number of children under 5 years	Continuous	Positive
Household size	Continuous	Positive
Grow Maize	Categorical (1 = yes, 0 = no)	Negative
Grow Cotton	Categorical (1 = yes, 0 = no)	Negative
Income from livestock sales ($/Year)	Continuous	Negative
Distance from crop markets (Km)	Continuous	Negative
Labour availability (People working on farm)	Continuous	Positive
Formal training in agriculture	Categorical (1 = yes, 0 = no)	Negative
Access to extension services	Categorical (1 = yes, 0 = no)	Positive
Tenure of land	Categorical (1 = fixed, 0 = temporary)	Positive
Access to extension	Categorical (0 = No, 1 = Yes)	Negative
Total farm size (acres)	Continuous	Positive
Total farm income ($ per year)	Continuous	Negative
Proportion of total income from farming (%)	Continuous	Negative

* Instrument for level of legume production on the farm.

Ethical considerations

The researchers obtained ethical approval from the Medical Research Council of Zimbabwe (MRCZ), a national institutional review board. The approval protects the welfare, rights, dignity and safety of research participants. It also ensures that the researchers conduct legitimate investigations. To ensure that the study is morally acceptable MRCZ reviewed the study protocol that includes study design, tools and consent forms. Participants have the right to know about the details of the study, their role, the risks and benefits associated with the study and issues such as who has access to their data and what is being done with it. All these issues were detailed in a consent form that was explained to them before they agreed to be in the study. The information was shared without any coercion, undue influence, or pressure.

4. Results presentation and discussion

Descriptive statistics

Comparison of characteristics of legume producing households and non-legume producing households.

Table 4.1 gives the summery statistics of households that were used in this study. The statistics are presented for legume adopters as compared to non-adopters. There are remarkable differences in a number of characteristics between legume producers and non-legume producers. Households that grow legumes have some notable differences from those that do not. These differences are more pronounced on are more pronounced on household demographic and farming characteristics. There is a significant difference in age of household head between legume producers and non-producers with older household having a greater inclination to produce legumes that younger household heads. This could be attributed to the proclivity by younger households to produce more marketable crops like maize and tobacco and the fact that younger households are not used to traditional sources of protein such as legumes. Younger households are also most likely to be employed elsewhere and therefore have a source of income with which to buy other sources of protein.

Married household heads with a relatively large number of children especially those below the age of 5 years are more likely to grow legumes that single heads with few children below the age of 5 years. Households with larger numbers of livestock especially chicken and goats tend not to grow legumes. The reason for this could be two-fold. Livestock is a substitute for legumes as long as proteins are concerned so the households probably prefer animal protein to plant protein. It can also be because legume production competes for resources with livestock production activities and so the farmers prefer to raise livestock which have a greater market value than legumes. Mangoma et al (2001) support this notion and add that crop production competes with livestock rearing for resources especially land and labour and farmers, especially those living in the semi-arid areas would prefer to raise livestock than to grow crops.

Table 4.1: Summery statistics of households used in the study (N = 620).

Variables	Legume Producers	Non-legume Producers	All Households	Significance level of difference P - Value
Household Head Characteristics				
Age	49	41	46	0.013
Gender (Male)	43%	58.7%	50.6%	0.025
Marital Status (Married)	68.3%	66.1%	67.2%	0.047
Education (Yrs)	11.6	10.1	10.8	0.098
Years farming	34.7	21.4	28.1	0.00
Agric. Training (Yes)	2.1	1.6	1.9	0.00
Household Characteristics				
Size	7.3	6.1	6.7	0.011
Income (USD/yr)	2640.23	2864.54	2752.38	0.094
Children < 5 yrs	3.2	2.7	2.9	0.010
< 5 yrs malnourished	0.23	0.34	0.25	0.021
Distance from market (metres)	2017	2019	2018	0.245
Receive Food Aid	37.3%	37.1%	37.2	0.145
Receive Input Aid	43.4%	39.7%	42.5	0.027
Farming Characteristics				
Grow Groundnut	87.2%			
Grow Maize	92.3%	92.7%	92.5%	
Grow cowpea	57.4%			
Grow Bambara	61.7%			
Grow cotton	12.3%	16.9%	14.6%	0.00
Grow tobacco	0.1%	0.3%	0.2%	0.059
Grow beans	65.7%			
Grow peas	23.1%			
Total land area (Ha)	3.7	3.2	3.5	0.022
Chickens number	9.2	14.4	11.8	0.017
Goats number	6.7	8.9	7.8	0.020
Cattle number	4.1	4.3	4.2	0.141
Donkey number	1.9	1.4	1.6	0.191
Sheep number	0.6	0.6	0.6	-

Finally, it is important especially for this study to note that there is a significant difference in the number of malnourished households between households that grow legumes and those that do not. Non legume producers have significantly higher income levels than legume producers, a result easily attributable to the fact that farmers who do not produce legumes either raise livestock which they sell for cash or grow easily marketable cash crops such as maize and cotton.

