Working Paper Series No. 65

Farmer perceptions on labor-saving technologies in groundnut production systems in Tanzania

INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

Citation: Ndossi Judith, Mwalongo Serapius, Akpo Essegbemon, Alex Gerald, Nzunda Joseph, Okori Patrick and Ojiewo Chris. (2022). Farmer perceptions on labor-saving technologies in groundnut production systems in Tanzania. ICRISAT Working Paper No.65, Patancheru 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 33 pp.

DOI: 10.5281/zenodo.7360497

ISBN: 978-81-956619-4-7

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Address: Patancheru 502 324, Telangana, India

Publisher: Self publish

Printed: ICRISAT, Patancheru 502 324, Telangana, India

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Farmer perceptions on labor-saving technologies in groundnut production systems in Tanzania

Report (draft v1)

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INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

September 2022

Acknowledgements

The authors appreciate the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) for financial support of the study through the Accelerated varietal improvement and seed delivery of legumes and cereals in Africa (AVISA) project which is funded by Bill and Melinda Gates Foundation (BMGF). We also thank the management of Tanzania Agricultural Research Institute (TARI) - Naliendele Center for administrative support towards the achievement of the study.

List of acronyms and abbreviations

ASA	Agricultural Seed Agency
GDP	Gross Domestic Product
EAC	East African Community
Ha	Hectare
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
Kg	Kilograms
LST	Labor Saving Technology
Ltd	Limited
SIDO	Small Industry Development Organization
SSA	Sub-Saharan Africa
TALIRI	Tanzania Livestock Research Institute
TARI	Tanzania Agricultural Research Institute
TL	Tropical Legumes
TZS	Tanzanian shillings
URT	United Republic of Tanzania

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EXECUTIVE SUMMARY

Groundnut is among the most valuable crops in Tanzania. It is a good source of oil, food, and income to many households however, it is considered a labor-intensive crop. Farmers perform tedious and laborious activities during ploughing, planting, weeding, harvesting, and shelling just to mention a few. Therefore, in ensuring that groundnut production achieves its potential within and outside the country, the introduction and use of labor- saving technologies cannot be overemphasized. This study intended to assess the farmers perception on groundnut labor-saving technologies in Tanzania. Specifically, the study aimed at (i) analyzing the labor-saving technologies used by groundnut farmers; (ii) Investigating farmers perception on the LSTs. Also, (iii) Comparing the farmers' resource (such as time and finances) use associated with the traditional tools versus the labor-saving technologies (LST) and (iv) Discussing policy environment for labor saving technology in Tanzania.

The survey included twelve districts of which eight districts had benefitted LSTs from TLII project namely Bahi, Chamwino, Kaliua, Ushetu, Kahama, Nanyumbu, Masasi, Mtwara. Three districts had not benefitted LSTs from TLIII project (namely Sikonge, Mbozi and Urambo) and the remaining one district (Morogoro) included LST assembler and Small Industries Development Organization (SIDO). Purposive and snowballing procedure was used to obtain respondents and a total of 100 farmers, 5 farmers group, 5 extension officers, 3 machine assemblers and 1 research institute who were interviewed in the study. Data was analyzed using Microsoft Excel, Stata version 14, statistics, weights, and Student t-test.

Socio-economic characteristics of the interviewed farmers showed that majority (46%) of the farmers using LSTs were aged between 35 to 50 years and had primary school education (80%). Most (63%) of the farmers using LSTs were male. About 43% of the farmers had household size of 7 to 10 family members. Majority (59%) of the farmers operated in farms of less than 1ha. The survey further identified 5 types of LSTs: ox-plough, planter, oil expeller, groundnut shellers and tractors. The findings exclusively revealed that planters, oil expellers, and groundnut shellers were perceived to be new LSTs while tractors and ox-plough, have been present in their communities for a long time. However, their use has gained popularity in the current years.

In this study farmers pinpointed convenience and time saving, cost saving, labor saving, among others as benefits of using LSTs. The overall perception of male farmers on planters, ox-plough and groundnut shellers were perceived satisfactory when weighed on a 5-point scale while women farmers were very dissatisfied with the planters and ox-ploughs mainly due to (i) Heaviness and (ii) cultural ties that don't allow women to operate heavy objects. Both male and female farmers were satisfied with the oil expellers and tractors. The study further compared the farmers' resources (time and finances) use associated with the traditional tools versus the labor-saving technologies (LST) and found out that farmers using traditional methods used more time and labor compared to farmers who used LST.

Moreover, the study observed that the use of Labor-saving technologies such as ox-plough increased productivity by about 50%. The LSTs used by farmers were manufactured by small industries. All these industries are under SIDO under the ministry of Trade, Innovation, and industries. They manufacture or assemble Planters, groundnut shellers, and oil expellers. However, they are challenged by (i) Limited electricity (ii) Limited credit from institutions in contract (iii) delayed payments from buyers (iv)Spare parts being expensive. Similarly, SIDO was highly challenged by limited funds to support all small industries.

The study concluded that the LSTs have been useful to farmers especially in terms of time management and cost efficiency. However, addressing the observed challenges associated with the LSTs will make farmers realize their expectations (high income, food security etc.). Therefore, this study recommends (i) promotion of LSTs to farmers, (ii) Linking machine manufacturers and farmers so as to monitor the performance of the LSTs (iii) Increase budget to SIDO to increase its ability oversee and support the small industries.

