Soybeans Imports Replacement Policies in Tanzania: Feasibility and the Anticipated Effects on People and Nature

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Research Report

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Executive Summary

Tanzania is one of the African countries where soybeans production is expected to grow exponentially (Khojely *et al.*, 2018; De Maria *et al.*, 2020). Soybeans production in Tanzania has increased by 74% in the five years from 6,030 tons produced in 2014/15 to 22,950 tons produced in 2018/19 (NBS, 2020). Soybeans' trade is also growing in Tanzania due to increased demand from the feed industry and other markets in Africa. The soybeans demand for feed in Tanzania is estimated at 150,000 tonnes annually (BFAP/SUA, 2018). In the period of five years (2014-2018), Tanzania imported soybeans worth 7.3 million dollars. In the same period, the country exported soybeans worth 5 million dollars (ITC, 2021). However, Tanzania remains to be a soybeans trade deficit country. Efforts to make Tanzania a soybeans trade surplus country are underway. The country is driving imports replacement policies aimed at increased production and export supply. For example in November, 2020 the country signed a bilateral agreement with China to export soybeans to China (CWGroup, 2020).

Literature suggests the crop to have both benefits and costs to the environment and the communities (Schmitz *et al.*, 2012; Peeters, 2013; Lufuke, 2017; De Maria *et al.*, 2020).The community can benefit from increased incomes, better food and nutrition security, and housing conditions leading to alleviation of poverty (Foyer *et al.*, 2019). The increased production and trade of the crop is likely to affect the environment (Schmitz *et al.*, 2012). Increased soybeans production leads to deforestation, biodiversity loss, and fragmentation of ecosystems. In the Tanzania production settings, the crop is also likely to lead to high land competition because the crop can be grown where maize and beans can grow which are among the main food staples in the country.

It is against this background; this study was conducted to analyze the soybeans imports replacement policies in Tanzania revealing their feasibility and the anticipated effects to both people and the environment. Specifically, the study mapped the soybeans supply chain to identify specific policies for private and public investments in the sector; evaluated the competitiveness of the soybeans production; identified environmental conservation practices among soybeans' farmers and determined the status of livelihood conditions of soybeans farmers.

Data for the study were collected by field survey method from 150 soybeans supply chain actors in Tanzania. This study used a combination of approaches in its analytical framework. It included descriptive statistics, factor analysis model, Gini decomposition and an estimation of the stochastic cost efficiency frontier model.

We find that;

(i)Soybean production and trade in Tanzania have grown in recent years. However, soybean production is characterized by low productivity (0.66t/ha) due to the low use of productivity-enhancing inputs which discourages private sector investments into the sector. There is also a shortage in soybeans' processing facilities which leads into reduced domestic market size and encourages the exportation of raw soybeans.

(ii)There are low economies of scale and specialization in soybeans' production. Farmers produce in an average farm size of 0.94 ha. Soybean production is less competitive with farmers producing at a cost of 319 USD/ton. Interestingly, productivity was found to increase with increasing farm sizes and the unit cost of soybeans production decreased by increasing productivity.

(iii)Soybean marketing system is the main source of inefficiency in soybean production and trade in Tanzania.

(iv)Soybeans' production and trade have positive impacts on the farmers. The crop was found to have an inequality-reducing effect on soybeans' farmers and contributes positively to incomes and food and nutrition security.

(v)Environmental conservation practices are not integrated into the existing good agricultural practices availed by the public extension agents to the soybeans' farmers. However, farmers were found to practice conservation agriculture on their own. It included crop rotation, intercropping, and crop residuals retention.

The study recommends that; -

(i)In order to make soybeans import replacement policies effective, there is a need to encourage commercial soybeans farming and increase soybeans farm sizes to achieve economies of scale. This will contribute to increased productivity and reduced production costs for achieving competitiveness. The current soybeans sector in Tanzania is small but its impacts into the environment cannot be ignored as it continues to grow. The import replacement policies should therefore be aligned with stringent environmental conservation policies.

(ii)Instill tax reforms by reducing the charges in soybeans and enforcing a transparent tax administration system under the local government authorities.

(iii)Raise awareness on environmental conservation and integrate environmental conservation principles into the soybeans' good agricultural practices.

(iv)Enhance the competitiveness of the soybeans marketing under the warehouse receipt system. This is because market-oriented policies will support and attract private investments.

(v)Support availability and access of soybeans' inputs such as improved seed varieties and services especially credit, soybeans specialized extension, and market information.

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List of Abbreviations and Acronyms

AMCOS	Agricultural Marketing Cooperative Societies
CAPI	Computer Aided Personal Interview
DAICOs	District Agricultural, Irrigation and Cooperative Officers
DAS	District Administrative Secretary
DCOs	District Crop Officers
EAs	Enumeration Areas
FGD	Focus Group Discussion
GCRF	Global Challenge Research Fund
KIIs	Key Informants Interviews
MoA	Ministry of Agriculture
MT	Metric tones
ODK	Open Data Kit
PO-RALG	Presidents' Office Regional Administration and Local government
RAAs	Regional Agricultural Advisors
ROSCAs	Rotating Saving and Credit Associations
SRS	Simple Random Sampling
SUA	Sokoine University of Agriculture
TARI	Tanzania Agricultural Research Institute
VSLAs	Village Saving and Lending Associations
WRS	Warehouse Receipt System

Acknowledgement

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1. Introduction and Context

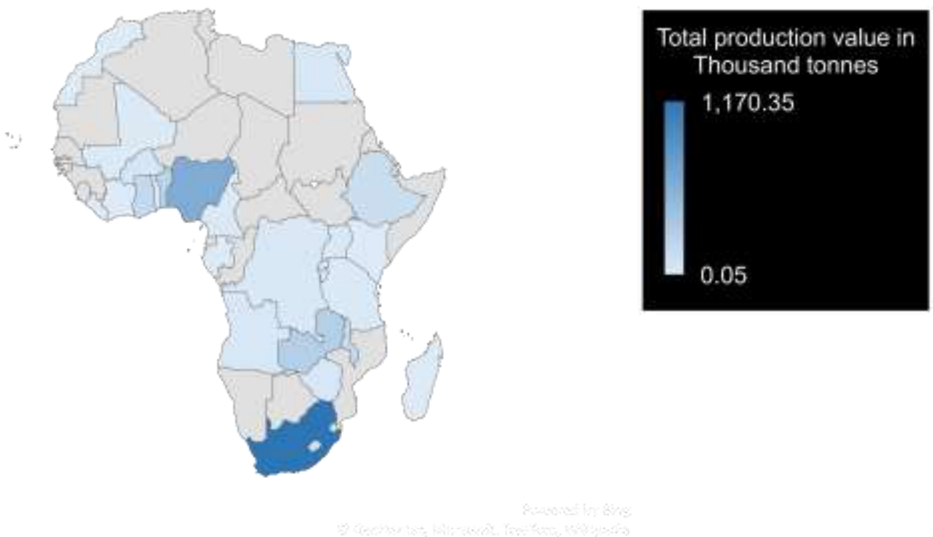
1.1 Background Information

Soybeans (Glycine max (L.) is the widely produced and traded crop in the World. The crop is one of the most valuable crops in the world serving numerous needs to human, animals, and fisheries (Khojely *et al.*, 2018). In 2019, the soybeans trade was worth 55.2 billion dollars representing 0.31% of the total world trade (OEC, 2021). The crop represents 27% of worldwide vegetable oil production (Peeters, 2013). Soybeans' production is concentrated in Brazil and the United States of America (USA). USA and Brazil represented 35.5% and 33.8% of the total global production in 2018 respectively. In the same year, five countries which are United States of America, Brazil, Argentina, China, and India produced 88% of the global soybeans (FAO, 2020).

The main soybeans exporters are Brazil, the USA, Argentina, Paraguay and Canada. These five countries exported soybeans worth 51.8 billion dollars in 2019 which is 94% of the total global soybeans trade value (OEC, 2021). China is the leading importer of soybeans importing soybeans worth 32 billion dollars annually. The other importers of soybeans in the world are Mexico, Netherlands, Egypt and Japan (ITC, 2021).

Africa represents about 1% of the total global soybeans production. The continent produces 3.2 million tons of soybeans annually (FAO, 2020). The main producers of soybeans in Africa are South Africa, Nigeria, Zambia, Benin, and Malawi. These five countries produced more than 80% of the total soybeans produced in Africa. The other small producers are Ghana, Ethiopia, Zimbabwe, Tanzania, and many others (Figure 1). Tanzania produces about 1% of the total soybeans production in Africa. These production statistics confirm that the level of soybeans production in Africa is very low. However, available evidence indicates an increasing trend of soybeans land expansion and intensification in the continent (Foyer *et al.*, 2019).

Figure 1: Soybeans' producers in Africa

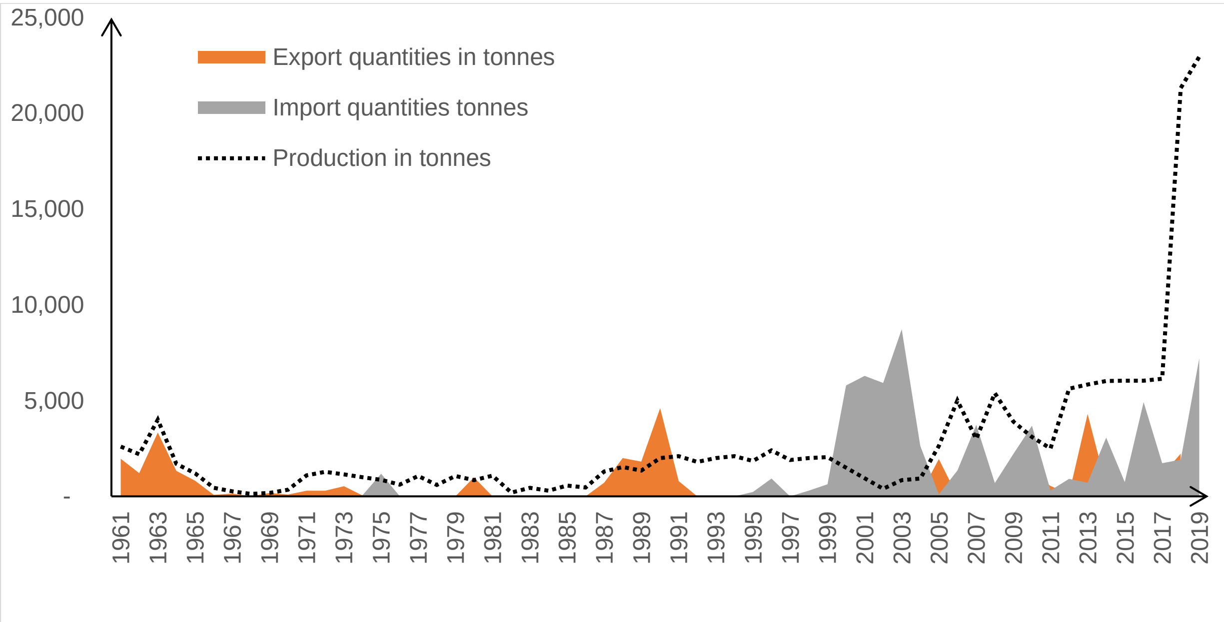


Source: Computed from FAOSTAT 2019 Data

Soybeans' value and importance are continuously growing in the world. This is due to the nutritional value of the crop and other benefits such as oil extraction, and animal feed (Foyer *et al.*, 2019). The crop can be used as food, feed, and as industrial raw materials (Khojely *et al.*, 2018). Soybeans land expansion continues to be witnessed in many parts of the world including Africa (Gasparri *et al.*, 2016). The crop can be used as an oil seed crop, livestock feed, fuel, aquaculture, and as a good source of protein for the human diet (Wilson, 2015). The crop has rich human nutritional properties. Other secondary products that can be made from the crop include protein powders, textured vegetable protein, soya bean vegetable oil, dry beans, sprouts, livestock feed, gluten-free flour, natto, tempeh, tofu, soy milk, soy cheese and curds.

Tanzania is one of the African countries where soybeans production is expected to grow exponentially (Khojely *et al.*, 2018; De Maria *et al.*, 2020). Available statistics suggests the same growth (Figure 2). Soybeans production in Tanzania has increased by 74% in the five years from 6,030 tons produced in 2014/15 to 22,950 tons produced in 2018/19 (NBS, 2020). Soybeans' trade is also growing in Tanzania due to increased demand from the feed industry and other markets in Africa. The soybeans demand for feed in Tanzania is estimated at 150,000 tonnes annually (BFAP/SUA, 2018). In the period of five years (2014-2018), Tanzania imported soybeans worth 7.3 million dollars. These imports are in form of soybeans oil cake and other soybeans solid residuals. In the same period, the country exported soybeans worth 5 million dollars (ITC, 2021). However, Tanzania remains to be a soybeans trade deficit country. Efforts to make Tanzania a soybeans trade surplus country are underway. The country is driving imports replacement policies aimed at increased production and export supply. For example in November, 2020 the country signed a bilateral agreement with China to export soybeans to China (CWGroup, 2020).

Figure 2: Soybeans' production, imports and export quantities in Tanzania



Source: Computed from FAOSTAT data

The growth trend of the crop in Tanzania and many other parts of Africa necessitates the analysis of the current and projected impacts of the crop on nature and people. This is due to the fact that the literature suggests the crop to have both benefits and costs to the environment and the communities (Schmitz *et al.*, 2012; Peeters, 2013; Lufuke, 2017; De Maria *et al.*, 2020). The community can benefit from increased incomes, better food and nutrition security, and housing conditions leading to alleviation of poverty (Foyer *et al.*, 2019). The increased production and trade of the crop is likely to affect the environment (Schmitz *et al.*, 2012). Increased soybeans production leads to increasing land competition, deforestation, and fragmentation of ecosystems. For example, there already exists some empirical evidence indicating increasing land fragmentation within the smallholder farming systems in Tanzania caused by small-scale farmers selling their land to large-scale farmers and investors (Kadigi *et al.*, 2017). This can have effects on the communities. Increased expansion of soybeans production to natural forests will ultimately cause biodiversity loss. In the Tanzania production settings, the crop is also likely to lead to land competition leading to production supply response. This is because the crop can be grown where maize and beans can grow which are among the main food staples in the country. Therefore, the creation of resilience to the communities can significantly contribute to a reduction of greenhouse gas emissions and achieve both socio-economic and environmental conservation objectives within the soybeans supply chain.

1.2 Objectives of the Study

The study was conducted to analyze the soybeans imports replacement policies in Tanzania revealing their feasibility and the anticipated effects to both people and the environment. Specifically, the study was intended to: -

(i)Map the soybeans supply chain to identify specific policies for private and public investments in the sector

(ii)Evaluate the competitiveness of the soybeans production

(iii)Identify environmental conservation practices among soybeans' farmers

(iv)Determine the status of livelihood conditions of soybeans farmers

2. Methodology

2.1 Deployment and Training of Enumerators

Enumerators were recruited, deployed, and physically trained to collect data through individual surveys, Key Informants' Interview (KIIs), and Focus Group Discussions (FGDs). Data were collected from soybeans farmers; Agricultural Marketing Cooperative Societies (AMCOS); processors; traders; feed manufacturers; Tanzania Agricultural Research Institute (TARI); extension agents; and input supply companies. The data were collected from two districts in Ruvuma region of Tanzania. All enumerators were trained in one group. Training was held on 21st January 2021 at SUGECO conference facility, Morogoro, Tanzania.