Household legume production and use

Table 4.2 shows the total production, percentage consumption and percentage sales and other uses of grain legumes by households in the study area for the 2016/17 farming season. These figures are only for legume producing households for the farming season.

Table 4.2: Legume production and utilization by study households (N = 620)

CROP	Total Production per household (Kgs)	% Consumed	% Sales	%other
Cowpea	15.32	90.4	7	2.6
Groundnut	621.57	84.6	12.9	2.5
Bambara	151.94	97.8	2.2	0
Sugar Beans	117.51	71.3	25.1	1.6

In the study area, legumes are mainly produced for domestic consumption. Focus group discussions revealed that this is primarily because of lack of lucrative markets for most legumes except for sugar beans and to some extent groundnuts. Farmers reported that this lack of market is one of the reasons why farmers are not willing to "waste" their land producing crops that do not provide them with income. The main pathway through which legumes contribute to child nutrition is thus the 'production – own consumption pathway'. Although most agricultural extension officers who were interviewed as key informants in this study confirmed that the local market for legumes, especially for groundnuts is available, the prices for legumes in these markets are pathetically low and farmers do not get a justifiable return to their investments if they sell legumes so they consume them. Also, farmers do not normally produce marketable surpluses because legumes are not considered as commercial crops and the levels of their production is still lower than for other crops.

Focus group discussions revealed that women and children were reported to provide most of the labour in the production of legumes with men preferring to produce cotton and sunflower which have a ready market. The income food purchase pathway in the study area is very limited since even though some households produce some surpluses for sale, the income is not directly used to purchase child nutrition enhancing goods. Households seldom purchase legumes for food except for limited amounts of sugar beans (glycine max) which they purchase from local markets. This further puts pressure on the production own consumption pathway to provide legume-derived nutrition to children. Legumes, especially their bi-products such as leaves, which are protein rich are also used for other uses such as feeding livestock and making compost manure to augment the production of other crops and livestock and hence, potentially contributing to food security and nutrition indirectly.

Legumes and child nutrition

Table 4.1 shows random effects probit regression results and the corresponding marginal effects for the household model of child nutrition with area under legume production as one of the explanatory variables.

Table 4.1: Random Effects Probit Regression Results: Dependent Variable is Child nutrition

Independent Variable	Coefficient (β)	SE
Constant	-0.88***	0.06
Age of household head (years)	0.32	0.41
Divorced (1 = yes, 0 = no)	0.92	0.02
Widowed (1 = yes, 0 = no)	-0.41*	0.09
Number of children under 5 years	-1.89*	0.11
Household size	0.98	0.16
Education (Years Schooling)	1.64**	0.19
Livestock unites	1.59***	0.14
Area Planted to legumes	1.35	0.96
Grow Maize (1 = yes, 0 = no)	1.93**	0.07
Grow Cotton (1 = yes, 0 = no)	0.99	0.87
Income from livestock sales	1.11	0.70
Distance from crop markets	-0.06	0.21
Labour availability	0.56*	0.25
Formal training in agriculture	1.77*	0.01
Access to extension services	1.08	0.02
Tenure of land	0.74*	0.17
Total farm size	2.11*	2.40
Total farm income	1.90*	0.01
Proportion of total income from farming (%)	0.18	1.21

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level

The results show that household education and number of livestock that a household has are significantly related to child nutrition and so are the growing of maize, formal training in agriculture and availability of labour. Total farm size and more permanent land tenure arrangements are also positive influencers of child nutrition. These variables are generally related to household wealth status implying that poorer households have a lower chance to child nutrition that rich households. We do not find any

statistically significant effect of our key variable of interest: legume production. The random effects probit treat all the right-side variables as exogenous. It is however plausible to expect that most of the household variables are endogenous. We use the level of seed availability in the main agricultural season as an instrument to take care of endogeneity level of legume production. Other household variables, such as value of livestock, land size, household size and education are also likely to be endogenous. However, we do not find credible IVs to instrument them. Thus, we do not make causal inference between migration and these variables, but we control for them in the estimations.