CHAPTER 1

General introduction

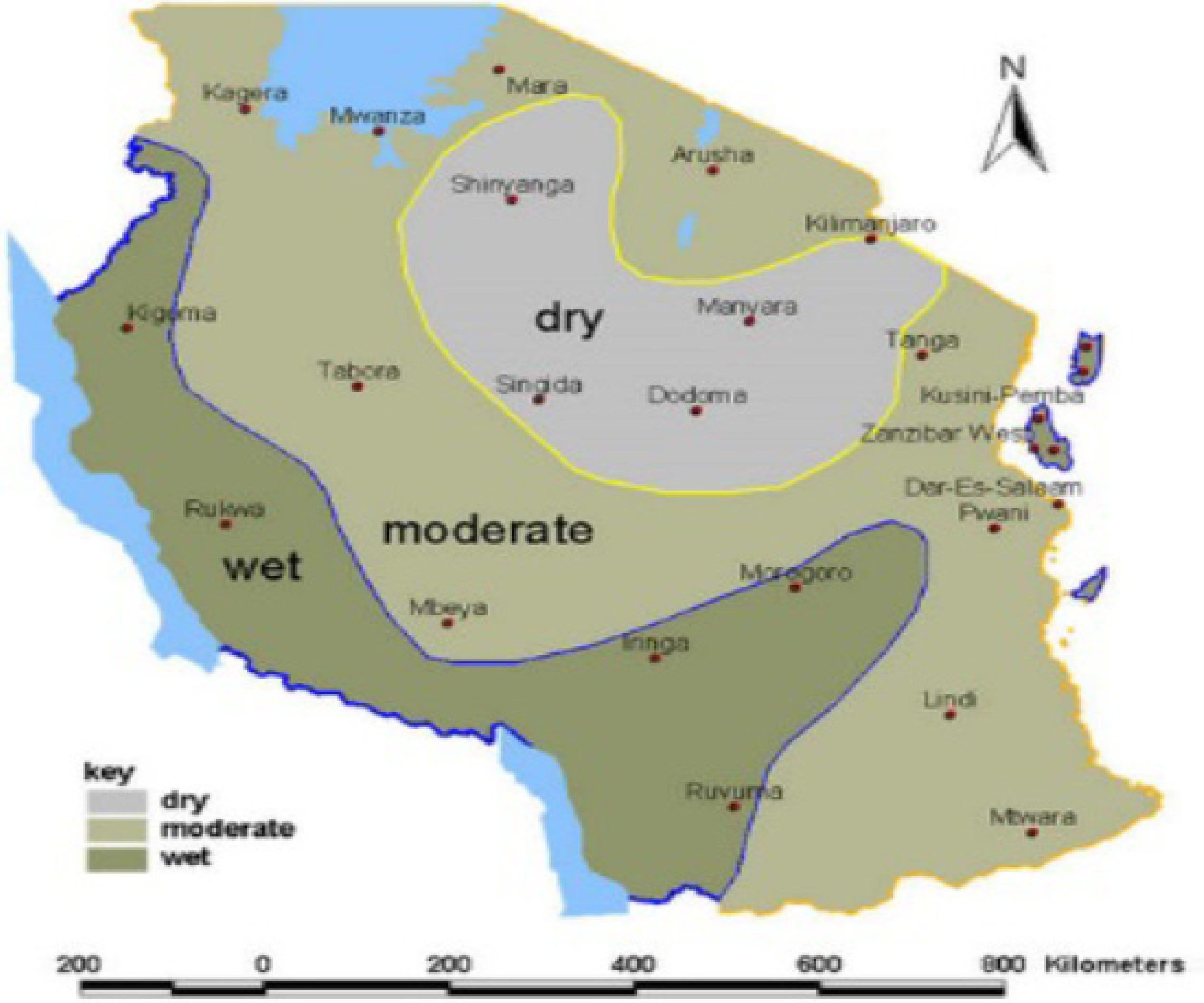
1.1 Background Information

Africa's economy is strongly rooted in agriculture such that 65-70% of the total population in the continent are employed in agriculture and the livelihood of about 90% of the population is derived from agricultural production system (OECD and FAO, 2016). Also, it accounts for about ¼ of the continent's GDP (OECD and FAO, 2016). In the Sub-Saharan Africa (SSA) agriculture plays a pivotal role in development as a major source of income, food, employment, and its effectiveness in reducing poverty (Ssozi *et al*.,2019). Despite the importance of the sector, about 25% of the population in this region experiences hunger (Shimeles *et al*., 2018). The state of food insecurity remains a pressing issue not only in SSA but also in other least developed countries around the globe (FAO *et al.,* 2017). This has called for a prompt global transformation in agriculture to prevent persistent challenges such as food and nutrition security as well as climate change (Chuang *et al*.,2020; Adjimoti *et al*., 2018). One way to achieve this has been through agriculture mechanization by providing labor saving technologies to farmers. Labor is an important input in agriculture; however, it cannot single handedly increase production enough to combat hunger. Labor alone is limited in capacity and effectiveness to achieve higher production. Application of mechanical technology aims at reducing drudgery, enabling farmers to intensify production, enhance their efficiency and improve production and quality of life (Mukasa *et all.*,2017).

Groundnut (*Arachis hypogea* L.) is one of the legume species that plays a critical role in assuring food security and livelihoods of many households in SSA. However, it is one of the crops which are labor-intensive especially for farm operations like weeding, harvesting, drying, and shelling. This makes it difficult for farmers to perform these tasks effectively and at scale (Govindaraj et al,2011; Garasia et al.,2015; Pandey et al.,2013). Farmers perform tedious, repetitive and drudgery prone tasks in their farms. This results from old techniques of performing tasks and incompatibility of the tools they normally use (Surabi et al.,2016; Sharma et al.,2015). Besides, low productivity, these old techniques may also have severe health implications to farmers. Moreover, due to low labor and agriculture productivity, farmers face a poverty trap which they cannot easily escape unless they are exposed to a swathe of innovation that improves labor productivity of the agriculture system. According to Gallardo *et al*., (2018) and Murray *et al*., (2016) technology innovations are crucial for the advancement of agricultural productivity and ultimately the economic prosperity of the nation. Some of these technologies include planters, animal traction, tractors, weeders, shellers, and harvesters (Khatri-Chhetri *et al*., 2020, Mukasa *et al*., 2017). Results of technology development in agriculture have led to increased productivity, lower production costs, reduced dependence on labor and related risks (Gallardo et al.,2018). Also, it is imperative in the transition from subsistence-oriented production to agribusiness (Mukasa et al.,2017).

1.2 Problem statement and Justification

In Tanzania groundnut has played a pivotal role in providing livelihood mostly to people living in Arid (dry) and Semi-Arid (Moderate) areas which cover about 50% of the country (Yanda *et al.,* 2015). Figure 1 describes the part of country's land falling in Semi-Arid areas.



Source: URT (2010) as refereed by Yanda et al., (2015)

Figure 1: Map of semi-arid lands of Tanzania.

People living in these areas experience prolonged drought such that crops that are not drought resilient cannot grow easily. In that context, groundnut is mostly grown in these areas since it is one of the crops that is drought tolerant (Mwalongo *et al*., 2020). Moreover, groundnut has become one of the most important crops for trade within the nation as well as for export (TPP, 2012). This has benefited households with increased income and forex for the government. Currently, the country is experiencing a shortage in edible oil of about 365,000 tons per year and spending over TZS 443 billion to cover the shortage (Sanawa, 2021). Similarly, the unemployment rate of the total workforce has in the country increased by 0.2% in between 2019 and 2021 (World Bank, 2021). To cover the oil shortage and increase employment, groundnut has been listed among the four strategic crops in the country. Others crops include Sunflower, Coconut and Palm oil (Sanawa, 2021).

However, the whole process of groundnut production is labor intensive such that it is suitable for the extreme small-scale farms only (Govindaraj *et al,* 2011; Garasia *et al.*,2015; Pandey *et al*.,2013). Hence, it is difficult to produce a large amount of groundnut which will significantly contribute to relieve the oil shortage existing in the country. In an effort to increase both groundnut productivity and production, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in collaboration with Tanzania Agricultural Research institute (TARI) established a project called Tropical Legume III(TLIII). This project was implemented between 2009 and 2019. It aimed at disseminating improved groundnut varieties, and towards its end (between 2017 and 2019) it disseminated the labor-saving technologies (LST) to reduce human drudgery. The LST disseminated included Ox-ploughs, Planters, groundnut Shellers and Oil expellers. Nevertheless, since their dissemination no feedback has been sought on their performance, environmental fitness, and efficiency for further policy actions. Assessing the current performance of the deployed LST will help assemblers, researchers, and policy analysts to improve and promote such technologies. Furthermore, it will help to increase groundnut production, ensure food security, minimize unemployment, and reduce oil deficiency in the country. Therefore, the current study aims at investigating the perception of groundnut farmers on LST in Tanzania.

1.3 Objectives

1.3.1 Overall objective

To analyze farmer's perception on deployed labor-saving technologies for groundnut in Tanzania.

1.3.1 Specific objectives

Specifically, this study intends to:

I. To analyze the labor-saving technologies used by groundnut farmers

II. Investigate farmers perception on the LSTs

III. Compare the farmers' resource (such as time and finances) use associated with the traditional tools versus the labor-saving technologies (LST).

IV. Discuss policy environment for labor saving technology in Tanzania.

CHAPTER 2

Literature review

2.1 New agricultural technologies.

Agricultural technology refers to a product, service, or application designed to assist farmers in farming activities and improve the yield, quality, profitability, and efficiency (Monteiro, Santos, and Gonçalves, 2021). Authors divide agricultural technologies into three stages of development namely: genetic innovations, physical inputs, and management techniques (Tripp, 2001). Furthermore, literature explains that genetic innovations deal with development of new crop varieties. In the developing world genetic innovations have been carried out since early 1960s and is expected to be an ongoing process in which new crop varieties through conversional plant breeding are developed (Persly and Latin 2000). The new crop varieties have characteristics that address environmental specific conditions such as Pests and diseases, and environments like acidic soils. Also, new varieties address market traits such as taste and size, and climatic conditions like drought (Zuric,2014; Daudi, 2018).