The training covered research ethics and other aspects of data collection. The other areas covered during the training were self-introduction; interviewing skills; management of software for data collection and use of tablets including downloading of forms/questionnaires, data entry, corrections if made mistakes, saving and uploading completed forms to the Open Data Kit (ODK) humanitarian response platform cloud server. The training also covered the general understanding of the key questions in the questionnaire and the Do's and Don'ts in data collection.

2.2 Sampling Procedures and Sample Size

The mix of purposive and random sampling methods were used to capture both probabilistic and non-probabilistic sampling effects. Random sampling was used in sampling soybeans farmers. The other supply chain actors (traders, feed manufacturers, food processors, and input suppliers and services providers) were sampled using purposive sampling method. Purposive sampling involved establishing the selection criteria and deliberately selecting the survey units. The criteria included quantity traded, and the role of the supply chain actor in the soybeans supply chain.

The study based on Sudman (1976) to establish the sample size required for the study. Sudman (1976) asserts that a minimum of 100 elements is needed for each major group and 20-50 for the minor subgroups. For the purpose of this survey, the major groups are farmers. Therefore, the sample size for soybeans farmers was 120. The distribution of sample sizes for each category is shown in table 1 making a total sample size of 150 soybeans supply chain actors.

Table 1: Distribution of soybeans supply chain actors involved in the study

SN	Supply chain actor	Sample size (n)
1	Farmers	120
2	Feed manufacturers	10
3	Traders	8
4	Food processors	5
5	Seed Companies	2
6	AMCOS	2
7	Extension agents	2
8	Tanzania Agricultural Research Institute (TARI) Uyole	1
	Total	**150**

The four-stage sampling/multi-stage random sampling method was used in sampling soybeans farmers. The first stage was purposive selection of the survey region based on current and potential production levels. Using this criterion, Ruvuma region was selected. The same criterion was used in selecting the study districts in which Songea and Namtumbo districts were selected in the second stage. The third stage involved selection of 5 enumeration areas (EAs)/Villages using Systematic Random Sampling (SRS) from the list of villages engaged in soybeans production within each district. The fourth and last stage involved random selection of 12 farmers from each EA using SRS. SRS was implemented by selecting each 5th farmer in the list of farmers after reshuffling it. However, the study covered one extra farmer from each district making the sample size to be 122 soybeans farmers.

2.3 Conduct of the Data Collection Exercise

The data collection involved reporting at the regional and district authority offices for the introduction of the field survey. The District Administrative Sectary (DAS) issued a permit that instructed the officials involved in agricultural production and trade to support the research team. The research team was mainly supported by the District Crop Officers (DCOs) through the District Agriculture, Irrigation and Cooperative Officers (DAICOs).

The survey involved human participation. Therefore, informed consent was obtained from the survey participants. Informed consent was signed by both the interviewer and the respondent. Respondents who were not able to read and write were assisted by their relatives/household members. Relatives/household members read for them and upon consent, they used thumbprint to sign.

The data collection involved collection of qualitative and quantitative cross-sectional data. It entailed the use of survey methods specifically Key Informants Interviews (KIIs), Focus Group Discussions (FGDs) and Individual Surveys. Focus Group Discussion (FGD) guide, a checklist and a semi structured questionnaire were used during data collection. Cross sectional data collection was implemented using Computer Aided Personal Interviews (CAPI) specifically on Open Data Kit (ODK) through the humanitarian response platform using tablets. The semi structured questionnaire was used in collecting data from soybeans farmers. The semi structured questionnaire was administered by trained enumerators. Checklists were used to collect data from key informants.

Qualitative data were collected through FGDs. Two FGDs were conducted in every survey district. Qualitative data from FGDs were transcribed, translated and kept as survey transcripts.

Figure 3: Farmers and researchers who participated in the FGD at Limamu village, Namtumbo district

2.4 Data Quality Assurance

The data collection organization and methods were designed to get and process quality information without delay. The on-station data manager was receiving data on daily basis, conducting a quick check and sending feedback to all enumerators in case of any need for corrections or improvement in the collection of data. The daily interaction of the data manager and the enumerators was the main method used in data quality assurance.

2.5 Methods of Data Analysis

This study used a combination of approaches in its analytical framework. This included descriptive statistics analysis to depict the levels of the variables under study and the association among the variables. In showing the association among the variables of interest, the chi-square statistic was used. The descriptive statistics analysis included proportions, frequencies, percentages, tabulations and cross tabulations of key survey variables and their correlates.

The wealth index of the soybeans farmers was constructed using exploratory (factor analysis) model. The factor analysis model was used to perform data reduction for the creation of Wealth Index (WI) of soybeans farmers. The model specification by Cleff (2019) was followed. The model in equation 1 was estimated in creation of the WI.

$$y_{ij} = Z_{i1}b_{1j} + Z_{i2}b_{2j} + \ldots\ldots\ldots\ldots Z_{ik}b_{kj} + \varepsilon_{ij} \quad \ldots\ldots (1)$$

Where; y_{ij} =Value of the i^{th} observation on the j^{th} variable; Z_{ik} is the i^{th} observation on the k^{th} common factor; b_{kj} is the set of linear coefficients (factor loadings) and ε_{ij} is the j^{th} unique factor similar to the residual.

The level of inequality among soybeans farmers was measured using Gini coefficient estimation method. The model by Lerman and Yitzhaki (1984) in equation 2 was used in estimation of the Gini coefficient.

$$Gini(X) = -2Cov\left(\frac{X}{\mu(\mathrm{X})}, 1-(F(\mathrm{X}))\right) \quad \text{...} (2)$$

Where X is the random variable of interest with mean $\mu(X)$ and $\mathrm{F}(X)$ is its cumulative distribution function.

In order to deduce whether soybeans production has an income inequality reducing effect, the decomposition of income inequality by source was computed using equation 3. The model in equation 3 was estimated using the *sgini* user-written Stata package by Van Kerm (2020) .

$$Gini(\mathrm{Y},\upsilon) = \sum_{k=1}^{K} \frac{\mu(Y^k)}{\mu(Y)} * \mathrm{CONC}(Y^k, \mathrm{Y}; \upsilon) \quad \text{...} (3)$$

Where $\mathrm{CONC}(Y^k, \mathrm{Y}; \upsilon)$ is the generalized concentration coefficient of incomes from source k with respect to total income, $\mu(Y^k)$ denotes means/average of source k and $\mu(Y)$ is the mean of the total income.

The competitiveness of soybeans production was estimated using stochastic cost efficiency frontier model. The model decomposed the soybeans production deviations into two components of inefficiency and error term (Coelli, 1995; Kumbhakar and Lovell, 2003). The soybeans production technology was modelled using aTranslog stochastic cost frontier (equation 4). The model was specified in a four-inputs framework (land, labour, agrochemicals and seeds). Fertilizer is rarely used by soybeans farmers in the claim that the crop fixes its own nitrogen hence it’s not important to use fertilizer.

$$lnC_i = \beta_o + \beta_1 lnY_i + \beta_{mi} \sum_{mi=1}^{4} \ln W_{mi} + 0.5\beta_5 \left[\ln \mathrm{Y_i}\right]^2 + 0.5\beta_{mn} \sum_{m=1}^{4}\sum_{n=1}^{4} \left[\ln \mathrm{W_{mi}}\right]^2 + \beta_{mr} \sum_{mr=1}^{4} \ln W_{mr} \ln Y_i$$
$$+\beta_{mn} \sum_{m=1}^{4}\sum_{n=1}^{4} \ln \mathrm{W_{mi}} \ln \mathrm{W_{ni}} + Vi + Ui \text{..} (4)$$

Given the fact that the cost efficiency frontier function is homogeneous of degree one in input prices such that $C(Y_i, \lambda W_{i;} \beta) = \lambda C(Y_i, W_{i;} \beta)$ where $\lambda > 0$, the function was thus normalized by dividing the equation except output by the price of seeds (Kangile and Mpenda, 2016; Kumbhakar *et al.*, 2020). The model in equation 5 was then estimated using Frontier version 4.1.

$$lnC_i = \beta_o + \beta_1 \ln \mathrm{Y_i} + \beta_2 \ln \mathrm{P\_labour} + \beta_3 \ln \mathrm{P\_land} + \beta_4 \ln \mathrm{P\_agroc} + 0.5\beta_5 (\ln \mathrm{Y_i})^2 + 0.5\beta_6 (\ln \mathrm{P\_labour})^2$$
$$+0.5\beta_7 (\ln \mathrm{P\_land})^2 + 0.5\beta_8 (\ln \mathrm{P\_agroc})^2 + \beta_9 \ln \mathrm{Y} * \ln \mathrm{P\_labour} + \beta_{10} \ln \mathrm{Y} * \ln \mathrm{P\_land} + \beta_{11} \ln \mathrm{Y} * \ln \mathrm{P\_agroc}$$
$$+\beta_{12} \ln \mathrm{P\_labour} * \ln \mathrm{P\_land} + \beta_{13} \ln \mathrm{P\_labour} * \ln \mathrm{P\_agroc} + \beta_{14} \ln \mathrm{P\_land} * \ln \mathrm{P\_agroc} \text{.........................} (5)$$

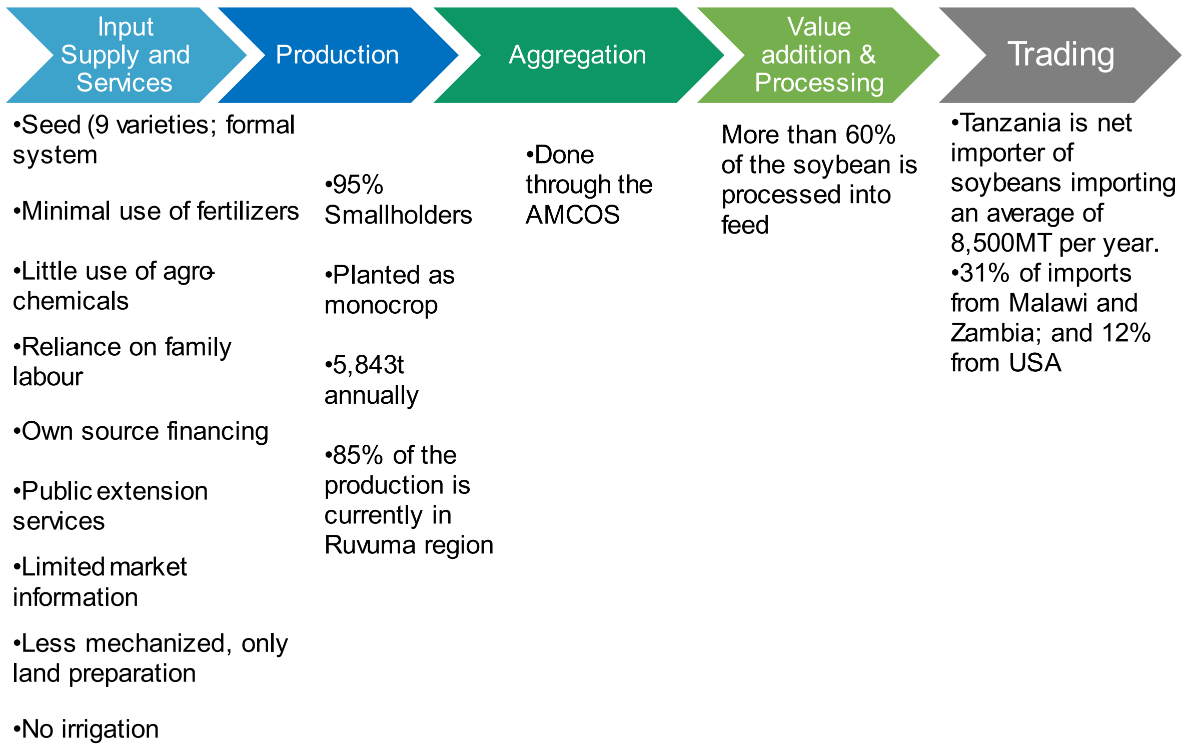
where; ln is natural logarithm; C_i is normalized total production cost incurred by a farmer; Y_i is soybeans output obtained by a farmer; P_labour is the normalized price of labour; P_land is the normalized price of land used in soybeans production; P_agroc is the normalized price of agrochemicals and β_s are parameters to be estimated.

3. Key Findings

3.1 The Soybeans Supply Chain Structure

The soybeans supply chain structure links from provision of inputs and services up to the trading of the soybeans produce (Figure 4). Seeds is one of key inputs in the soybeans supply chain. Currently, there are 9 improved soybeans seed varieties. Among these varieties, 4 are public varieties maintained by the Tanzania Agricultural Research Institute (TARI) which are bossier, soya Uyole_1, soya Uyole_3 and soya Uyole_4. The private sector owns five varieties which are Sc Semeki, Sc Signal, Sc Saxon, Lundi and Mwenezi. However, the production, availability and accessibility of certified soybeans seeds is challenging. Farmers uses recycled seeds which affects the level of soybeans productivity.

Figure 4: The soybeans supply chain in Tanzania



In general, fertilizers constitute one of inputs that are needed in soybeans production processes and are generally available from local agro-dealers in producing areas. The crop responds better to phosphate and potash fertilization. However, many farmers do not use fertilizers because they are expensive and smallholder growers lack the capital that would enable purchasing these inputs. The majority also lack the basic knowledge on proper use of fertilizers. Despite of its cost, farmers declared that soybeans add nutrients to the soil, hence no need of applying fertilizer.

The use of insecticides and fungicides is also low. The reasons for low use of herbicides and pesticides include lack of capital to buy agrochemicals. The low priority attached to the crop makes the farmers use the agrochemicals in other crops. However, it is important to note that no serious soybeans pest and disease infections are reported for Tanzania and the crop is stored well without chemical dressing without significant deterioration in its nutritional quality.

In essence, the agronomic practices of farmers in soybeans producing areas in the country are generally similar to those adopted in other subsistence crops, especially legumes. These are characterized by limited knowledge and application of suitable land preparation, planting and post-planting techniques. The pre-planting factors that determine soybeans productivity include, among others, the use of proper tillage and sowing methods. Deep tillage could be optimal but is virtually non-existent in many soybeans producing areas in the country due limited capital and access to deep-tilling equipment, such as, tractor and other agricultural tools. The costs of owning and hiring these equipment and tools are generally prohibitive without a substantial re-organization of smallholder farmers into large and strong producing entities that are inherently able to provide own custom tillage services using appropriate farm equipment, such as, tractors. In non-mechanized cropping systems, broadcast sowing is possible, but seeds should be worked into the ground. Soybeans' production in Tanzania is mostly done under rainfed farming systems using mainly family labour.

Availability and accessibility of services is limited. For example, agricultural credits are extremely limited and available only to a few. Public extension services are available but provision is clearly inadequate due to transport and funds to support. Private extension services are emerging through local nongovernmental organizations. There is limited market information to farmers on soybeans. This results into inconsistency in soybeans production in various areas in the country.