The first-stage and second-stage regression results from the instrumental variable probit estimator are reported in Tables 4.1 to table 4.3. We begin with the first-stage regression results. Table 4.1 shows that the first-stage relationship between availability of legume seed and legume production is strongly significantly positive: the quantity of legume seed available to the farmer is significantly related to farm level of legume production at the one percent significance level. This relationship is robust to exclusion of the other variables and the Wald test rejects the null hypothesis of no endogeneity (p-value = 0.001). This makes sense because in a country like Zimbabwe, the availability of inputs especially seed is a powerful determinant of the level of crop production. For legumes, this is especially the case because farmers use retained seed whose availability depends on the level of the previous harvest and how much seed the household retains for the next season after consumption.

Table 4.1: IV Probit - First Stage Regression: Dependant Variable – Area under legume

Factor	Coefficient (β)	SE
Age of household head (years)	0.42	0.086
Widowed (1 = yes, 0 = no)	0.95*	0.064
Divorced (1 = yes, 0 = no)	0.73	0.015
Number of children under 5 years	1.35	0.117
Household size	0.92*	0.048
Livestock Units	2.92**	0.055
Availability of legume seed (Kgs)	2.18***	0.76
Grow Maize (1 = Yes, 0 = No)	0.38	0.140
Grow Cotton (1 = Yes, 0 = No)	-1.27*	-0.014
Income from livestock sales ($/Year)	-0.24	-0.018
Distance from crop markets (Km)	0.29	0.146
Labour availability (People working on farm)	0.13*	0.015
Formal training in agriculture (1 = Yes, 0 = No)	-1.61*	-0.063
Access to extension services (1 = Yes, 0 = No)	-0.65*	-0.015
Tenure of land (1 = fixed, 0 = temporary)	1.11*	0.132
Total farm size (acres)	2.15*	0.001
Total farm income ($ per year)	-1.82	-0.007
Proportion of total income from farming (%)	-0.66*	-0.012

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level

Demographic and socioeconomic factors were also among the greatest prime movers to the adoption of legumes. Households headed by elderly people and divorced or widowed women were found to have a greater inclination to cultivate legumes as opposed to younger households and especially with a male head. This could be attributed to the fact that these households are generally poor and cannot afford more expensive sources of protein such as animal protein. The adoption of legumes was found to be lower for male headed households. This finding tallies with evidence from studies carried out by Bourdillon and Hebinnck in Zimbabwe in 2001. Confirming the results from focus group discussions and even from the interviews with key informants, lack of legume seeds is one of the major constraints to the growing of legumes. Focus group discussions attributed this to the fact that most households consume the seed before, during and after the final harvest and so by the coming of the next farming season, little seed would be available for planting. This is why legume seed availability is so highly influential on level of legume production.

Other economic factors such as degree of crop commercialization which is the proportion of the total value of crops sold (β = --0.66) and the household's total income which has (β = -1.82) were found to have a negative relationship with the adoption of legumes. The reason for this might be related to the availability of lucrative markets for legumes. Besides groundnuts, which have a relatively larger local market, other legumes such as bambara nuts and cow peas are largely subsistence crops in the study area. Striking to note is the negative effect of both formal agricultural training and advice from agricultural extension advice on the cultivation of legumes. This shows that both formal educational systems and formal agricultural extension have a negative effect on production of legumes at household level. This finding goes in line with findings from focus group discussions, which revealed that both formal education and advice from government extension promote the growing of cash crops and cereals and shift farmers from producing their traditional crops, mainly legumes.

Widowed women are more likely to grow larger areas of legumes than their married counterparts. This outcome could be attributed to household wealth status with widowed households being the poorest and not being able to afford animal (meat) protein and thus resorting to growing legumes as an alternative source, a finding that tallies considerably with studies a study carried out by Mate, R (2001) in Southeastern Zimbabwe. For married households especially with the husband resident on the farm, the inclination to grow legumes is less because male heads in rural communities are mainly interested in commercial crops that are readily marketable like cotton and maize and because it is these male heads who make cropping decisions. Key informant interviews with representatives of women groups support these results and so do FGDs.

Regression results from the second stage of the instrumental variables probit model presented in Table 4.2 demonstrate the importance of controlling for endogeneity of level of legume production in the child nutrition equation. Column [1] presents the parameter estimates and Column [2] presents the corresponding marginal effects.