The second category is physical inputs which are further divided into two groups;(i) agricultural chemicals, and (ii) biological innovations. The agricultural chemicals include fertilizers and pesticides that have met strict and safety standards and normally provided by the private sector, whereas biological innovations include micro-organisms or natural enemies (Buckles *et al*., 1998; Marrone, 1999). The major role of the physical inputs is the provision of soil nutrients required by a plant (Marcus and Bernad, 2009).

Finally, the third category of technology (new management techniques) emphasizes new resource conservation such as tillage to control soil erosion and reduce costs (Sain and Barretto,1996). There are other management techniques which deal with input efficiency like changes in timing and rates of fertilizer application intended to reduce both financial costs and environmental impacts (Matson et al., 1998). The use of integrated pest management though pest monitoring is based on economic thresholds that guide pest control practices. The afore described agricultural technologies have been improved and disseminated among farmers since the green revolution in the 1960's.

2.2 New Agricultural Technology among groundnut farmers in Tanzania.

Literature highlights that since early 1960s, Tanzania has been experiencing low yield for key crops such as maize with production of less than 2 Metric tons/ha which could have been improved with the use of good agricultural technologies (Otsuka, et al., 2017). Similarly, Groundnut productivity which is the center of the current study reached a maximum average of 0.444 metric tons/ ha of grain productivity in between 1960s to 1990s (URT,2016). URT (2016) further recommended that the productivity was below the expectations during that period. Since then, the government, private organizations and CGIARs have been engaged in developing new varieties and have released 18 new groundnut varieties to date (Mwalongo *et al*., 2020). The released varieties have important characteristics which address difficult environmental conditions such diseases and pests, market changes like taste and color and the increasing climatic harshness. In addition to this, there are also various agronomics practices in every farming stage that goes along with the use of these varieties in order achieve the potential yield. However, these practices have been observed to be tedious and time consuming when implemented with traditional hand-held tools.

For example, land tillage is required to be 15-30cm deep whereby a farmer using a hand hoe will require considerably more time to finish a unit piece of land (ha) as when compared to while using a labor-saving device. Likewise, planting requires 10cm between seed and 50cm between lines. Moreover, it is recommended that only one seed should be planted in one hole at a depth of 2.5 cm to 5cm (Mponda, 2011). Planting is recommended to take place during the first rains to avoid eruption of diseases like rosette, leaf spot and rust. During weeding, groundnuts require cleanliness and thinning to avoid the spread of diseases commonly known as Aphids. After weeding, harvesting is done either by hand or hand hoe. Finally, farmers have to transport the harvested groundnut to their homes where they pluck to get groundnut pods which is either sold or shelled depending on the farmer's need (Mponda, 2011).

Despite the tedious work, about 23% of the national total farming households are involved in groundnut production (NBS, 2017). Also, Groundnut production and area have increased from 206,800 tons in 2001 to 1.83 million tons in 2015 and from 247,300 ha in 2001 to 1.62 million ha in 2015, respectively (FAO, 2018). Similarly, productivity has increased to an average of 745 kg/ha, although still less than the average productivity in Africa, which is 800 kg/ha (URT, 2007, ACCI, 2016, URT, 2018).

2.3 Farm size, Gender and Labor-Saving Technologies

In Tanzania expansion of land suitable for farming is not a problem since the country is reported to have total land of about 44,000,000 ha of arable land (Mosh 2014). From this arable land, about 17,120,571 ha is under farming in which 16,977,740 ha (92.2%) is on mainland and 142,831ha (0.8%) is in Zanzibar (NBS, 2017). This implies that about 26,880,000 ha suitable for agriculture is still idle. It is estimated that most (77%) of groundnut farmers are small scale holders with at most 2ha and 55% of them being women (Mwalongo et al., 2020). Furthermore, in rural areas, majority of the farmers are poor and mostly women. Therefore, they need more time and energy for other farm and non-farm activities to generate more income for their life (Bishop-Sambrook, 2016). However, in the last two decades researchers, and policy analysts have been engaged in developing strategies for agricultural development. These mostly involved increasing farm size and enhancing production environment (Dorward, 1999; Harris-White and Janakarajani,1997). But, Tripp 2001, argued that Policies targeting agricultural development assume that small farms are more efficient than large farms. However, evidence from other authors show that larger farms are more efficient than small size farms (Dorward, 1999; Harris-White and Janakarajani,1997). In the current study both views are captured. Small farm sizes suggest that attention should be given to other factors particularly human capital available for farm operation. Paying closer attention to the Labor, skills and education of farming households will help in making their development consonance with wider rural development goals.

2.4 Tropical Legume III project and research gap

In 2017 the Tropical Legume III Project in collaboration with the Tanzania Agricultural Research Institute (TARI-Naliendele) deployed four types of Labor – saving technologies; Ox-plough, Planters, Groundnut shellers and Oil expellers to various farmer groups in 5 regions. These labor-saving technologies were designed and assembled by a company known as Intermech Engineering Limited. The major aim of the deployed Labor- saving technology was to reduce human drudgery. These technologies need skills and awareness and knowledge on how they fit the farmers environment. Also, their performance with regard to agronomic practices and seed and grain quality management had not been assessed. Moreover, their fitness for use in the context of gender and age is also not known. Therefore, the current study intends to cover these gaps.

CHAPTER 3

Methodology

3.1 Study areas, data sources, and sampling procedures

The study was conducted in Tanzania being one of the six East African Community (EAC) member states. This study was carried out in 5 regions which benefitted from the groundnut labor–saving technologies (LSTs) supported by Tropical Legume III project.

The study generally covered individual farmers, farmer groups, Machinery assemblers, extension officers, and the Tanzania Agricultural Research Institute (TARI). The survey included eleven districts, of which eight underwent interventions by TLIII project while three districts were non-intervention ones, and one was dominated by LSTs assemblers (Table 1). The three districts which didn't benefit from LSTs (supported by TLIII), were involved in study because groundnut production is pursued widely, and farmers apply LST from other sources than those deployed by TLIII project.

Table 1: Districts covered by the study.

Region	District	Type of respondents
Mtwara	Masasi	Focus group, Farmers using LST and extension officer
	Nanyumbu	Focus group, Farmers using LST
	Mtwara Municipal	TARI-Naliendele
Dodoma	Chamwino	Farmers using LST, extension officer
	Bahi	Focus group, Farmers using LST and extension officer
Shinyanga	Kahama	Focus group, Farmers using LST, Extension officer and assemblers
	Ushetu	Focus group, Farmers using LST, Extension officer and assemblers
Tabora	Kaliua	Focus group and Farmers using LST and Extension officer
	Urambo	Farmers using LST
	Sikonge	Farmers using LST
Morogoro	Morogoro Municipal	LST assemblers
Songwe	Mbozi	Farmers using LST

The study employed a purposive sampling and snowballing procedure to obtain a total of 100 farmers using LST, and six farmer groups. Here, groups of farmers that benefitted from LSTs from the project were purposively visited in their respective districts using the projects 'guide (Table 2). In these farmer groups, the respective LSTs were identified, their photos were taken and a focus group discussion of at least eight group members was finally conducted. Thereafter, a snowballing process resumed to identify individual farmers who used and deployed technology in their farms. Every farmer who used the group LST in his/her own farm was interviewed as an individual farmer. After the interview a farmer was asked to show another farmer who used the technology within the group and /or the extension officer was asked to identify another farmer within a village who used LST but from other sources. We also interviewed one extension officer in each village or ward, where a total of five extension officers were interviewed. We further interviewed one research institute (TARI-Naliendele) and three machinery (LST) assemblers.

Table 2: Deployed LST per district and group.