Tanzania produces an average of 5,843MT of soybeans annually[1]. Yield is generally low (1.02MT/ha) which is lower than the World average of 2.74 MT/ha in 2017/18. Like in many other countries in Africa, the main reasons for the low yield are use of low yielding seed varieties, presence of acidic soils, limited application of fertilizer and poor crop management practiced by farmers (Khojely *et al.*, 2018). The soybeans production is dominated by smallholder farmers (>95%).

Crop aggregation would help reducing the marketing costs in the country's soybeans value chain but this is complicated and sometimes not practical given the fact that smallholder farmers of soybeans are scattered and production is often inconsistent. However, introduction of soybeans in Warehouse Receipt System (WRS) as one of cash crop enhance aggregation process through AMCOS. The crop is currently collected by the AMCOS and the AMCOS takes the responsibility of selling the crop through the auction.

Most of soybeans value addition in the country is in form of animal feed manufacturing which amounts to more than 60% of the total produce processed into feeds for chicken, fish, pigs

[1] Based on five years average data (2012-2016), National Bureau of Statistics (NBS)

and other animals to substitute dried fish (*dagaa*) meals (Wilson, 2015). The rest is used for human consumption in various forms mainly as soy drink, soy oil and soy flour (ibid). Value addition activities into animal feed manufacturing are common in areas where there is commercial poultry husbandry, such as, Dar es Salaam, Iringa, Morogoro and Arusha. Value addition is also common around producing areas. Feed manufacturers in Ruvuma region processes soybeans grains into soybeans meals and sell in other feed manufacturing areas in the country. However, the level of processing technology used is low (Figure 5).

Figure 5: Soybeans' meal machine and the processed soybeans meal in Ruvuma region

Existence of erratic supply and inconsistence in quality of soybeans sourced from smallholder farmers makes the commercial feed producers revert to importing soybeans and/or soybeans meals from other producing countries, such as India, Zambia and Malawi. Available statistics indicate that about 31% of the soybeans imports of soybeans to Tanzania comes from Malawi and Zambia and 12% from the United States of America (ITC, 2021). The country imports an average of 8,500 metric tons of soybeans per annum.

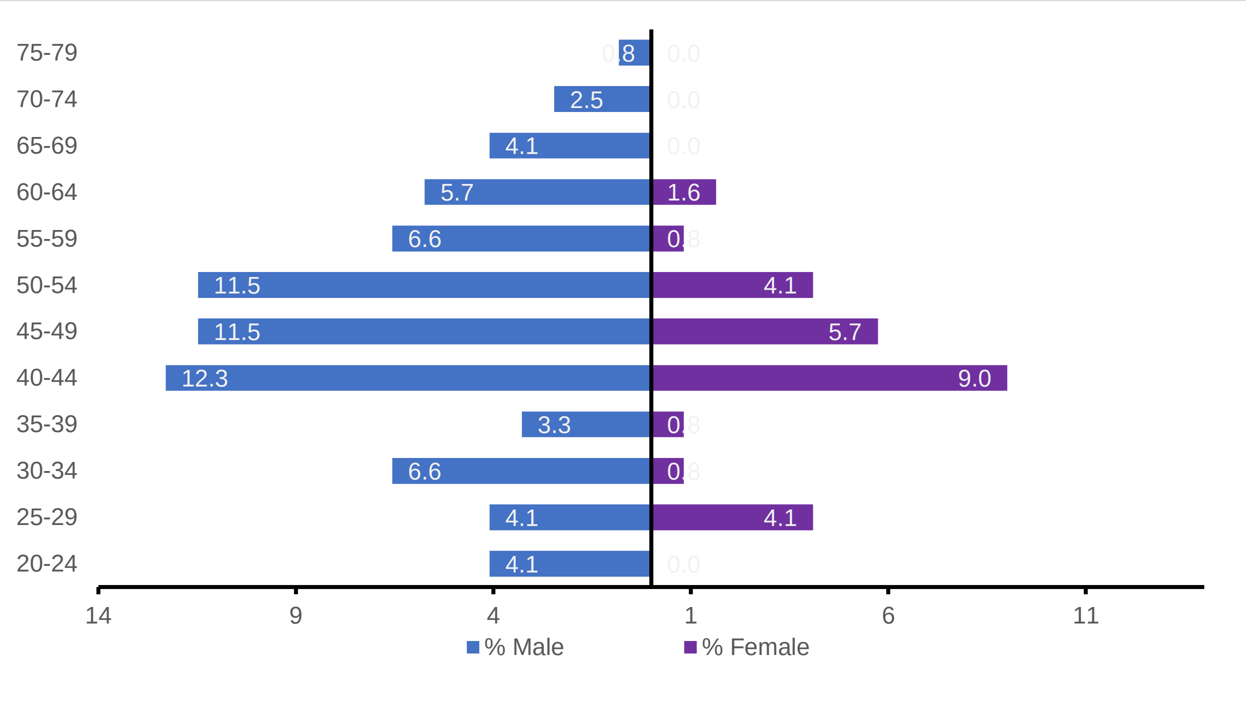
3.2 Socio-Economic Characteristics of Farmers Involved in the Survey

3.2.1 Age-sex distribution of farmers

Age varied across soybeans farmers surveyed. Results shows that 73% of the soybeans farmers interviewed were male and 27% were female. Male soybeans farmers dominated all the age brackets. The dominance of male farmers in the soybeans supply chain implies that the crop has high level of commercialization given the fact that men are always attracted with more commercialized crops. Namtumbo district had the highest proportion (83.6%) of male soybeans farmers compared to Songea district with 62.3%. Similarly, Songea district recorded the highest 37.7% proportion of female soybeans farmers. Adults (36-59 years) constituted a significant group among soybeans farmers (65%) while few percent were in the old and youth groups of 15% and 20% respectively. The highest proportion (67.2%) of adult soybeans farmers was found in Songea district. The age bracket of 40-44 years constituted many soybeans farmers in all the two sex categories (Figure 6).

Additionally, results showed that soybeans farmers are experienced in soybeans production activities. The average experience of farmers was 6 years. The more experienced farmers had 20 years of soybeans farming experience.

Figure 6: Age-sex distribution of soybeans farmers.



3.2.2 Marital status, education level and occupation of farmers

Among all soybeans farmers involved in the study, 85.2% were found to be married while the remaining percent were in the other groups of single, divorced/separated, and widowed. Namtumbo district had the highest proportion (91.8%) of married group and lowest proportion in other groups as compared to Songea district. However, there were no significant variations in marital status across the districts surveyed.

There were no significant variations in education level across the two districts surveyed. Results revealed that 84.4% of interviewed farmers have primary education, 13.1% have secondary education level and 2.5% have college education and above. Interestingly, no soybeans farmers were found with no formal education in both districts.

Crop farming was the main occupation to many soybeans farmers involved in the survey (94.3%). Results shows further that 2.5% of soybeans farmers are engaged in business-trade services in Songea district. The other occupations were wage employment in the primary sector and government employment. The disaggregation of the level of occupations for the soybeans farmers is shown in Table 2.

Table 2: Marital status, education level and occupation of soybeans farmers

Socio-economic variable (%)		District		Overall	χ^2 statistics
		Songea	**Namtumbo**	**(n=122)**	
Marital status	Single	6.6	1.6	4.1	4.368 (0.224)
	Married	78.7	91.8	85.2	
	Divorced/Separated	8.2	3.3	5.7	
	Widowed	6.5	3.3	5.0	
Education level	Primary education	85.3	83.6	84.4	0.3430(0.842)
	Secondary education	13.1	13.1	13.1	
	College and above	1.6	3.3	2.5	
Occupation	Crop farming	91.8	96.7	94.3	3.0783 (0.380)
	Business-trade/services	4.9	-	2.5	
	Wage employment	1.6	1.7	1.6	
	Government employment	1.7	1.6	1.6	

†Values in brackets are p-values; *** p<0.01, ** p<0.05, *p<0.1

3.2.3 Household types and sizes

Household sizes varied across the household types in the two districts surveyed. Results shows that 86.1% of soybeans farmers' households are male adult headed households and 13.9% are female adult headed household. Findings shows that soybeans farmers have an average of 6 people per household where, Namtumbo district has an average of 7 household members while Songea district has an average of 5 household members (Table 3). Based on type of household, male adult headed households have an average of 6 members while female adult headed households have an average of 5 people. Household size is the proxy for family labour that is important in farming activities.

Table 3: Average household sizes

District	Family type	
	Male adult	**Female adult**
Namtumbo	6.1	6.6
Songea	5.2	4.2
Overall	**5.7**	**4.9**

3.2.4 Land ownership status and level of specialization

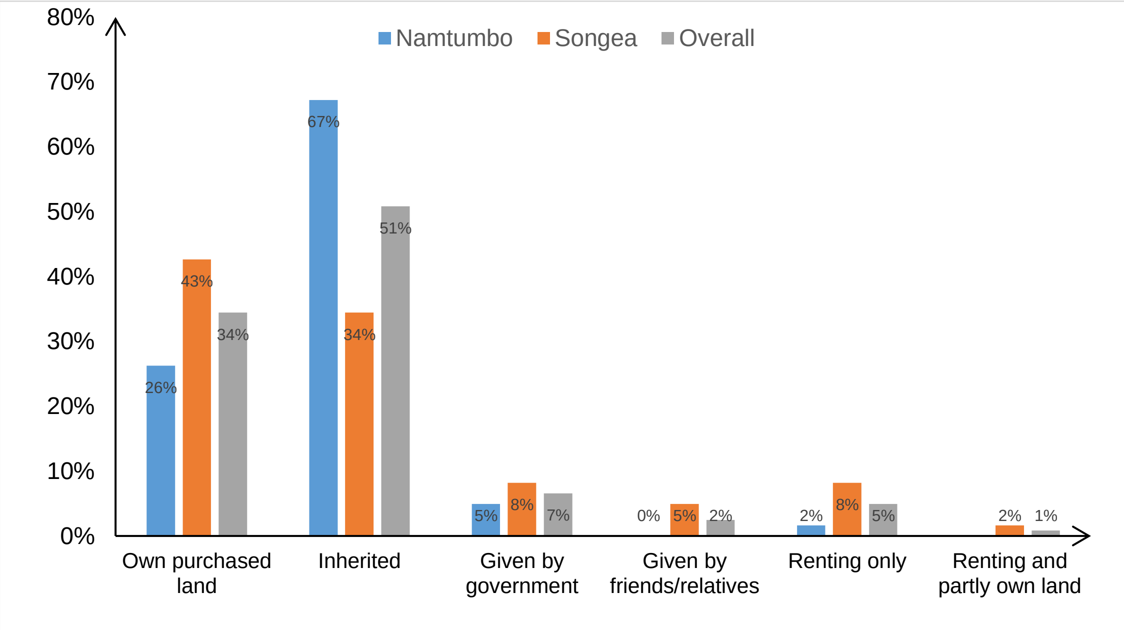
The level of specialization in soybeans production is low. Results shows that 42.6% of the farmers produces soybeans in less than 25% of their land holdings. Few farmers (4.1%) have devoted more than 50% of their total farming land to soybeans production. This implies that low economies of scale may be affecting farmers. The other implication is that the crop has low importance in the farmers' crop portfolios. Level of specialization in soybeans production did not vary across the districts involved in the study (Table 4).

Table 4: Level of specialization among soybeans farmers

Level of specialization (%)	District		Overall
	Songea	Namtumbo	
Less than 25%	44.26	40.98	42.62
25-50%	52.46	54.10	53.28
More than 50%	3.28	4.92	4.10

Soybeans land ownership is dominated by own purchased land and inherited land. This is a good indicator for farmers to practice sustainable production and apply various production technologies. Results shows that 51% of the soybeans farmers are practicing soybeans production in their inherited land. Soybeans land inheritance in Namtumbo district is the highest (67%). Land purchases was found to be the highest (43%) in Songea district. Soybeans' farmers also produce soybeans in land given by government, friend and relatives. Renting of soybeans farms also exists though to small extent (6%).

Figure 7: Soybeans land ownership among farmers

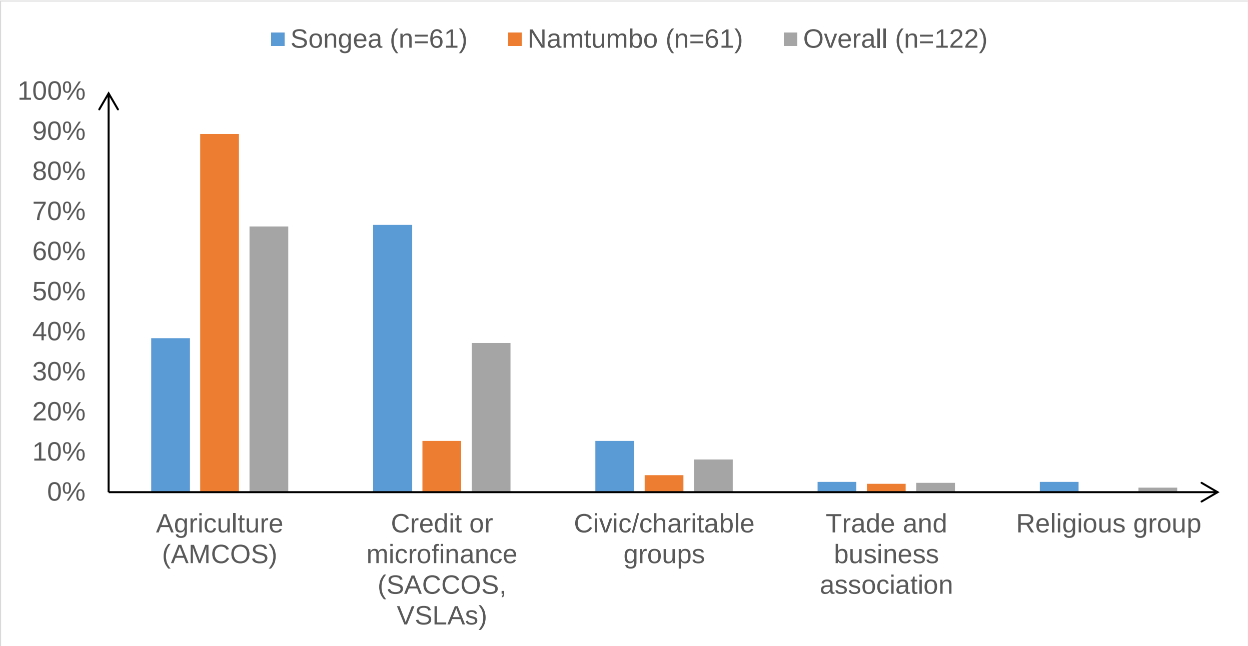


3.2.5 Participation of soybeans farmers in collective actions

The participation of soybeans farmers in collective actions is high (71%). Results indicated that only 29% of the farmers have no membership in various organisations. However, results showed that 88.4% of the farmers have membership in one organization and 11.6% have membership in more than one organization. Furthermore, findings revealed that 66.3% of the farmers with membership, have membership in agricultural/livestock/fisheries farmers' group including marketing groups such as AMCOS. The other organisation with high proportion of soybeans farmers is credit or microfinance group including SACCOS/merry-go-rounds/Village Saving and Lending Associations (VSLAs) (Figure 8). The study noted low participation of farmers in civic groups (improving community) or charitable groups (helping others); trade and business association; and religious groups.