Table 4.2: IV Probit – Second Stage Results: Dependent Variable – Child Nutrition

Variable	[2]		[1]	
	[IV-Probit]		[Marginal Effects]	
	Coefficient	SE	Coefficient	SE
Age of household head (years)	1.66*	0.015	0.173*	0.091
Divorced	-0.98	0.127	0.110**	0.081
Widowed	- 0.43*	0.011	-0.172*	0.044
Number of children under 5 years	-1.97**	0.031	-0.150**	0.029
Level of legume Production (“Legume”)	1.98**	0.034	0.164**	0.011
Grow Maize	1.93**	0.088	0.095**	0.006
Grow Cotton	0.99	0.035	0.031	0.083
Income from livestock sales	1.11	0.124	0.055	0.707
Distance from crop markets	- 2.34*	0.051	-0.010*	0.018
Labour availability	0.56 *	0.025	0.011*	0.059
Formal training in agriculture	1.63*	0.072	0.025	0.033
Access to extension services	1.34**	0.154	0.133**	0.024
Tenure of land (Fixed)	1.44*	0.067	0.019	0.065
Total farm size	2.17*	0.074	0.088*	0.081
Total farm income	1.90*	0.166	0.014*	0.121
Proportion of total income from farming (%)	0.98	0.127	0.021	0.087
Intercept	-3.28**	0.27		
anthrho	-1.068**	0.412		
InSigma	0.422**	0.016		
Log-likelihood	-689.366			

N = 620; * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level

We will now analyse how the level of legume production instrumented by the availability of seed is related to household child nutrition. Instrumental variable probit regression results presented in Table 4.2 suggest that a kilogram increase in the average availability of legume seed increases the chances of a household being child nutrition secure by 16.4%. This relationship is significant at the 5% level. This result can easily be attributed (as confirmed by focus group discussions and key informants) to the role that legumes play in the preparation of child food dishes such as porridge and vegetable and meat dishes, especially with groundnut peanut butter. Focus group discussions also indicated other uses of legumes such as consumption as boiled and as roasted. This multipurpose and multiform consumption of legumes makes them central to child nutrition and thus increasing legume production would not surprisingly increase their contribution to child nutrition.

Households that grow maize (that are in areas where soils and rainfall allow maize production) are 9.5% more likely to have no malnourished child than those that do not grow maize. Maize is used for preparation of porridge for children under 5 years and peanut butter porridge is a common food staff for children under the age of 5 years. The results also show that a unit increase in the number of children under the age of 5 years reduces the chances of a household being child nutrition secure by 15.1%, implying that households with higher levels of fertility are likely to have malnourished children. It would therefore be beneficial if these households are encouraged to grow larger areas of legumes. Despite the land reform program, land availability still emerges as a constraint to the attainment of child nutrition security with a unit increase in household total land ownership likely to increase the chances of a household being child nutrition secure by 8.4%.

5. Conclusions and policy implications

In this study, instrumental variable probit analysis has shown a significant positive contribution of legume cultivation to child nutrition security. Households with higher levels of legume production have a greater chance of being child nutrition secure than those with lower levels of legume production or that do not produce any legumes. This finding has immense policy implications especially considering the fact that legumes are easier to produce than other crops. They are also cheaper to produce than other sources of protein such as livestock. The promotion of legume production through educational campaigns by agricultural and extension workers and nutritionists might enable households to cheaply attain adequate nutritional levels for their children. Also, since legumes are mainly produced by females who lack adequate access to land and other farming inputs especially seed, empowering women with land and other farming inputs would most likely increase legume production and thus child nutrition. Agricultural aid programs by government and NGOs which have been focusing their agricultural input provision to the staple maize crop should diversify the input packages include legume inputs such as seed.

Since the study found a weak link between markets and level of legume production, the adoption a value chain approach in which agricultural innovations (legumes) are promoted and directly linked to market opportunities and increased value of produce can be a sound policy recommendation to government and other stakeholders wishing to stimulate increased legume production. However, while farmer-market linkages are of great importance to achieve sustainable adoption of new technologies and stimulate development of the agricultural sector, such approaches easily bypass the poorest farmers who are oriented towards food self-sufficiency and lack resources to produce for markets.

Focus group discussions and key informants revealed that the attention being given to the production of legumes by both government and private sector extension is negligible as compared to other highly marketable crops such as cotton and maize or livestock activities. The nutritional value of legumes has been neglected for long and stakeholders (especially private sector and government extension) have been concentrating on highly marketable crops and livestock. Sensitizing these extension agents on the need for farm level groomed child nutrition enhancement methods such as the growing of legumes would have positive results. This is especially so considering the fact that the income - food purchase pathway to nutrition enhancement was found to be week in the study areas.

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Mission

To strengthen local capacity for conducting independent, rigorous inquiry into the problems facing the management of economies in sub-Saharan Africa.

The mission rests on two basic premises: that development is more likely to occur where there is sustained sound management of the economy, and that such management is more likely to happen where there is an active, well-informed group of locally based professional economists to conduct policy-relevant research.

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