Regions	District	Group name	Technology given
Dodoma	Chamwino	Daspa	1 planter & 1 shelling machine
		Makoja (women group)	1 planter & 1 shelling machine
	Bahi	OYE-UTUKUFU (Youth group)	1 planter, 1 shelling machine &1 ox-plough
Singida	Singida Rural	Recoda	1 planter
Tabora	Kaliua	Tuifashe group	1 ox-plough, 1 planter & 1 shelling machine
Mtwara	Nanyumbu	Umoja group (youth group)	1 planter, 1 shelling machine & 1 oil expeller
	Masasi	Mapambano (women group)	1 planter & 1 shelling machine
	Mtwara	TARI-Naliendele	1 shelling machine, 1 oil pressing & 1 planter
Shinyanga	Ushetu	Tumaini group	1 planter, 1 ox-plough & 1 shelling machine
	Kahama	Upendo group	1 planter & 1 shelling machine

The districts (sites) visited were Morogoro municipal in Morogoro region, Bahi and Chamwino in Dodoma regions, Kahama in Shinyanga region. Other districts studied include Kaliua, Urambo and Sikonge in Tabora region, Mbozi in Songwe region, and finally Masasi, Nanyumbu and Mtwara Municipal in Mtwara region (map 1).

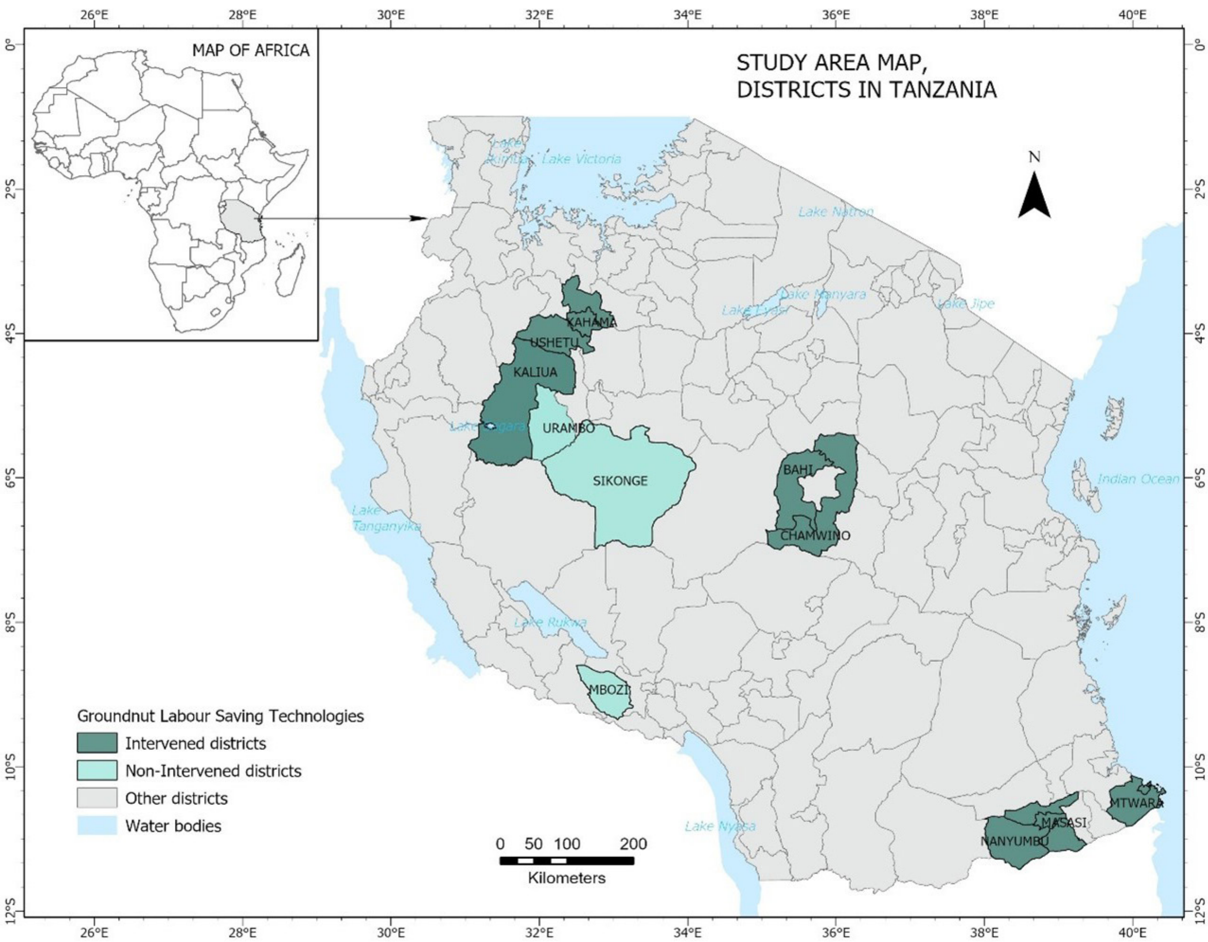


Figure 2: Map showing study area for the Labor-saving technologies survey

3.2 Data processing and analysis

Data were organized, processed, and analyzed by objectives through Microsoft excel and Stata version 14.

3.2.1 Objective 1: To analyze the labor-saving technologies used by groundnut farmers

The analysis of identified LSTs was done, and percentages for each individual LST was computed. The percentage was computed by dividing the sum of an individual LSTs (say "$\sum_{i=1}^{k} n_i$") by the total summation of all LSTs (say "$\sum_{j=1}^{y} N_i$") multiplied by 100%.

$$\frac{\sum_{i=1}^{k} n_i}{\sum_{j=i}^{y} N_i} * 100\% \qquad (1)$$

Where, ∑ = Summation, n= LST in the same category i = 1, 2…, and k count of the same LST, N= LST in all categories, j = counts of all LSTs (1, 2…, and y).

3.2.2 Objective 2: Investigate farmers perception on the LSTs

The responses for weights reflecting a five-point scale were arranged in a matrix of factors (in rows) and type of LSTs (in columns). Thereafter, average weights attributing the LSTs were computed by summing individual weights $(\sum_{i=1}^{n} w_i)$ (from both individual farmers and Focus group discussion. Then, the total weights $(\sum_{i=1}^{n} w_i)$ (were divided by total number of observation (N).

$$\frac{\sum_{i=1}^{n} w_i}{N} \qquad (2)$$

Where i= weights per LST category (i= 1,2,3, 4,……., n-1 and n), w_i = weight score of individual farmers or focus group discussion per LST category, N= Total number of scores per LST category.

Moreover, in the five-point scale used, the 5 scores were assigned with labels to give meaning, as ascribed here; 1=very dissatisfied, 2 = slightly dissatisfied, 3= neither satisfied nor dissatisfied, 4=slightly satisfied, 5 =very satisfied.

In addition, these 5 scales were applied to 9 factors purposively chosen to evaluate the 5 types of LSTs (Ox-plough, Planters, Oil expellers, Tractor and Groundnut sheller). These 9 factors were (i) Easiness to use (ii) Fitness to intended use (iii) Affordability (iv) Adopted to multiple use (v) Acceptability by farmers (vi) Women perception (vii) Youth perception (viii) Men perception (ix) Overall perception.

3.2.3 Objective 3: Comparing the farmers' resource (such as time and finances) use associated with the use of traditional tools versus LSTs.

The two farmers' resources were sorted which are time (in man days) and finance (in terms of cost or expense in TZS). Here 1 man day meant 8 working hours of the day (Nyaki, 2014). The time used in farming using traditional tools was compared to the time spent with the use of LSTs using student-t test. Similarly, the cost incurred using the traditional technology was compared against the cost incurred by using LSTs using a two sampled t-test at 95% level of significance. The comparison involved the time and cost for Planting, Ploughing and Shelling, because they are the only activities which employed LSTs.