Participation in collective actions is important for facilitating collective sales of soybeans and collective purchases of agricultural inputs. Additionally, it offers a platform for sharing various technical knowledge essential to spur agricultural production.

Figure 8: Soybeans' farmers participation in collective actions



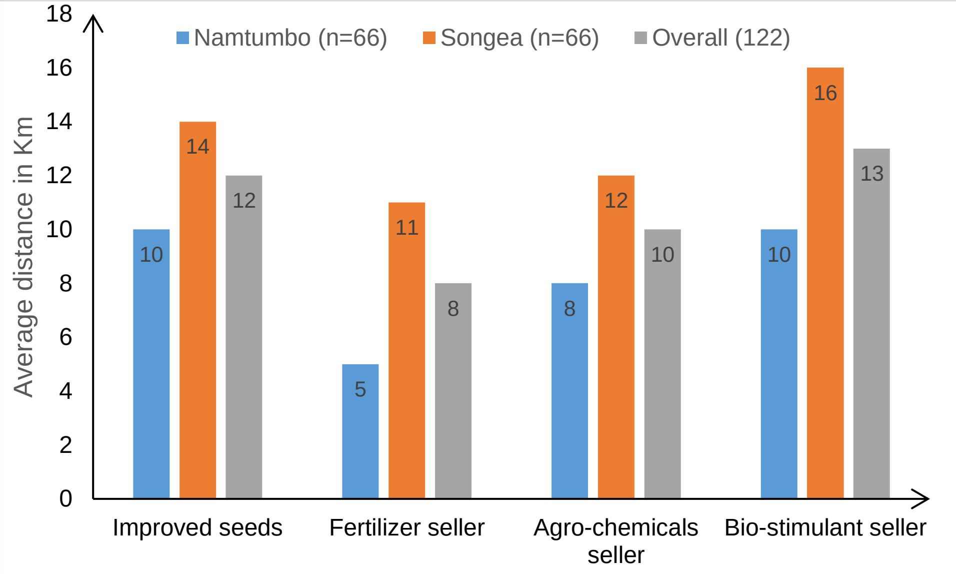
3.3 Access to Inputs and Services Among Soybeans Farmers

3.3.1 Access to agricultural inputs

Accessibility of soybeans agricultural inputs varied across the surveyed districts. However, the study revealed low use of productivity enhancing inputs in soybeans production such as fertilizer, improved soybeans seeds, agro-chemicals and bio-stimulants. Results indicated that farmers cover an average of 12km, 8km,10km and 13km in accessing improved soybeans seeds, fertilizer seller, agro-chemical seller and bio-stimulant seller respectively.

Furthermore, farmers in Namtumbo district are nearer to the agricultural inputs than farmers in Songea district. Generally, it is only fertilizer access in Songea district which is accessed within the distance of 5km. All other agricultural inputs are accessed in a distance above 5km. Therefore, last mile alliance delivery of agricultural inputs in the soybeans supply chain remains to be an important intervention in the soybeans sub-sector.

Figure 9: Average distances in accessing agricultural inputs



3.3.2 Access to financial services

Financial inclusion was found to be high among soybeans farmers. However, access to financial services was low. Results showed that 30.3% of all soybeans farmers involved in the survey had accessed credit in the past 12 months. Results shows further that 68% of soybeans farmers have saving/bank account including commercial bank, Savings and Credit Cooperative Societies (SACCOS), microfinance, groups such as Rotating Saving and Credit Associations (ROSCAs), village banking (VICOBA) and phone banking.

Ownership of saving/bank account in commercial banks constituted the highest proportion of 54.2% (Table 5). This may be attributed to the introduction of the Warehouse Receipt System (WRS) which operate together with financial institutions and Agricultural Marketing Cooperative Societies (AMCOS). Marketing through the WRS and AMCOS requires farmers to be paid through commercial banks.

Table 5: Financial inclusion among soybeans farmers

	Responses		
Financial institution	**N**	**Percent**	**Percent of Cases**
Commercial bank	45	47.9	54.2
SACCOS	2	2.1	2.4
Microfinance	1	1.1	1.2
Groups such as ROSCAs	3	3.2	3.6
Village banking (VICOBA)	30	31.9	36.1
Mobile/phone Banking	13	13.8	15.7
Total	**94**	**100.0**	**113.3**

3.3.3 Access to extension services

Access to extension services among soybeans farmers was found to be low. Results shows that 22.1% of all the farmers involved in the study indicated to have obtained extension services in the production of soybeans for the past 12 months. The remaining farmers (77.9%) did not access extension services. Standard extension services should be delivered at least three times per year, during the time of acquiring agricultural inputs, soybeans farm management activities, and harvest and post harvesting management activities. Findings shows that among 22.1% of soybeans farmers who received extension services, 33.3%% received only once and 40.7% received twice per year. Results show further that 26% of the soybeans farmers have received extension services three times and above. Therefore, level of extension services provision is still low perhaps as a result of poor commitment in production of soybeans among farmers. This can be attributed to the low market pull in the soybeans supply chain.

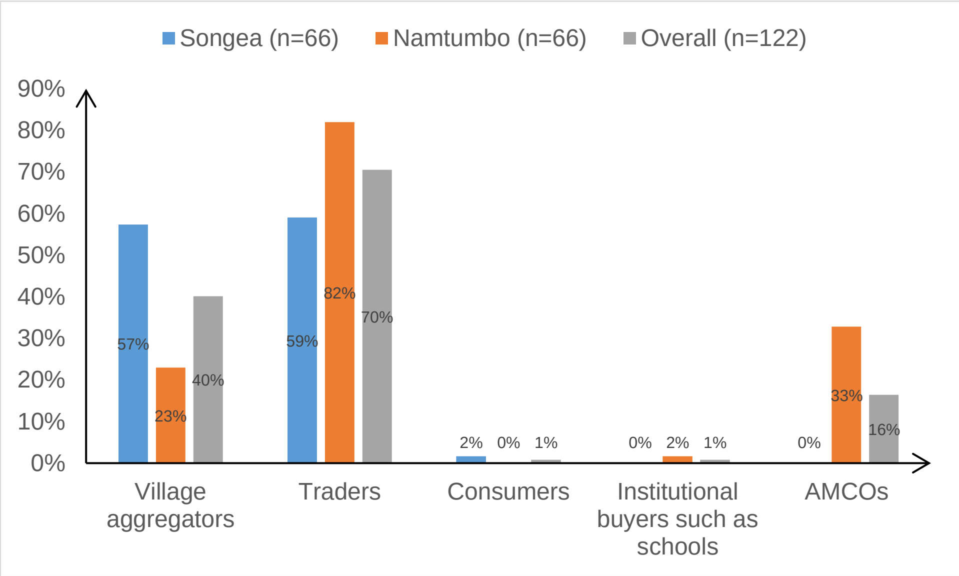
3.3.4 Access to markets

The current soybeans marketing system is through the Agricultural Marketing Cooperative Societies (AMCOS) and through the private buyers. However, government policies discourage the sale of soybeans through the private buyers. Government policies require soybeans to be sold through the Warehouse Receipt System (WRS) under the AMCOS. Results shows farmers to cover an average of 6km in accessing soybeans markets. Farmers in Namtumbo district experience the nearer distance of 3km in accessing markets than farmers in Songea district who covers the distance of 10km. This implies that there are few AMCOS which operates on soybeans marketing in Songea district. Furthermore, 42.6% of the soybeans' farmers indicated that the status of roads to the soybeans collection centres are seasonal while 41.8% indicated the road to be accessible throughout the year and few of them indicated the road to be tarmac (15.6%).

The compliance to the government system of selling soybeans through the WRS is low. Findings revealed that 16.4% of the soybeans farmers sold their soybeans through this system and it was reported in Namtumbo district only. Many farmers sell their soybeans through other market outlets (informal markets). Disaggregated results shows that 70% of the farmers sold their soybeans to traders. Other farmers sold their soybeans through village aggregators, consumers and institutional buyers (Figure 10).

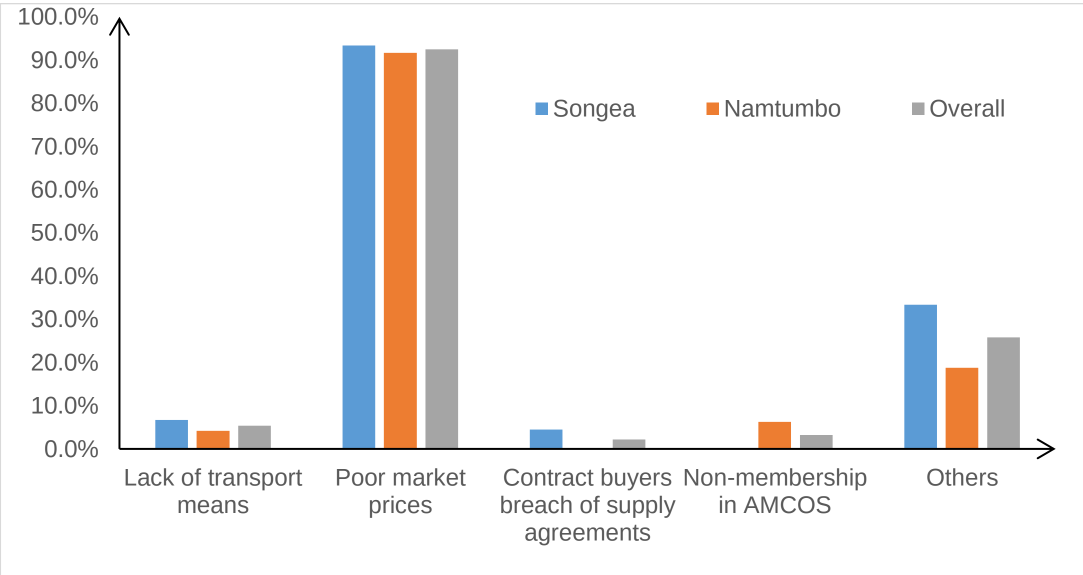
All interviewed farmers sold unprocessed soybeans (selling in grain form). Many of the transactions involved in soybeans are carried out in spot markets. Results showed that 99.2% of interviewed soybeans farmers do not have contractual agreements with the buyers of their soybeans.

Figure 10: Soybeans market outlets



Many soybeans' farmers (76%) indicated to face constraints during selling of soybeans. Results showed that 92.5% of soybeans farmers reported poor market prices to be the main soybeans marketing constraint. The other key constraints included lack of reliable markets, late payments for those selling their soybeans through AMCOS and manipulation of weighing balance in various market channels especially the village aggregators and traders. Non-membership in AMCOS was also mentioned as a constraint by farmers in Namtumbo district (Figure 11).

Figure 11: Constraints faced during selling of soybeans



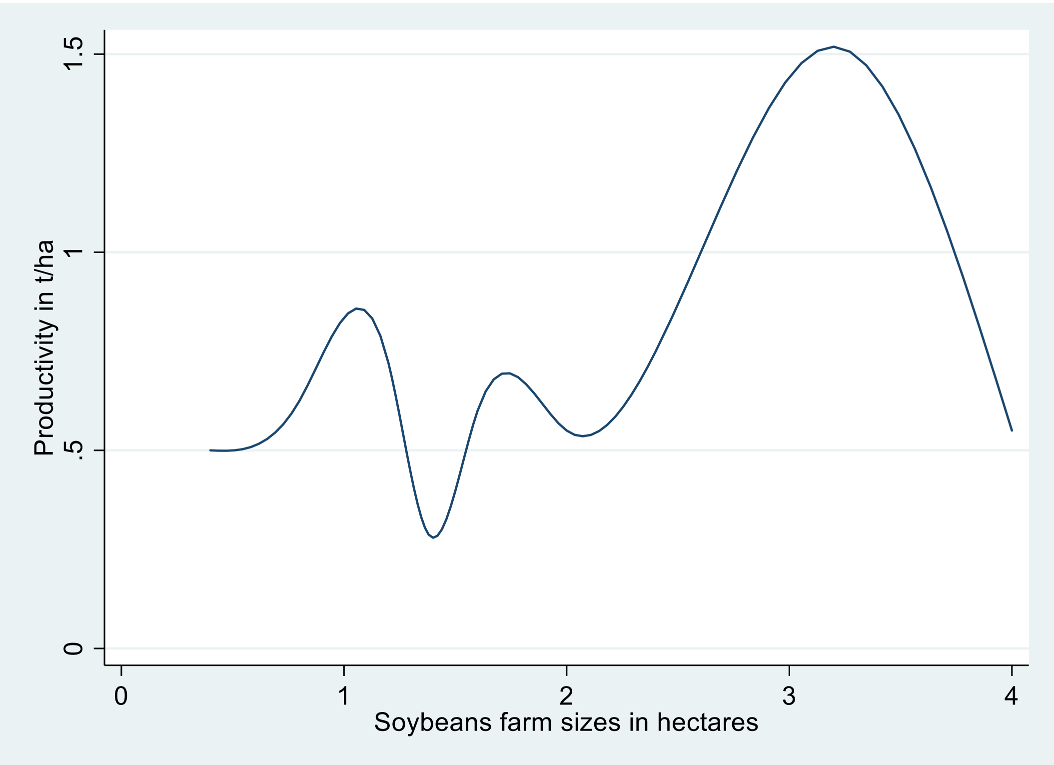
3.4 The Economics of Soybeans Production

3.4.1 Production and productivity

Smallholder soybeans farmers were found to produce in an average farm size of 0.94 ha. The level of productivity was 0.66t/ha. However, productivity was found to significantly vary from one district to another. Namtumbo district had an average productivity of 0.7t/ha while Songea district had 0.6t/ha. The two surveyed districts produced an average of 82.8 tons of soybeans in the year 2020. This represents 0.61% of the country soybeans produced in this year. Additionally, sampled farmers in Namtumbo district produced 2.7% of all soybeans traded via Namtumbo Warehouse Receipts System (WRS) in the same year of 2020. Generally, each farmer produced an average of 0.68 tons.

The level of productivity increased with increasing farm sizes of smallholder farmers. This means that as farmers increase their farm sizes, the level of productivity will increase. This is due to the fact that the small the farm size, the less the importance may be attached to it hence inadequate management of the farm. It is thus important for the farmers to increase their soybeans farm sizes to achieve increased economies of scale and productivity.