Here the hypothesis was: -

Ho: Time spent by using a traditional tool is equal to the time spent by using an LST,

(Ho: Tt = LSTt) ………………………………………………………………………… (3)

similarly,

Ho: Cost spent by using a traditional tool is equal to the cost spent by using an LST.

(Ho: Ct = C_{LST})………………………………………………………………………… (4)

3.2.4 Objective 4: Discuss policy environment for labor saving technology in Tanzania.

In this objective, the responses for extension officers regarding their awareness on various policies for LSTs promotion were computed and expressed in percentages. Then, from both qualitative and secondary information collected, the policy environment was explained.

CHAPTER 4

Results

4.1 Social economic characteristics of the interviewed groundnut farmers using LSTs.

Findings show that most (46%) farmers using LSTs were aged between 35 to 50 years followed by 50 to 65 years (26%), 24 to 35 years (24%) and 65+ years (4%) (Table 3). Also, most (63%) farmers using LSTs were male, while only 37% of them were females. Findings further show that about 80% of the farmers had primary school level, with very few farmers 9% and 4%, having secondary and post-secondary level of formal education respectively while 7% had no formal education. Besides, majority (63%) of the interviewed farmers were involved in only farming, followed by 35% involved in both farming and livestock keeping and 2% of the farmers were involved in both farming and formal employment. Moreover, results reveal that about 43% had a household size of 7 to 10 family members, 15% had small household size of less than 4 members and 6% had more than 10 family members. Finally, majority (59%) of the farmers operated in small scale farms of less than 1ha (2.5 acres) while 41% operated in large scale farms of more than 1ha (2.5 acres).

Table 3: Social economic characteristics of the interviewed groundnut farmers using LST.

Variable	Category	Percentage (%) of respondents using LST (n=100)
Age	< 20	0
	20 – 35	24
	35 – 50	46
	50 – 65	26
	65+	4
Gender	Female	37
	Male	63
Education	No formal education	7
	Primary	80
	Secondary	9
	Post-secondary	4
Occupation	Formal employed and farmer	2
	Both farmer and livestock keeper	35
	Farmer	63
Household size	<4	15
	4 to 6	43
	7 to 10	36
	>10	6
Farm size	<1ha	59
	>1ha	41

4.2 Analysis of Labor-saving technologies used by groundnut farmers

4.2.1 Labor-saving technologies used by farmers

Findings revealed that farmers used different labor-saving technologies to perform various agricultural activities pertaining to groundnut value chain. Table 4 shows that about 74.6% of the farmers use ox-plough and 1.7% use tractor during ploughing, 5.1% use planters to plant, 12.7% use shellers during shelling and 5.9 % farmers use oil expeller to extract oil from the groundnuts (Table 4).

Table 4: LSTs used by farmers.

Technology used	Farmers (%)
Planter	5.1
Ox-plough	74.6
Tractor	1.7
Groundnut sheller	12.7
Oil expeller	5.9
Total	**100**

4.2.2 Sources of labor-saving technologies used by farmers

The study observed that labor-saving technologies used by farmers were obtained from five different source (Table 5). Most (50%) of the farmers used planters obtained from TARI, while 33.3% bought their own planters and about 16.7% obtained the planters through borrowing. Among all farmers who used ox-plough: 2.3% used ox-ploughs obtained from TARI, 46.6% bought their own ox-ploughs, 45.5% rented and 4.5% borrowed. Moreover 13.3% of the farmers who used groundnut shellers had bought whereas 86.7% had rented. Table 5 shows that majority (71.4%) of the farmers rented the oil expellers, 14.3 % obtained from TARI and the remaining 14.3% bought their own. Results also show that 50% of the farmers used their own tractors while 50% used tractors they had rented.

Table 5: Different sources of LSTs used by farmers.

Sources of LSTs	Planters (%)	Ox-plough (%)	Sheller (%)	Oil expeller (%)	Tractor (%)
TARI	50	2.3	-	14.3	-
Bought	33.3	46.6	13.3	14.3	50
Rented	-	45.5	86.7	71.4	50
Borrowed	16.7	4.5	-	-	-
Inherited	-	1.1	-	-	-
Total	**100**	**100**	**100**	**100**	**100**

4.2.3 Attitude of farmers on newness of the Labor-saving technologies

It was observed that all (100%) farmers who used planters said that the technology were new to them, and they had started using them recently (Table 6). About 27.3% of the farmers using ox-plough said the technology was new to them, while 72.7% of the farmers said that they have been using the technology for a long time. About 53.3% of the farmers using groundnut shellers, said the technology was new whereas 46.7% of the farmers said that the technology had been around for a long time. Farmers (71.4%) who used oil expeller said that it was new while 28.6% said the technology was not new to them. Moreover, all (100%) farmers using tractors said that the technology was not new, and that it has existed in the community for a long time (Table 6).

Table 6: Attitude of farmers on newness of the LSTs.

Newness of technology	Farmers using Planters (%)	Farmers using Ox-plough (%)	Farmers using Groundnut sheller (%)	Farmers using Oil expeller (%)	Farmers using Tractor (%)
Yes	100	27.3	53.3	71.4	0
No	0.0	72.7	46.7	28.6	100
Total	**100**	**100**	**100**	**100**	**100**

4.2.4 Attributes farmers liked about the labor-saving technologies

Results show that farmers had different attributes that they liked from the labor-saving technologies (Table 7). The best attributes for planters were height (33.3%), mechanism of planting seed (22.3%), weight (22.2%) and seed container (22.2%). For the ox-plough the best attributes were Mode of operation (36.8%), Sharp share (31.6%), Height (19.3%), Handles (8.8%) and weight (3.5%). Also, results show that the best attributes for groundnut shellers reported by farmers were Fan (38.9%), Hopper (33.3%) and Height (27.8%). Moreover, for the oil expeller the best attributes were motion controller (62.5%) and hopper (37.5%). For the tractor, the reported attributes were engine of the tractor (25%), tires (25%), adaptation to the row width (25%) and four-wheel drive (25%).

Table 7: Attributes of the LSTs among interviewed farmers.

Technology	Attributes	Farmers percentage (%)
Planter	Height	33.3
	Mechanism of planting seeds	22.3
	Weight	22.2
	Seed container	22.2
Ox-plough	Mode of operation	36.8
	Sharp share	31.6
	Height	19.3
	Handles	8.8
	Weight	3.5
Groundnut sheller	Fan	38.9
	Hopper	33.3
	Height	27.8
Oil expeller	Motion controller	62.5
	Hopper	37.5
Tractor	Engine	25
	Tires	25
	Adaptation to the row width	25
	Four-wheel drive	25

4.2.5 Benefits of the labor-saving technologies

Each of the LSTs had its own benefits as reported by the farmers (Table 8). Survey shows that the most reported benefit of using planters was convenience (41.7%), here the farmers asserted that planters were easy to handle with very little complications and that anyone could use it. Also, 25.0% of the farmers reported that the planters were time saving, indicating that farmers used a short period of time to plant a unit area (days/ha). Other reported benefits of the planters as being less tedious (16.7%), ability to plant a large area (8.3%) and ability to follow the recommended planting space (8.3%).

Results further showed that, for the ox-plough the most reported benefit was time saving (39.4%). Farmers also reported easier management of labor (14.2%) whereby farmers used less labor hence it was easy to supervise them. Also, ox-plough makes weeding activity easier (10.6%) here the farmers asserted that during ploughing, weeds were buried, this controlled and delayed their growth. The least reported benefits were: - making large ridges (3.2%), helps in maintain soil fertility (3.2%) through turning over the soil and bringing fresh nutrients to the surface. Also, some (1.8%) farmers earned income through renting the ox-plough to other farmers (Table 8)

Most reported benefits for the groundnut sheller included time saving (45.2%) and less labor cost (35.7%). Here, farmers asserted that it was cheaper to use groundnut sheller as compared to when using human labor. Other reported benefits included making work easier (11.9%), compost from the shells (4.8%) and earning income (2.4%).

Benefits of oil expeller included time saving (58.3%), less labor cost (25.0%) and addition of value (16.7%). For the tractor, farmers reported benefits like cultivation of large area (28.6%), makes weeding easier (28.6%), time saving (28.5%) and easy to make ridges (14.3%) (Table 8).

Table 8: Benefits of the LSTs among interviewed farmers.

Technology	Benefits	Farmers percentage (%)
Planter	Convenience	41.7
	Time saving	25.0
	Less tedious	16.7
	Plants large area	8.3
	Observes planting space	8.3
Ox-plough	Time saving	39.4
	Easier management of Labor	14.2
	Makes weeding easier	10.6
	Cultivates large area	7.8
	Good Ploughing depth	5.5
	Tillage the soil well	5.0
	Perform multiple task	4.7
	Increase productivity	4.6
	Make large ridges	3.2
	Helps maintain soil fertility	3.2
	Earn income	1.8
Groundnut sheller	Time saving	45.2
	Less labor cost	35.7
	Makes work easier	11.9
	Fertilizer from the shells	4.8
	Earn income	2.4
Oil expeller	Time saving	58.3
	Makes work easier	25.0
	Addition of value	16.7
Tractor	Cultivates large area	28.6
	Makes weeding easier	28.6
	Time saving	28.5
	Easy to make ridges	14.3

4.2.6 Weakness of labor-saving technologies

The most reported weakness for planter was that it drops a lot of seed in a single hole (40.0%), it is heavy to carry (30.0%), tires sink in the soil (10.0%), high fuel consumption (10.0%) and difficulty to push when planting (10.0%) (Table 9). For the ox-plough the most reported weakness was its heaviness to lift (39.7%), difficult to plough in hard soil (19.0%), leaves gaps during ploughing (17.5%) this happens when there are stumps left in the farm, also it is only suitable for farmers with cows (12.7%). The least reported weakness of the ox-plough was: - tires sinking in the soil (4.8%), not durable (4.7%) and difficulty to get spare parts (1.6%). The weaknesses for the groundnut sheller reported by farmers included high breakage percent (60.0%), failure to shell all kernels (30.0%), not durable (5.0%), and small fan (5.0%) here the farmers explained that the fan was too small to produce enough energy (wind) to separate the grain from the shells. Farmers (22.3%) reported that the oil expeller was not specifically for groundnut, small cooling drum (22.2%), it lacks oil filter (22.2%). Other weakness included ineffective oil extraction (11.1%) farmers explained that the machine failed to fully extract oil from the grain, poor quality oil (11.1%), small capacity of the machine (11.1%) here farmers reported that it could not work for long hours. All (100%) farmers reported that tractors were inconvenient meaning that it needs a high skill to operate (Table 9).

Table 9: Weakness of LSTs among interviewed farmers.

Technology	Weakness	Farmers percentage (%)
Planter	Drops a lot of seed	40.0
	It is heavy to carry	30.0
	Tires sinks in the soil	10.0
	High fuel consumption	10.0
	Difficult to push	10.0
Ox-plough	Heaviness to lift	39.7
	Difficult to plough in hard soil	19.0
	Leaves gaps during ploughing	17.5
	Suitable for farmers with cows	12.7
	Not durable	4.8
	Tires sink in the soil	4.7
	Difficult to get spare parts	1.6
Groundnut sheller	High breakage percent	60.0
	Failure to shell all kernels	30.0
	Not durable	5.0
	Small fan	5.0
Oil expeller	Not specifically for groundnut	22.3
	Lacks filter	22.2
	Small cooling drum	22.2
	Ineffective oil extraction	11.1
	Poor oil quality	11.1
	Small capacity of the machine	11.1
Tractor	Inconvenient	100

4.2.7 Suggestions by farmers on Improvement of Labor-saving technologies

Farmers proposed different improvements for the weakness that they observed in the LSTs. Table (10) shows that the most suggested improvements for the planter included seed metering device (75%) to control the number of seeds for each hole. Other suggestions included reduced weight (12.5%) and invention of manual operated planters (12.5%). The most suggested improvement for the ox-plough was to reduce the weight of the ox-plough (59.2%), availability of spare parts (14.3%), increase its durability (12.2%), sharpness (8.2%) to facilitate smooth plough even in hard soils. The least reported suggestions included extra wheel (2.1%) to facilitate easy transportation to the field, medium height (2.0%) and bigger wheels (2.0%).

Results show that for the groundnut sheller farmers suggested that it should be more durable to reduce the breakage rate (50%), improvement to the fan (33.3%), increase the motor size (8.4%), make spares durable (8.3%). For the oil expeller, farmers suggested effective extraction of oil from the grain (50%), make specific oil expeller for groundnut (33.3%), large cooling drum (8.4%), installation of oil filter (8.3%). Farmers (100%) suggested that tractor should be convenient to local use (Table 10).

Table 10. Suggested improvements for the LSTs.

Technology	Suggestions	Farmers percentage (%)
Planter	Seed metering device	75
	Less weight	12.5
	Invention of manual operated planters	12.5
Ox-plough	Less weight	59.2
	Availability of spare parts	14.3
	Increase its durability	12.2
	Sharp share	8.2
	Bigger wheels	2.1
	Medium height	2.0
	Extra wheel	2.0
Groundnut sheller	Low breakage percent	50
	Improved fan	33.3
	Big motor	8.4
	Durable spare parts	8.3
Oil expeller	Enhance capacity to extract oil	50
	Oil expeller for groundnut	33.3
	Large cooling drum	8.4
	Installation of oil filter	8.3
Tractor	Convenient	100

4.2.8 Suggestions for future use at scale

To increase the uptake of the LSTs in future, farmers provided different suggestions as shown in table 11. Amongst the key suggestions were knowledge dissemination (75.0%), and availability of planters (25.0%). Table (11) shows that for the ox-plough there should be seminars (37.2%), subsidies on the ox-plough price (34.6%), increase availability of ox-plough (25.6%) and more machine assemblers (2.6%). For the groundnut sheller most farmers suggested future seminars (37.5%), availability of more shellers (33.3%) and demonstrations (20.8%) as fundamental to its upscaling. Availability of more oil expellers (38.5%), seminars (30.8%) and demonstrations (23.1%) were mentioned as important factors that would increase the uptake of oil expellers. For the tractors suggestions included lower prices (66.7%) and deployment through projects (33.3%).

Table 11: Suggested future use at scale.

Technology	Future use at scale	Farmers percentage (%)
Planters	Knowledge dissemination	75.0
	Availability of planters	25.0
Ox-plough	Seminars	37.2
	Subsidies on the ox-plough	34.6
	Increase availability of ox-plough	25.6
	More machine assemblers	2.6
Groundnut shellers	Seminars	37.5
	Availability of more shellers	33.3
	Demonstrations	20.8
	Capital	4.2
	More machine assemblers	4.2
Oil expeller	Availability of more oil expellers	38.5
	Seminars	30.8
	Demonstration	23.1
	Flyers	7.6
Tractors	Lower prices	66.7
	Deployment through projects	33.3
Total		100

4.3 Farmer's perceptions on Labor-saving technologies

Findings show that the interviewed farmers were very satisfied with the oil expellers and tractors and categorized them as very useful LSTs, despite their minor challenges (Table 12). They also were satisfied with the groundnut shellers, ox-plough, and planters. However, the planter had the least perceived satisfaction of all LSTs, because of its poor design especially with the iron tires which sink when planting operations are carried out. Women were dissatisfied with planters and ox-plough while the youth were satisfied with planter and ox-plough. The perceived difference between women, men and youth arose due to (i) manual operation for both ox-plough and planter which is difficult for women. Also, (ii) cultural ties, that do not allow women to carry or operate heavy objects.