Figure 12: Soybeans' productivity and farm sizes

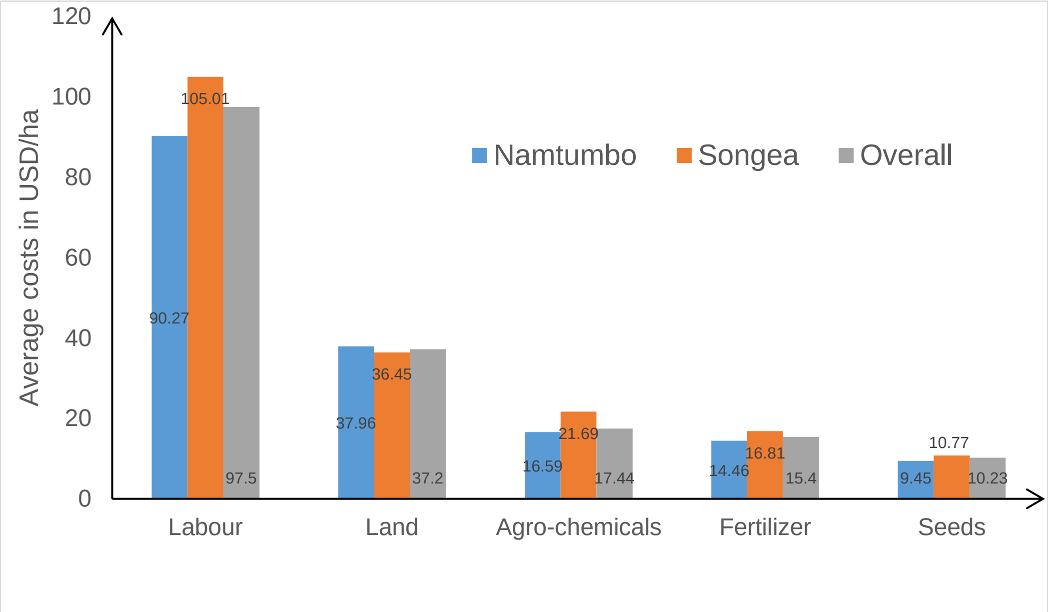


3.4.2 Costs of production

Cost of productions are divided into two categories inputs costs and labour activities. They are presented in USD/ha. Input costs include seeds, fertilizer, agrochemicals, land and labour. Results showed high labour cost in soybeans production of an average of 97.50 USD/ha whereby, Songea has the highest costs of labour compared to Namtumbo.

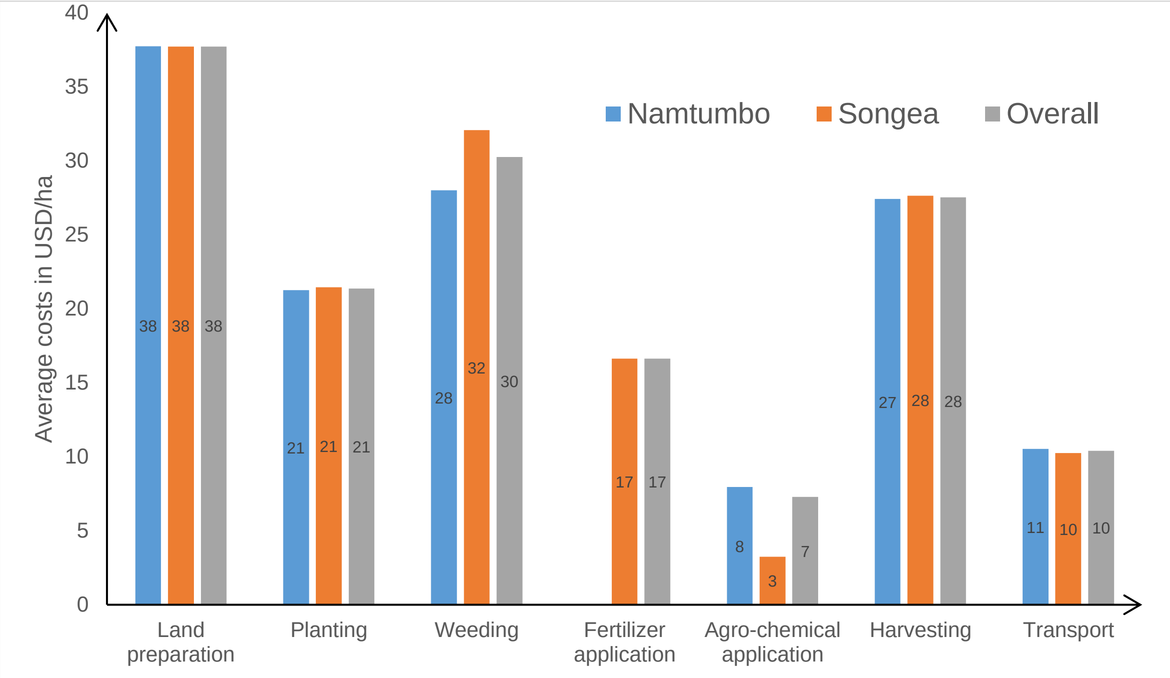
The costs of other key inputs that is land, agrochemicals and fertilizer are shown in figure 13. Seed takes the least cost of an average 10.23 USD/ha. This is due to the fact that most of farmers use retained seeds. There is no use of certified seeds implying that no seed renewal and replacement in the soybeans production system

Figure 13: Soybeans inputs production costs



Labour activities analysis showed that land preparation has the highest cost of an average of 37.7 USD/ha followed by weeding, harvesting and planting activities by 30.3 USD/ha, 27.5 USD/ha and 21.4USD/ha respectively (Figure 14). Fertilizer application costs an average of 16.6 USD/ha though it is done with very few farmers in Songea district only. The application of agro-chemicals costs an average of 7.3USD/ha. These findings imply that soybeans production is mostly done using family labour. The use of hired labour in soybeans production is low. This can be attributed to the economies of scale in soybeans production. The sizes of farms used in soybeans production are small hence can easily be managed using family labour.

Figure 14: Costs of labour activities involved in soybeans production



3.4.3 Production cost efficiency

Soybeans cost efficiency was modelled in a four inputs framework. The key inputs used in the production of soybeans are labour, land, seed and agro-chemicals. There is minimal to no use of fertilizer in soybeans production. Farmers indicated that a crop is nitrogen-fixing crop hence it's not important to use fertilizer. The cost of seeds was used in normalization of the cost production function. The increase in land sizes, and labour were found to increase the costs of production (Table 6). The increase in the use of agro-chemicals decreased the total cost of production. However, these inputs were found to be not significant determinant of the costs of production in soybeans production. This is due to the fact that farmers use mostly family labour and own land in the production of soybeans. The output produced was found to be significant ($p<0.05$). The unit cost of soybeans production decreased by increasing soybeans productivity. The study found that the average production cost was 735.58TZS per kg that 319 USD/tone of soybeans produced.

Findings indicate further that an increase of the soybeans output by 1% could decrease the total production cost by 0.87%. It implies that soybeans productivity is a key in the current soybeans production system. Therefore, interventions that would support farmers to use productivity enhancing inputs are highly needed. In the squared terms of the cost efficiency function, results indicate output to be not significant but labour only. This means that there is lack of economies of scale in the current system of soybeans production.

All the interaction terms were not significant. Some of the interaction terms were positive showing complementarity of the production inputs. Output was complementary to land and labour. Findings showed further that the use of agro-chemicals can be substituted in the soybeans production system.

The likelihood Ratio (LR) test rejected the hypothesis of no cost inefficient. This means that soybeans farmers are not 100% efficient in their production system (the LR test chi-square was 6.829 which is greater than the critical value read from the table by Kodde and Palm (1986).

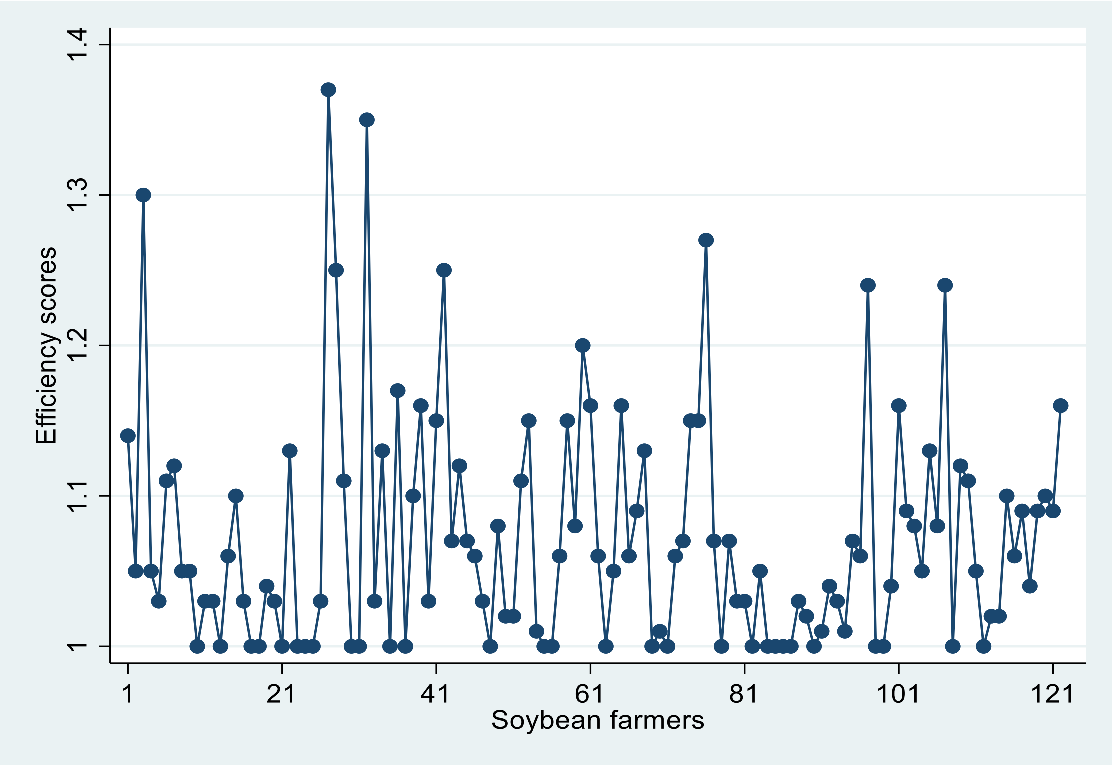
Table 6: Maximum likelihood estimates of the cost efficiency model

Variable	**Coefficient**	**Standard error**	**t-ratio**
Constant	3.0365	0.9865	0.3078
LnY	0.8744	0.4657	-1.8777
LnP_labour	0.8823	0.9814	0.8990
LnP_land	0.3803	1.0392	0.3659
LnP_agrochemicals	-0.3584	0.1379	0.2599
$(LnY)^2$	0.0307	0.0345	0.8900
$(LnP\_labour)^2$	0.1066	3.2612	3.2679
$(LnP\_land)^2$	0.1509	0.1187	0.1271
$(LnP\_agro\text{-}chemical)^2$	0.0855	0.1245	0.6866
LnY* LnP_labour	0.0480	0.0669	0.7170
LnY* LnP_land	0.0236	0.0721	0.3278
LnY* LnP_agrochemical	-0.0675	0.1273	-0.5299
LnP_labour* LnP_land	-0.2193	0.1587	-1.3812
LnP_labour* LnP_agrochemical	-0.0592	0.0701	-0.7554
LnP_land * LnP_agrochemical	-0.0226	0.1675	-0.1349
Sigma-squared(σ^2)	0.1173	0.0168	7.0027
Gamma (γ)	0.0000	0.0000	0.6451
Number of observations=122; Log likelihood function=42.925; LR test =6.829			

*** p<0.01, ** p<0.05, *p<0.1

All farmers were found to operate above the cost frontier with efficiency levels above 1 (Figure 15). Results showed further that 60.7% of all the farmers were below the mean cost efficiency. This means that these farmers need to achieve a cost saving of 21.7% to reach the average cost efficiency level. The average efficiency level was 1.072 indicating that 7.2% of the cost of production can be avoided by the farmers without affecting the level of soybeans output.

Figure 15: Distribution of efficiency levels among soybeans farmers



Years spent in formal training, years of experience in soybeans farming activities, level of specialization as the measure of economies of scale calculated as the ratio of the soybeans farm size to the total farm sizes of the entire household crop enterprises, and market channel whether the farmer sold through the Agricultural Marketing Cooperatives Societies (AMCOS) or not were assumed to be sources of inefficiency in soybeans production activities (Table 7). Results shows that market channel was the only significant source of inefficiency (p<0.05). Results showed that selling through the AMCOS contributed positively to decreasing cost efficiency. This can be attributed to the current marketing system of soybeans through the AMCOS. Farmers selling through the AMCOS are linked to the Warehouse Receipt System (WRS) which was reported to offer lower price to farmers than the private buyers that were found to be prohibited from buying soybeans. Payments through the AMCOS are also delayed. These findings imply that if the marketing system of soybeans through the AMCOS under WRS is not intervened, it will keep on contributing to increasing inefficiency among soybeans farmers.

Table 7. Sources of inefficiencies in soybeans production

Variable	Coefficient	Standard error	t-ratio
Constant	-0.2301	0.5069	-0.4539
Z_1 =Education	0.0137	0.0497	0.2755
Z_2 =Experience	0.0163	0.0216	0.7531
Z_3 =Level of specialization	0.1246	0.2017	0.6179
Z_4 =Market channel through the AMCOS	0.093132***	0.054039	1.72344

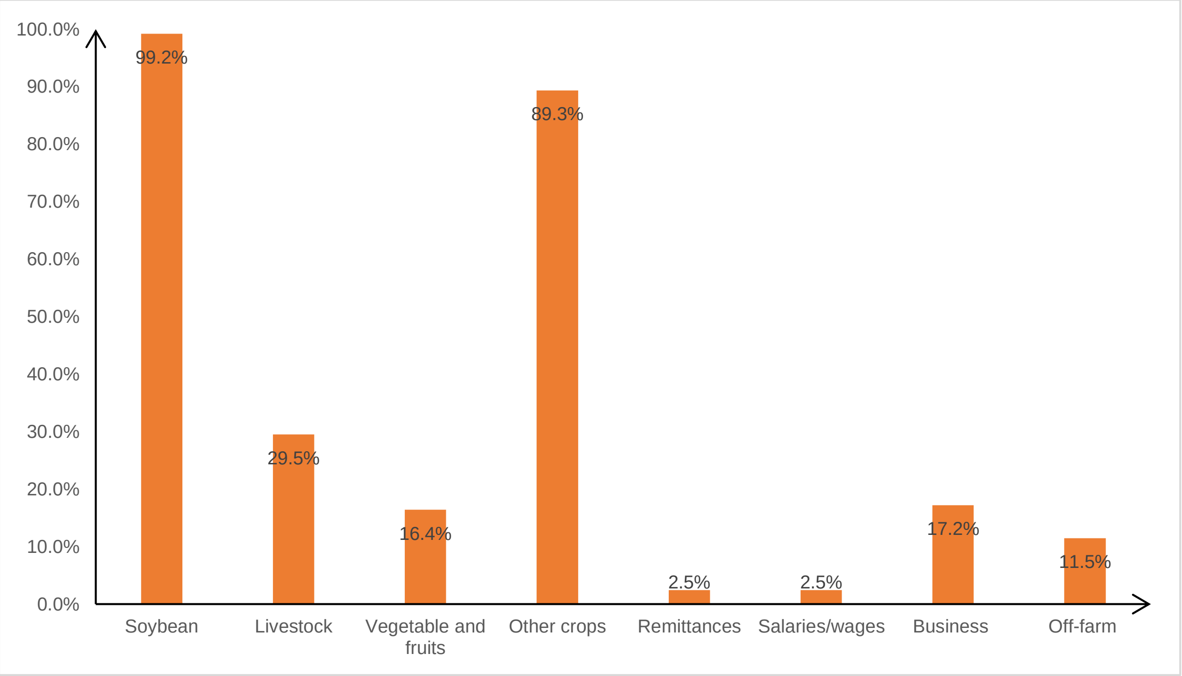
*** p<0.01, ** p<0.05, *p<0.1

3.5 Income Distribution Among Soybeans Farmers

3.5.1 Sources of income for soybeans farmers

Soybeans' farmers get their income from production of various crops and other reliable sources. Apart from generating income from soybeans, they also generate income from the production of food crops (finger millet, maize, beans. cassava, sweet potatoes, pigeon peas, paddy and groundnuts), cash crops (sesame, tobacco and sunflower), vegetable, fruits and spices. Results shows that 99% of the farmers got their incomes from soybeans production activities. Findings indicate further that 89% of the surveyed soybeans farmers obtained income from production of other crops. The other income sources were found to be livestock production activities, business (e.g., shop, kiosk), vegetable and fruits, off-farm activities, remittances and salaries/wages (Figure 16).

Figure 16: Sources of income for soybeans farmers



Annual amount of income earned from these sources varied between districts surveyed (table 8). Results shows that annual income generated from salaries and wages was found to be higher than other sources of income with an average of USD 846.82. Other sources with high value were found to be business that generated an average annual income of USD 821.37, other crops with an average of USD 780.51, and off-farm activities with an average of USD 662.20. However, income generated from other sources found to be low. These included income from livestock, soybeans production, vegetable and fruits and remittances.

Table 8: Income levels from different sources

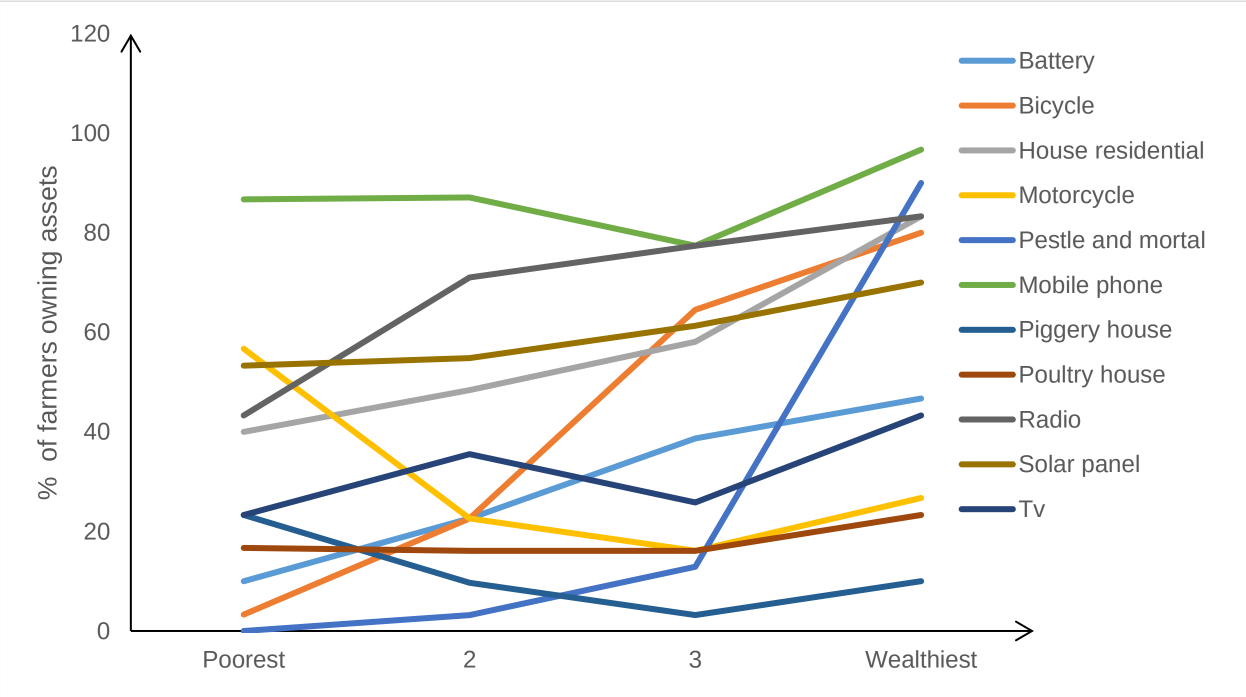
Income source	Annual amount of income in (USD) Songea	Namtumbo	overall
Coffee	209.14	173.66	191.40
Livestock	240.66	210.22	230.52
Vegetable and fruits	159.75	215.67	179.32
Other crops	900.04	667.38	780.51
Remittances	95.44	-	95.44
Salaries/wages	1759.58	390.44	846.82
Business	968.66	526.78	821.37
Off-farm	518.73	805.67	662.20

1USD=2305.10, the average exchange rate for the year 2020 (BOT, 2020)

3.5.2 Wealth ranking among soybeans farmers

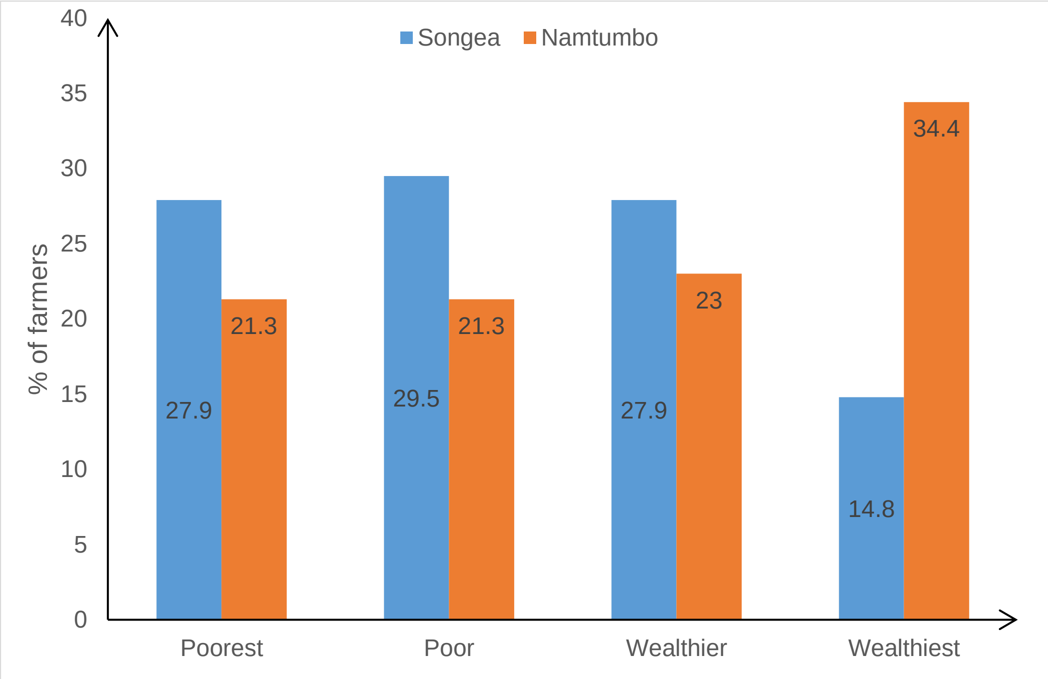
The wealth index was constructed using the ownership of assets by soybeans farmers. These assets were battery, bicycle, house residential, motorcycle, pestle and mortal, mobile phone, piggery house, poultry house, radio, solar panel, television and others. Mobile phone, radio, solar panel and house residential were the assets owned by many farmers. The study found that wealth index increased with the increase in ownership of assets. The wealthier and wealthiest groups of soybeans farmers owned many assets than the less wealthy soybeans farmers.

Figure 17: Assets' ownership across wealth groups



Wealthiness among soybeans farmers varied across the district surveyed ($p<0.05$). Results indicated that about 50% of all the soybeans farmers felled in the less wealthy groups that is poor and poorest. The remaining proportion (50%) felled in the wealthy groups that is wealthier and wealthiest. Farmers in Namtumbo district were more in the wealthy group (57.4%) than farmers in Songea district. This means that there is higher ownership of assets by soybeans farmers in Namtumbo district than Songea district. The distribution of farmers in the wealthy groups is shown in Figure 18.

Figure 18: Wealthiness among soybeans farmers



3.5.3 Income inequality among soybeans farmers

Income from production of vegetables and fruits, livestock, salaries and wages, off-farm production activities and business showed higher level of income inequality than other income sources. However, the increase on incomes from off-farm decrease the Gini coefficient of the total incomes earned by soybeans farmers. Findings show that a 1% increase in income earned from off-farm, all else being equal decreases the Gini coefficient of total income by 0.007%. The livestock income, income earned from other crops and business income showed to increase with increasing level of inequality among soybeans farmers. The lowest level of inequality was revealed from the production of other crops and soybeans. Income earned from soybeans and other crops showed the highest level of equality among farmers.

Results of soybeans income show that 1% increase in income earned from soybeans production all else being equal, decreases the Gini coefficient of the total income by 0.062% (Table 9). This implies that, soybeans production has an inequality reducing effect to soybeans farmers. Therefore, supporting soybeans production and trade will contribute to the reduction of inequality among soybeans farmers.

Table 9: Gini decomposition

Income Source	Share of income in the total income (S_k)	Gini coefficient (G_k)	Correlation coefficient (R_k)	Share	% change
Soybeans	0.1560	0.5224	0.5588	0.0938	-0.0622
Livestock	0.0555	0.8765	0.6212	0.0622	0.0067
Vegetable and fruits	0.0240	0.9363	0.4125	0.0191	-0.0049
Other crops	0.5685	0.5702	0.8780	0.5860	0.0176
Remittances	0.0019	0.9858	0.0668	0.0003	-0.0017
Salaries and wages	0.0170	0.9851	0.4417	0.0152	-0.0018
Business	0.1153	0.9347	0.7606	0.1688	0.0535
Off-farm income	0.0619	0.9369	0.4575	0.0547	-0.0073
Total income		**0.4856**			

3.6 Soybeans Production Constraints

Soybeans' farmers are faced with different challenges. Many (64.8%) reported lack of reliable markets to be the main challenge. Farmers claimed that the existing soybeans marketing system is not systematic, not organized, inconsistent, lacks transparency and has poor communication system. This challenge was reported to contribute on reduced investments in the soybeans production in the study area. Plant diseases was the second constraint reported by many farmers. The other constraints reported were inadequate extension support, lack of suitable soybeans seed varieties, weather variability and seasonality, non-availability of improved agricultural technologies other than suitable seed varieties, high production cost, shortage of labor and soil fertility challenges (Table 10). The qualitative data revealed that the crop is easy to produce and uses minimal inputs. However, the access to productivity enhancing inputs is challenging to many farmers. This includes seed varieties and mechanized service technologies such as threshing machines. These bottlenecks discourage privates investments in the soybeans' subsector. Additionally, 96.7% of soybeans farmers indicated to be willing to continue producing soybeans.

Table 10: Soybeans' production constraints

Constraints	Responses		Percent of cases
	N	Percent	
Lack of suitable soybeans seed varieties	18	7.9	14.8
Non-availability of improved agricultural technologies other than suitable seed varieties	9	3.9	7.4
Inadequate extension support	29	12.7	23.8
High production cost	8	3.5	6.6
Shortage of labour	1	0.4	0.8
Lack of reliable markets	79	34.5	64.8
Plant diseases	52	22.7	42.6
Soil fertility challenges	1	0.4	0.8
Weather variability	12	5.2	9.8
Others	20	8.7	16.4
Total	**229**	**100.0**	**187.7**

3.7 Impacts of Soybeans Production and Trade on Livelihood

Optimistically, one would infer the trend of soybeans trade and farmer prices as reflecting burgeoning soybeans production and market opportunities of which it is not always the case especially to farmers in Ruvuma region of Tanzania. The upsurge in farmers prices is likely to trigger more soybeans production. However, such kind of causal relationships are normally difficult to ascertain as crop production may vary intra- and/or inter- regionally due to a number of shocks, including the changes in market forces and weather conditions, just to mention two. It is also important to note that the highest prices are often offered to farmers operating in areas located close to major animal feed processing facilities, and the opposite is true for farmers producing in remote areas. Again, this has particular livelihood implications on for the rural farmer: low farmers prices would imply low annual household income and limited probability for the farmer to escape from poverty. The livelihood impacts were examined in terms of household shocks, food security, housing conditions and access to utilities.

3.7.1 Households' shocks and coping mechanisms

Soybeans' farmers (57.4%) were found to be affected by different shocks. Too much rain, crop disease or crop pests and large fall in sale price for crops were the main shocks affected most of the soybeans' farmers (Table 11). The other shocks mentioned by few farmers were challenge of large rise in agricultural input price, and theft of crops. Large rise in price of food, livestock pests or diseases, too little rain and floods, fire/arson, extreme temperature and earth quakes/tremors also affected some farmers.

The severity of the key shocks was found to be high. Results show that 86.6% of the farmers affected by too much rain, crop disease or crop pests and large fall in sale price for crops indicated these shocks to be severe. Disaggregated results show that 50.9% reported the shocks to be most severe and 35.7% severe. The remaining 13.4% of the farmers reported the shocks to be less severe. The most severe shocks reported by soybeans farmers were destruction of property by lighting, large rise in price of food, fire/Arson, crop diseases/pests, large fall in sale price for crops, large rise in agricultural input prices, theft, too much rain and livestock pests or diseases. Other shocks were reported to be less severe.

The key shocks affected the farming households in terms of income loss and loss of assets. Results shows that 96.4% of the soybeans farmers lost income due to crop diseases or crop pests and lose asset for the same case of crop pests/diseases. Likewise, all farmers lost income due to destruction of property by lighting, earth quakes/tremors, extreme temperature, large fall in sale price for crops, large rise in agricultural input prices, theft, large rise in price of food and too little rain. Additionally, results showed further that some farmers lost assets due to fire/arson, floods, livestock pests/diseases and too much rain.

In responding to the shocks, 33.3% of the farming households did nothing. The remaining 66.7% used various measures in attempt to regain the former welfare level. Results show that 11.1% relied on own saving in dealing with the shocks. The other measures included sale of agricultural assets, crop stock and livestock.