The farmers' perception on the easy usability of the oil expellers was indifferent or neutral because it required more training and skill for operation. Additionally, farmers signaled that operators had limited skills hence failed to carry out the operation smoothly. Similarly, oil expellers were perceived inappropriate to intended use compared to other LSTs under this study. The major reason was the Oil expellers lacked oil filters which elongated the oil extraction process to 72 hours compared to only 15 to 30minutes if it had a filter.

Table 12: Farmers' weighting of the perceptions on the LSTs.

Variable	Groundnut shellers (n=4)	Oil expellers (n=2)	Ox-plough (n=96)	Planter (n = 12)	Tractors (n=2)
Easiness to use	4.25	3	4.7	4.3	4
Fitness to intended use	4.25	3	4.9	4.5	5
Affordability	2.5	3	3.25	2.7	5
Adopted to multiple use	3.5	3.5	3.9	3.5	5
Acceptability by farmers	4.75	4.5	4.8	4.2	5
Women perception	-	-	1.5	2.2	-
Youth perception	-	-	4.6	4	-
Men perception	-	-	5	4.5	-
Overall perception	4.75	5	4.8	4.5	5

Note: Figures in the table are averages of weights attributed by the indicated number of farmer responses by their categories (n). The study used a five-point scale, where higher values indicate higher importance. Cell with 'colors' means no perception capture

4.4 Comparing the farmers' resource (such as time and finances) use associated with the traditional tools versus the Labor-saving technologies (LST).

4.4.1 Time taken to plough using traditional tool (hand hoe) vs labor-saving technologies (ox-plough & tractor)

Table (13) shows that there is a significant difference (t (140) =20.9, p=0.000) in the time taken to plough between farmers using Traditional tools and farmers using LST. The mean difference suggests that farmers using traditional tools (M= 5.25, SD =1.7) used more time as compared to farmers using LST (M= 1.2, SD = 0.08).

Table 13: t-test Results comparing ploughing time using traditional tools and LST.

	Mean	SD	t	df	p
Traditional tools	5.25	1.7	20.9	140	0.00
LST	1.2	0.08			

4.4.2 Cost of ploughing using hand hoe vs ox-plough and tractor

Results show that there was no significant difference in the mean cost of ploughing (t (184.6) = 1.8, p = 0.06) despite farmers using traditional tools having higher cost (M = 38940, SD = 16986.5) than farmers using LST (M = 34911, SD = 13320) (Table 14).

Table 14: t-test Results comparing ploughing cost using traditional tools and LST.

	Mean	SD	t	df	p
Traditional tools	38940	16986.5	1.8	184.6	0.06
LST	34911	13320			

4.4.3 Time taken to plant using hand hoe and bare hands vs planter

Results from Table (15) shows there is a difference in mean time taken to plant using traditional methods (M=4.07, SD=1.9) and using LST (M = 1 SD=1). Time taken to plant groundnut using traditional methods was longer than that of LST, and the mean difference was large enough to be statistically significant (t (99) =0.000, t=1.9) (Table 15).

Table 15: t-test Results comparing planting time using traditional tools and LST.

	Mean	SD	t	df	p
Traditional tools	4.07	1.9	15.3	99	0.00
LST	1	1			

4.4.4 Cost of planting using hand hoe and bare hands vs planter

Results reveal that, on the cost of planting groundnut the mean score for the traditional tool (M=24930 SD = 13370) was higher than the mean for farmers using LST (M=19285 SD = 8864). However, this difference was not statistically significant (t (8.05) = 1.5, p = 0.15) Table (16)

Table 16: t-test Results comparing planting cost using traditional tools and LST.

	Mean	SD	t	df	p
Traditional tools	24930	13370	1.5	8.05	0.15
LST	19285	8864			

4.4.5 Time taken to shell groundnut using Traditional tools (bare hands) vs Labor-saving technologies (groundnut sheller)

In comparison to the shelling time, it was observed that there was a mean time between farmers using tradition tools (M = 3.9, SD = 0.47) and those using LST Farmers (M = 1 SD = 1) (Table 17). Results shows that the difference was significant (t (98) = 60.8, p = 0.00). This indicates that farmers using traditional shelling methods used more time to shell the groundnuts compared to farmers who used LST.

Table 17: t-test Results comparing shelling time using traditional tools and LST.

	Mean	SD	t	df	p
Traditional tools	3.9	0.47	60.8	98	0.00
LST	1	1			

4.4.6 Cost of shelling using bare hands vs groundnut sheller

At $\alpha = 0.05$ level of significance, there is enough evidence to conclude that the mean shelling cost is different for farmers using traditional tools (M = 5503 SD = 4188.6) and farmers using LST ((M = 2400 SD = 1365.3). Table (18) shows that the difference was significant (t (63.8) 5.6 p= 0.00). This indicates that farmers that shelled groundnut by using traditional tools incurred higher cost as opposed to farmers who used LST.

Table 18: t-test Results comparing shelling cost using traditional tools and LST.

	Mean	SD	t	df	p
Traditional tools	5503	4188.6	5.6	63.8	0.00
LST	2400	1365.3			

4.4.7 Agronomic practices and grain productivity by technologies across the zones

This study revealed that in farms where farmers did not apply LSTs, it is hard for them to follow the recommended practices such as seed spacing. For the farmers who used traditional tools and practices, their farms had a wide distance between lines (15cm to 30cm) and between rows (60 cm to 90cm) (Table 19). Conversely, those farmers who applied the LSTs had farms with close seed spacing of 10cm to 20cm between holes and 50 cm between lines. Moreover, in the Southern Highland a peculiar farming practice was observed. Here, a farmer after cleaning his/her farm, seeds were broadcasted (Bd) first then ploughing of the farm followed. Similarly, farmers who used ox-ploughs in this zone, the ploughing of the farm was carried simultaneously with planting of seeds. Here, ox-plough being pulled by oxen comes first then a farmer follows behind while throwing seeds at an estimated seed spacing of about 10cm.

Table 19: Technologies and seed spacing among interviewed farmers by zones.

Zone	Use of traditional tools			Use of LSTs		
	Seed spacing hole to hole (cm)	Seed spacing line to line (cm)	Productivity (kg/ha)	Seed spacing hole to hole (cm)	Seed spacing line to line (cm)	Productivity (kg/ha)
Lake zone	25 – 30	75 - 90	300	10	50	600
Central zone	15- 25	70	575	10	50	1,050
Southern Zone	20-30	75	600	10	50	1,200
Southern Highland	Bd	Bd	650	10	20	771
Western Zone	15 – 20	60	350	10	50	750

4.5 Discuss policy environment for Labor-saving technology in the country.

4.5.1 Awareness among extension agents on policies which promote the use of LSTs.

Findings show that 80% of the interviewed extension officers are aware of some policies which promote the adoption and use of Labor Saving in Agriculture (Table 20). Conversely, about 20% of them were not aware of any policy which promotes the use of LSTs. The extension officers who were aware of some policies, explained that Nanenane Agricultural Exhibition is the most popular public arrangement which is effective in promoting labor-Saving technologies (Table 20). In these exhibitions new technologies, ideas, discoveries, and alternative solutions concerning agricultural sector are displayed across regions in the country every year.

Table 20: Policy awareness among extension officers concerning promotion of LSTs.