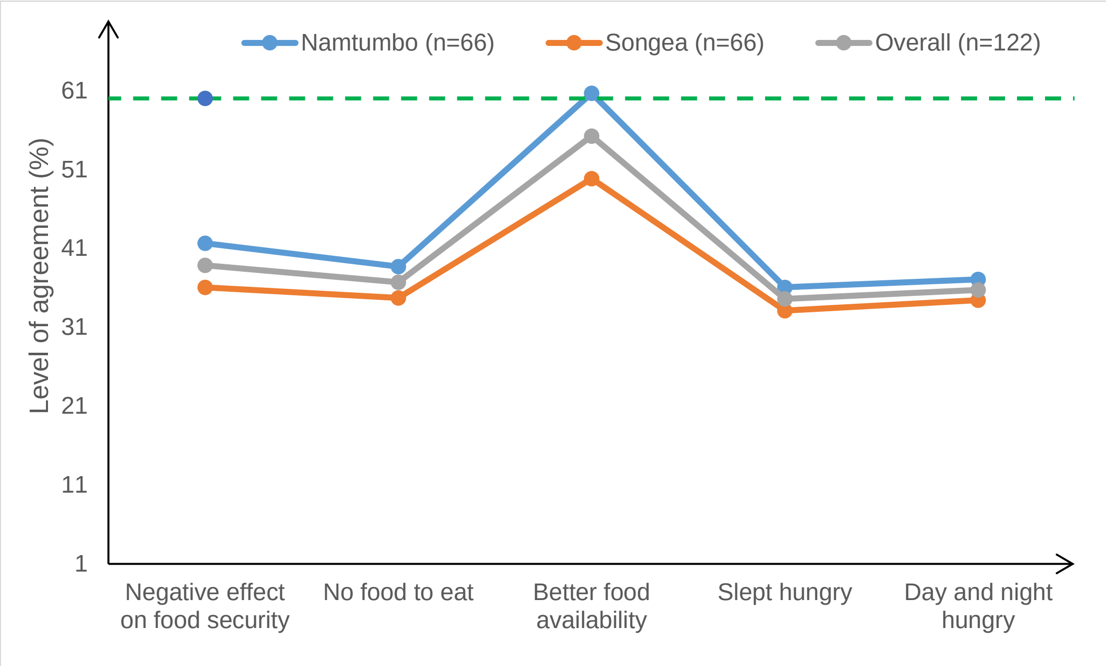
Table 11:Shocks affected soybeans farmers

Shocks	Responses		Percent of Cases
	N	Percent	
None	52	33.3	42.6
Too much rain	33	31.7	47.1
Too little rain	3	2.9	4.3
Fire/Arson	2	1.9	2.9
Floods	3	2.9	4.3
Theft/Hijacking/Robbery/burglary/assault	4	3.8	5.7
Crop disease or crop pests	27	26.0	38.6
Livestock Pest or Diseases	3	2.9	4.3
Extreme temperature	2	1.9	2.9
Large fall in sale prices for crops	18	17.3	25.7
Large rise in price of food	3	2.9	4.3
Large rise in agricultural input prices	5	4.8	7.1
Earth quakes/ Tremors	1	1.0	1.4
Total	**104**	**100.0**	**148.6**

3.7.2 Households' food security

Many of the soybeans' farmers showed disagreement in different statements of food security (Figure 19). This implies that soybeans production affects positively food security in terms of food availability because soybeans farming improves soil nutrients hence farms become more productive in other food crops especially maize. The income earned from soybeans is also used to purchase food. Many farmers (93.4%) showed disagreement for two different statements stated "it happened where a household member spent a whole day and night without eating anything at all because there was no enough food" and a scenario that happened where "one of the household members went to sleep at night because there was no enough food". This means that the response of the farmers on these statements were strongly disagree and disagree. However, 88.5% of interviewed farmers showed disagreements on two statements stated that "there was no food to eat of any kind in the household because of lack of resources to get food" and soybeans production being affecting negatively household food security". Additionally, 47.5% of farmers showed disagreement on the statement stated ''the status of food availability is better for soybeans farmers than the other farmers not engaged in soybeans. This means that 52.5% of the farmers agreed on the statement. This agreement was reported by farmers in Namtumbo district. Generally, farmers are better in terms of food security and the production of soybeans contributes positively to food security. The contribution is through soil nutrients enhancements which allows crop rotation for food crops and the use of income from soybeans to buy food crops.

Figure 19: Level of agreements on food security status



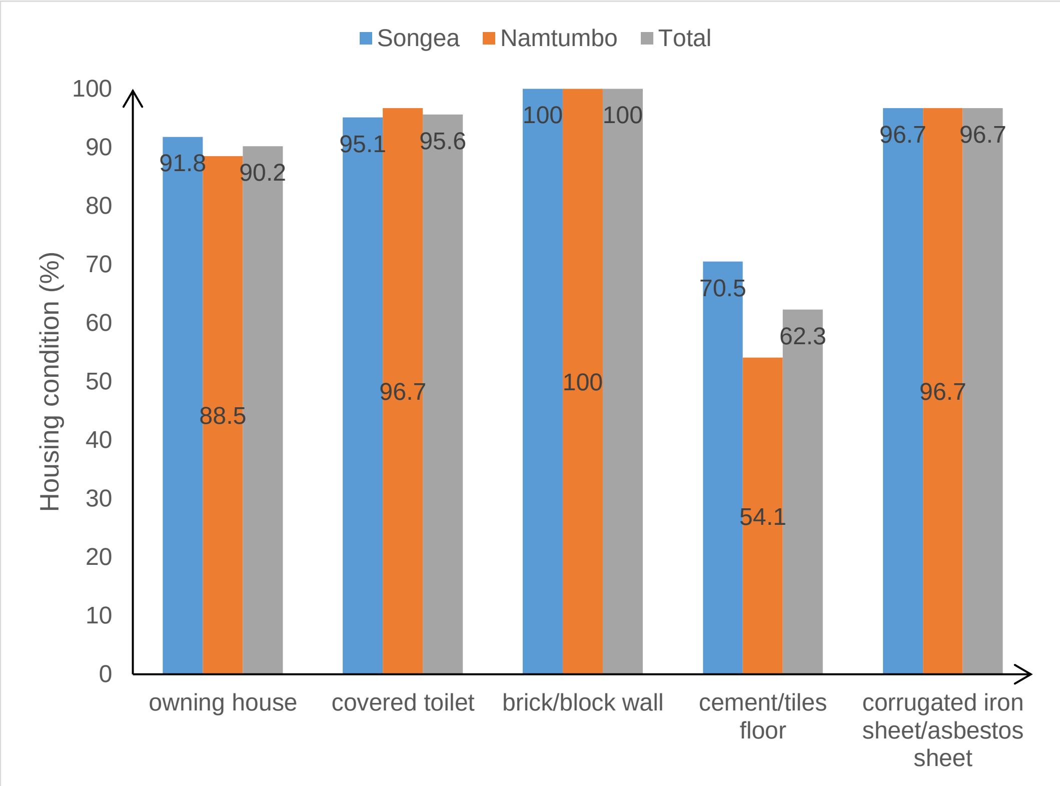
3.7.3 Household's housing conditions

Housing conditions of soybeans farmers was measured in terms of ownership of the house, availability and type of toilet, and features of the house such as roofing materials, exterior wall materials and floor materials. Results revealed that 90.2% of interviewed farmers owns houses with more farmers in Songea district owning houses than farmers in Namtumbo district. However, 7.4% of the farmers indicated to be living in rented houses and 2.5% living in their relatives' houses.

Regarding the features of the house, findings shows that 96.7% of the soybeans' farmers live in houses with corrugated iron sheets. 2.5% and 0.8% of farmers indicated to live in houses with grass and straws roofing materials respectively. Based on exterior wall, all farmers (100%) indicated to live in houses with bricks/blocks materials. Regarding status of houses floor, 62.3% indicated to live in houses with cement floor, 36.9% in earth floor houses and only 0.8% in houses with wood floor. On the other hand, 99.2% of interviewed soybeans farmers indicated to live in houses with toilets while only 0.8% indicated to live in house with no toilet. However, results showed 95.6% of the farmers to be using covered pit latrine.

Generally, these findings imply that farmers have good housing conditions. However, the study did not establish the linkage of better housing condition with soybeans production and trading activities.

Figure 20: Household housing conditions

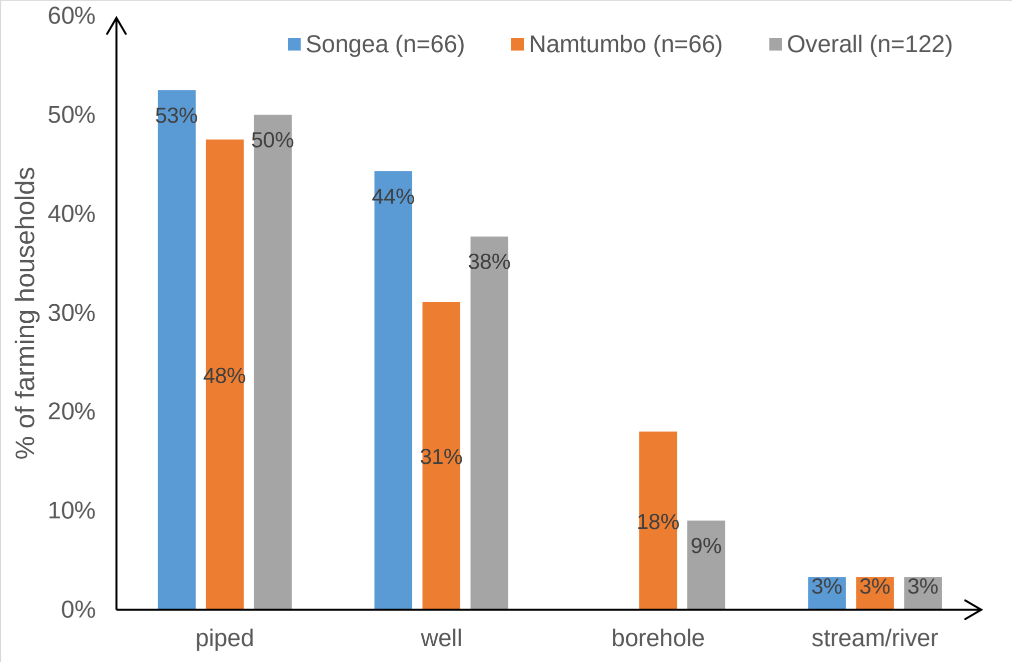


3.7.4 Households access to utilities

The access to electricity, water, and fuel were the key utilities examined among soybeans farmers. Among all interviewed soybeans farmers, 54.9% indicated to have access and use electricity while 45.1% have no access. This includes electricity of both national grid and solar electricity. Based on districts, accessibility and usage of electricity for Namtumbo and Songea district is 59.0% and 50.8% respectively.

Fuel is used for cooking and lighting. Most of soybeans farmers (85.2%) indicated to use firewood as a main source of cooking fuel while 14.8% indicated to use charcoal for cooking. Results showed the use of firewood is high (86.9%) in Songea district. On the assessment of fuel for lighting, results showed that 52.5% of farmers are using solar energy for lighting. 40.2% of the soybeans' farmers indicated to use electricity as a main source of fuel for lighting. Other soybeans farmers indicated to use dry cells, tin lamp (paraffin) and lantern (paraffin) by 5.7%, 0.8% and 0.8% respectively. Domestic water used by soybeans farmers are obtained from different sources. Results shows that 50.0% of the farmers use piped water as a main source for domestic use. The use of piped water is high in Songea district (52.5%) and less in Namtumbo district (47.5%). However, 37.7% indicated to use water from wells. other farmers reported to use borehole and stream/river water by 9.0% and 3.3% respectively (Figure 21).

Figure 21: Sources of domestic water among soybeans farmers



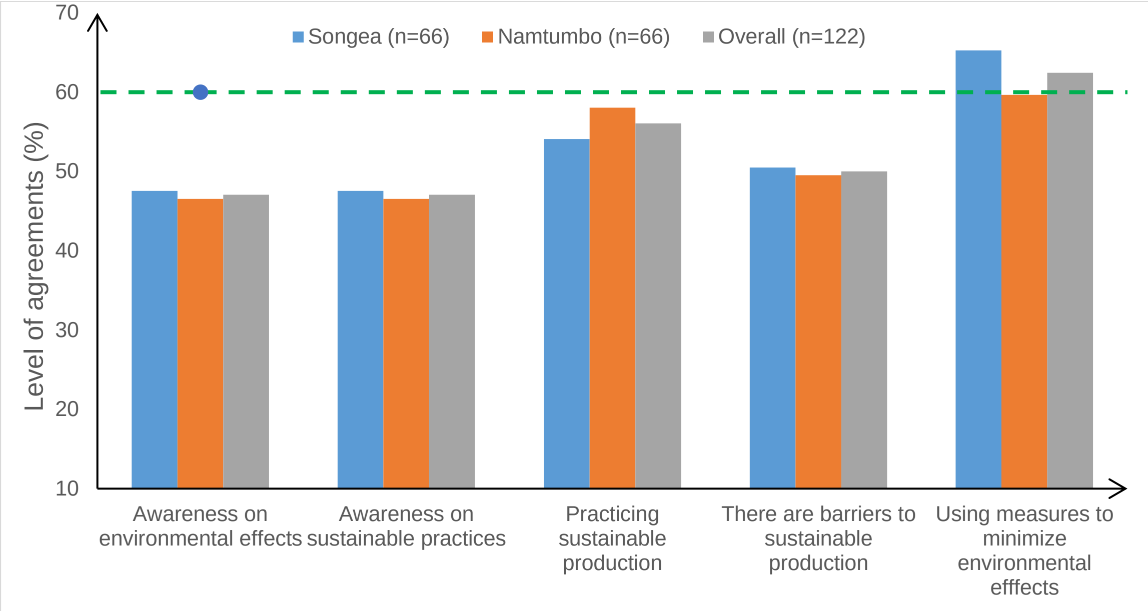
3.8 Soybeans Farmers' Awareness and Practice of Environmental Conservation

The study measured the level of awareness and practice of environmental conservation among soybeans farmers by establishing a scale with agreed level, disagreed level and neutral/undecided. Most of farmers showed high level of disagreement towards different statements concerning awareness and practice of environmental conservation. Results indicated that 73.8% of soybeans farmers disagreed with the statement of being aware of the environmental effects associated with soybeans production. It is only 15.6% of the farmers who agreed on this statement while 10.6% were neutral/undecided. Likewise, many farmers (71.3%) disagreed on the statement of knowing sustainable production practices for soybeans that conserve the environment, general biodiversity and ecosystem. The level of agreement towards this statement was 15.6% and 13.1% of farmers were neutral. Farmers they also disagreed on existence of barriers to practice sustainable production practices for soybeans that conserve the environment, general biodiversity and ecosystem.

On the other hand, some farmers showed agreement with the statement of using measures to minimize environmental effects. Soybeans' farmers reported to use some measures to minimize environmental effects associated with soybeans production. They are practicing mulching where farmers are using by-products from soybeans to cover the soil and allowing them to decompose and therefore improving soil nutrients. This increases fertility of land as soybeans farmers declared that the land cultivated soybeans in one year have positive effect of increasing productivity of other crops especially maize in the next farming year. This makes soybeans farmers practice crop rotation.

Generally, findings revealed that there is low level of awareness and practices of environmental conservation. Therefore, there is a need of establishing environmental conservation seminars to create and/or increasing awareness towards environmental conservation. Nevertheless, there are practices among soybeans farmers geared towards minimizing environmental effects.

Figure 22: Level of agreements on awareness and practice of environmental conservation



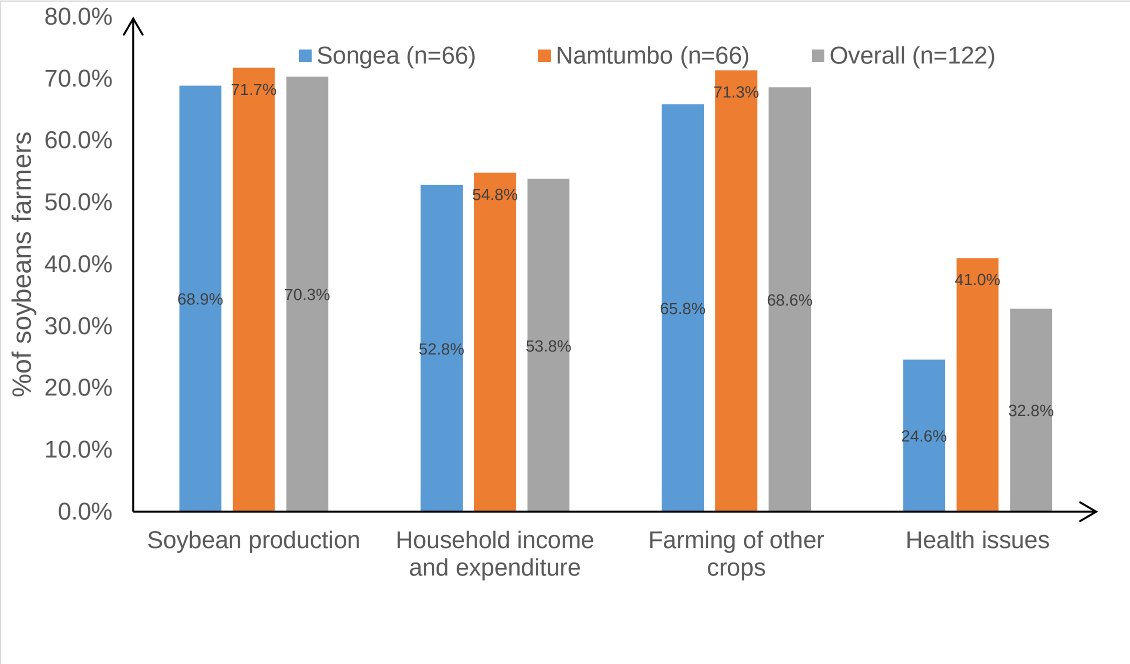
3.9 Gender Dynamics and Intra-Household Decision Making in the Soybeans Supply Chain

3.9.1 Decision making among soybeans farmers

Soybean's farmers participated in making decisions on various socio-economic aspects namely; soybeans production, household income and expenditure, farming of other crops and health issues. Many of the soybeans farming household (70.3%) participated in making decisions on soybeans production aspects. These included selection of soybeans seed varieties; sells of soybeans; use of revenue from soybeans sales; and cash crop farming. The highest proportion of farmers (71.7%%) who participated in making decisions on soybeans production were from Namtumbo district.

Results show further that 68.6% of the soybeans farmers participated in making decisions on the farming of other crops including selection of crops, allocation of land to crops, use of production, crop planting, household family labour and food crop farming. Household income and expenditure decisions were made by 53.8% of the soybeans' farmers. These included decisions on wage and salary employment, major and minor household expenditure, school fees expenditure and non-farm incomes for the household. Few soybeans' farmers (32.8%) participated in making decisions on health issues such as family planning (Figure 23).

Figure 23: Decision making among soybeans farmers



The participation of women into decision making among the soybeans farmers was high (66.5%). Results shows that women were included in making most of the household decisions. Disaggregated results show that 53.3% of the soybeans farmers participated in making decisions jointly in their households (Table 12). Interestingly, about 13.2% of women indicated to make decisions in their own. However, these decisions were mainly on minor household expenditures such as food for daily consumption or other household needs. Women were more involved on the decisions about whether or not to use family planning to space or limit births; children education such as whether to send them to school, where should children be sent; non-farm economic activities including things like running a small business; and use of the revenue from sales of soybeans. Results shows that women are involved in decision making under many aspects in their households.

Table 12: Participation of men and women in decision making

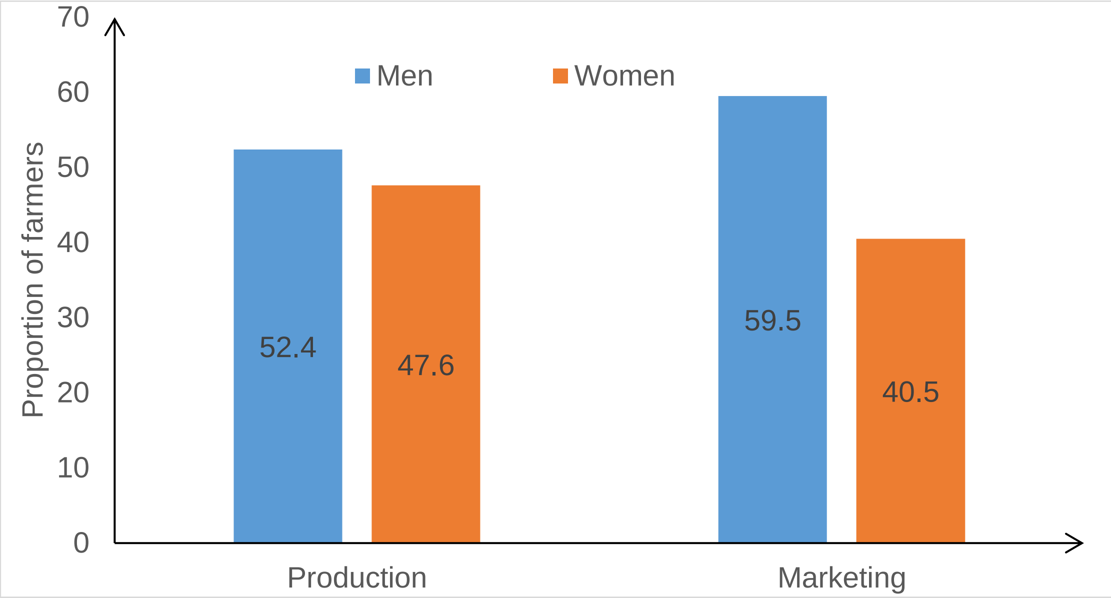
Decision	Person made the decision (%)				
	Male household head	**Female household head**	**Spouse**	**Jointly**	**Other household members**
Allocation of land to crops	39.8%	10.2%	2.3%	46.6%	1.1%
Cash crop farming: These are crops that are grown primarily for sale in the market	34.2%	13.2%	2.6%	50.0%	0.0%
Children education (e.g., whether to send them to school, where should children go to school)	8.9%	12.2%	11.1%	67.8%	0.0%
Crop planting/sowing activities: This would include method of sowing, timing, land preparation.	22.5%	15.5%	0.0%	60.6%	1.4%
Food crop farming: These are crops that are grown primarily for household food consumption	18.9%	14.4%	17.8%	48.9%	0.0%
Household labor (family members working in the field, when family who from the family works in the field and when they work)	27.5%	11.6%	1.4%	59.4%	0.0%
Major household expenditures (such as a buying a bicycle, land, motorbike)	33.3%	9.5%	6.0%	50.0%	1.2%
Minor household expenditures (such as food for daily consumption or other household needs	5.3%	27.7%	21.3%	44.7%	1.1%
Non-farm economic activities: This would include things like running a small business, self-employment, buy-and-sell	29.5%	18.2%	0.0%	52.3%	0.0%
Selection of crops to grow	35.6%	11.5%	2.9%	49.0%	1.0%
Selection of soybeans variety to plant	23.1%	12.3%	4.6%	60.0%	0.0%
Sells of soybeans	38.7%	13.4%	5.0%	42.9%	0.0%
Use of production (amount of harvest saved for household consumption, sold, stored, used as animal feed, etc.)	27.5%	11.3%	8.8%	51.3%	1.3%
Use of the revenue from sales of soybeans	15.7%	7.2%	12.0%	65.1%	0.0%
Wage and salary employment: This could be work that is paid for in cash or in-kind, including both agriculture and other wage work	31.3%	25.0%	6.3%	37.5%	0.0%
Whether or not to use family planning to space or limit births	5.0%	2.5%	20.0%	72.5%	0.0%
Overall	**25.3%**	**13.2%**	**7.7%**	**53.3%**	**.5%**

3.9.2 Involvement of women along the soybeans supply chain

Women are highly integrated in the soybeans' activities along the supply chain. Women perform activities such as weeding, assist in fetching water used in fertilizer/agro-chemical application, harvesting and post harvesting handling activities that includes drying, winnowing and sorting. Men are involved in fertilizer/agrochemicals application, threshing, bagging and transporting produce from the farm. However, participation of men and women in soybeans supply chain are approximated to be equally due to the fact that all activities can be performed by both sexes.

Results indicate that 47.6% of women are fully involved in soybeans production against the proportion of men which is 52.4% (Figure 24). Result indicates further that the participation of women into soybeans marketing activities is 40.5%. This implies that the soybeans supply chain is inclusive of women. Women not only benefit from the supply chain but also equally participate in various activities.

Figure 24: Involvement of men and women along the soybeans supply chain



3.10 The Impact of COVID19 on the Soybeans Supply Chain

The COVID-19 pandemic has created significant impacts on the global economy and affected various sectors. The agriculture sector is one of the sectors that has been affected globally. Results indicate COVID19 to have less effects into the soybeans subsector in Tanzania. This is due to the fact that the crop does not depend much on imported inputs. Additionally, less of the crop is exported due to high domestic demand hence not depending much on export markets.

Survey results shows that 9.8% of the soybeans farmers indicated that Novel Coronavirus (COVID19) pandemic had an effect to soybeans sub-sector including their soybeans production activities while the remaining percent (90.2) stated the absence of COVID19 effects to the sector. The few farmers who indicated to have been affected associated the decrease in soybeans prices with COVID19. In 2020, the farmgate price of soybeans was 0.26USD/kg while in 2019 it was sold at 0.28 USD/kg.

3.11 Policy Issues Affecting the Soybeans Supply Chain

Production and trade policies may affect the efficiency of the soybeans' supply chain positively or negatively. Results indicated that 29.5% of the soybeans' farmers are aware of the existing policies and regulations that affect negatively the production and trade of soybeans in the country.

Government intervention into the soybean marketing system was the main policy issue reported by soybeans' farmers. The government requires all the soybeans to be sold through the Warehouse Receipt System (WRS). Private buyers are not allowed to buy soybeans directly from farmers. They are only supposed to buy at the auction. However, farmers claimed that the existing soybeans marketing system under the WRS lacks transparency and has a poor communication system. There are also delays in payments. This challenge was reported to contribute to reduced investments in soybeans' production in the study area. Farmers reported the WRS to implement various charges which were found to be more than 13% of the price offered at the auction. The study found further that these charges are not clearly communicated to farmers. The composition of the charges is also not well known. For example, Namtumbo district was found to deduct 92 Tanzanian Shillings (TZS) per kilogram sold through the WRS. The price offered at the auctions under WRS in the Namtumbo district ranged from 692-834 TZS/kg. This means that in order to attract private sector investments into the soybeans supply chain, the marketing system needs to be intervened by making sure that all the principles of WRS are correctly applied by the market participants. Furthermore, a study is also required to understand why the private buyers that are prohibited by the government to buy directly from farmers are offering a higher price than those offered under the WRS.

There are low private and public investments into soybeans' processing facilities. The lack of soybeans' processing facilities was reported in all the districts surveyed. Key informants in other areas also reported the same. Feed manufacturers prefer buying soybeans meals and not grains. It should be noted that feed formulation in Tanzania includes about 20% soybeans. The lack of soybeans' processing facilities leads to the reduced domestic market size for soybeans. It also encourages the exportation of raw soybeans.

Taxation reforms are also needed as a key policy instrument to spur investments in the soybeans supply chain. There are charges in both the soybeans marketing and the marketing of feeds. This implies that soybeans are taxed at two different stages of the value chain. They are taxed as grains under the WRS and in the feeds. The feed manufacturers reported that there is the removal of Value Added Tax (VAT) on domestically manufactured feeds. However, other charges such as the movement of animal feeds and livestock resources still exist.

The study also noted that environmental conservation practices are not integrated into the existing good agricultural practices availed by the public extension agents to the soybeans' farmers. There are no specialized extension agents that would ensure farmers practice sustainable and productivity-enhanced soybeans production practices. However, farmers were found to practice conservation agriculture on their own. It included crop rotation, intercropping, and crop residual retention. Crop rotation is done by planting soybeans in one season and maize or sunflower in the next season. This was reported to enhance soil fertility due to the ability of soybeans to fix nitrogen in the soil. Intercropping is sometimes done with maize or sunflower though this is done by few farmers. Soybeans' residuals are retained in the fields for increased soil fertility.

The shortage of specialized crop extension agents was mentioned to be one of the reasons for the low use of productivity-enhancing inputs by farmers. The study established that the access to productivity-enhancing inputs is challenging to many farmers. This includes the non-availability of improved seed varieties and mechanized service technologies such as threshing machines. The low soybeans productivity discourages privates investments into the sector. The commercial farming of soybeans is important for the effective implementation of the soybeans' import replacement policies in the country.

4. Conclusion and Recommendations

4.1 Conclusions

This study has analyzed the soybeans imports replacement policies in Tanzania revealing their feasibility and the anticipated effects to both people and the environment. The study has found that the import replacement policies are only feasible if the existing bottlenecks are addressed. It will therefore require implementation of production and market-oriented policies. This is because the soybean production is characterized by low productivity (0.66t/ha) due to the low use of productivity-enhancing inputs which discourages private investments into the sector. There is also a shortage in soybeans' processing facilities which leads into reduced domestic market size and encourages the exportation of raw soybeans. The low economies of scale and specialization in soybeans' production also catalyzes the problem. Farmers produce in an average farm size of 0.94 ha. The soybean production is less competitive with farmers producing at a cost of 319 USD/ton.

Although all soybeans' farmers were found to operate above the cost frontier with efficiency levels above 1, they were not 100% efficient in their production system. Soybean marketing system was found to be the main source of inefficiency in the soybean supply chain. However, there are positive impacts of the crop to farmers. The crop was found to have an inequality-reducing effect on soybeans' farmers and contributed positively to incomes and food and nutrition security. The production of the crop also enhanced environmental conservation through crop rotation, intercropping, and crop residuals retention.

4.2 Recommendations

The effectiveness of the soybeans import replacement policies will require encouraging commercial soybean farming and increasing soybean farm sizes to achieve economies of scale. This will contribute to increased productivity and reduced production costs for achieving competitiveness. The current soybeans sector in Tanzania is small but its impacts into the environment cannot be ignored as it continues to grow. The import replacement policies should therefore be aligned with stringent environmental conservation policies. These policies should include efforts to raise awareness on environmental conservation and integrate environmental conservation principles into the soybeans' good agricultural practices.

The competitiveness of the sector should also be enhanced through supporting availability and access of soybeans' inputs such as improved seed varieties and services especially credit, soybeans specialized extension, and market information. Reforms in tax and market-oriented policies is also important. Tax reforms should focus on reducing the charges in soybeans and enforcing a transparent tax administration system under the local government authorities. Additionally, improving the soybeans marketing under the warehouse receipt system will attract private investments into the sector.

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