Variable	Percentage (%) of awareness	Type of policies
Aware	80	Nanenane Agricultural Exhibition
Unaware	20	none
Total	100	-

4.5.2 Small Industries Development Organization (SIDO) with LSTs

Nanenane exhibitions are comprehensive because they cover all technologies under the agricultural sector. However, the development and promotion of such technologies in the country goes beyond such exhibitions in the agricultural sector. The promotion of technologies includes, but not limited to three ministries which work closely to achieve the potential performance in agriculture. These ministries are the Ministry of Agriculture, Ministry of Finance, and the Ministry of Trade, Industry and Investment which play important roles to ensure farmers, companies and individuals benefit from Agricultural technologies (Figure 3). Under the ministry of Trade, Industry, and Investment we find all types of labor-saving technologies both imported and locally manufactured. Also, under the same ministry, there exists a government Small Industries Development Organization (SIDO), which develops the small industry sector in the country. SIDO recognizes SMEs development as a key avenue for realizing national economic and socio development objectives of growth and employment. The organization has many functions grouped into 3 broad categories: Coordination, industrial development, and extension. The extension functions include (i) make provision to technical services for improving technical process production planning, selecting appropriate machinery, and preparing factory lay-out and design; (ii) provide consultancy and training services to strengthen the competitive ability of small-scale industries; (iii) provide marketing platform which assistance to small-scale industries to effectively sell their products. This study further found that SIDO provides loans to start up industries from their accounts or provides guarantees to small industries to obtain loans from commercial banks (Figure 3; relations 2, 3 & 4). On the other hand, farmers, seed companies, individuals benefit from the skills imparted the government through either TARI, TARILI, Universities, or local governments. Similarly, SIDO works jointly with institutions (TARI, PASS, TARILI, Universities and local governments) in the ministry of agriculture in promotion of LSTs.

4.5.3 Feedback of Small Industries Assembling LSTs And TLIII Project

In this study, three small industries which assemble various machines for agricultural crops were contracted by TARI in collaboration with ICRISAT under TLIII project to assemble LSTs (Table 20). These small industries were the Intermech Ltd in Morogoro district and other two in Kahama district known by individual names. They assemble groundnut shellers, planters and oil expellers. Their main buyers are the groundnut farmers, traders, companies, and institutions like TARI. Buyers are found in the Western zone (Tabora and Kigoma regions), Central zone (Dodoma and Singida regions) and Lake zone (Shinyanga region). Other buyers are found in the Southern Highlands (Rukwa and Katavi regions). In all these regions groundnut is highly produced. However, these have policy related constraints which include (i) limited electricity (ii) limited credit from institutions in contract (iii) delayed payments from buyers (iv) spare parts being too expensive (Table 20).

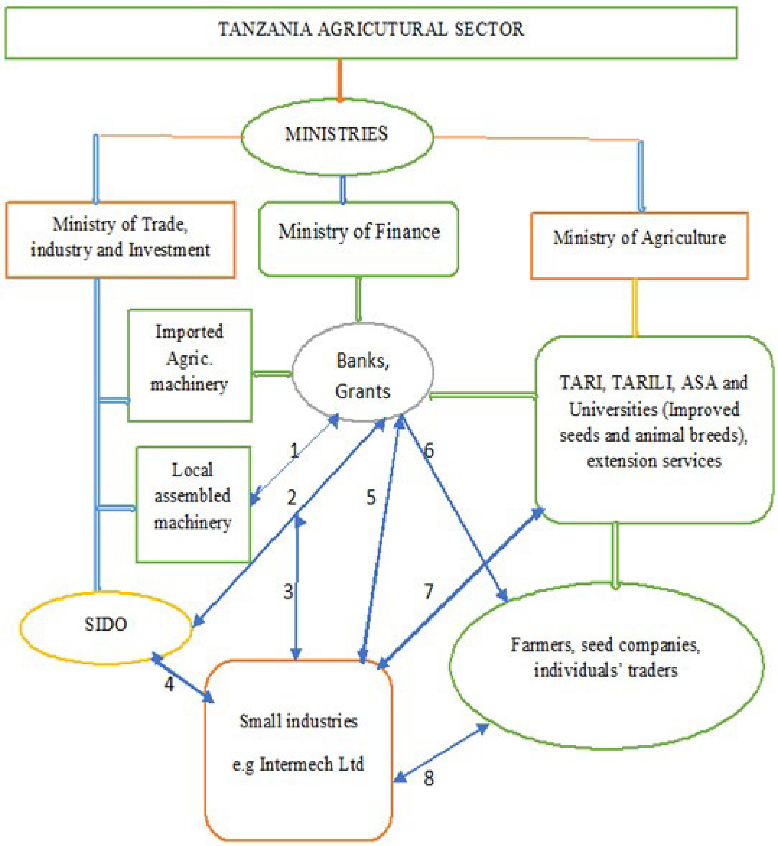


Figure 3: Organizations, roles and, linkages in the agricultural sector

Table 21: Technology manufacturers and their details.

Variable	KAHAMA-Industry 1	KAHAMA-Industry 2	Morogoro manufacturer
Technologies Manufactured	Groundnut sheller & Peanut butter machine	Groundnut sheller & Peanut butter machine	Groundnut sheller, Planters, Oil expeller & Peanut butter machine
Main buyers	Groundnut traders & farmers	Groundnut traders & farmers	Research institution-TARI, Individual, Farmers, Processors, Shelling merchants
Consuming regions	Shinyanga, Rukwa, Singida	Tabora, Shinyanga, Singida, Katavi	Dodoma, Tabora
How to meet buyers	Networking with current buyers	Networking with current buyers	Participation in exhibition, Networking with buyers, institutional linkages
Information	Reach customers at their location, phone contacts	Reach customers at their location, phone contacts	Flyers, Exhibition, SIDO
Cooperation with other stakeholders	Communicate with other machine makers	Communicate with other machine makers, Ask various groundnut size, Institution for small groups	Sokoine University, Ministry of Agriculture, UDSM, IITA, TARI Naliendele
Manufacturing Challenges	Customers want products in short time, unfriendly environment-theft, Lack of power, expensive spares	Fluctuation of input price	Uncertain demand, high cost of inputs, Little knowledge of farmers on maintenance
Marketing challenges	Customers are seasonal, customers are not reliable	Delayed pay by customers customer care costs,engagement with customers	Limited credit from the buyers especially institutions, Lack of resources to reach out to more people

Chapter 5

Conclusion and Recommendations

5.1 Conclusions

The current study was conducted to assess farmers' perceptions on groundnut labor-saving technologies in Tanzania. The study involved with 4 objectives namely (i) identify the labor-saving technologies used by groundnut farmers, (ii) investigate farmers perception on the LST, (iii) compare the farmers' resource (such as time and finances) use associated with the traditional tools versus the labor-saving technologies (LST) and finally, (iv) discuss the policy environment for labor saving technology in Tanzania.

Findings reveal that Ox-plough is the most (74.6%) used labor saving technology. This is followed by groundnut shellers (12.7), Oil expellers (5.9%) Planters (5.1%), and Tractors (1.7%). Results further show that majority (100%, 53.3%, and 71.4%) of the farmers acknowledged that Planters, Groundnut shellers and Oil expellers were new to them and their communities alike. Besides, farmers reported several advantages in using the LSTs. The common advantages listed include time saving, reduced labor costs and increased efficacy and efficiency.

Despite their benefits, several weaknesses were also observed. The planter was reported to drop more seeds than required in one hole (40%), heavy to carry (30%), tires sink in the soil (10%), and difficult to push when planting (10.0%). Using the same lense, Ox-ploughs were said to be heavy to lift (39.7%), difficult to plough in hard soil (19.0%), and left gaps during ploughing (17.5%). Also, groundnut sheller weaknesses reported by farmers included high breakage (60%), failure to shell all kernels (30%), not very durable (5%), and small fan (5%). On oil expellers farmers (22.3%) found that the oil expeller was not specifically for groundnut, had a small cooling drum (22.2%) and lacked an oil filter (22.2%). Other weakness included ineffective oil extraction (11.1%), poor quality oil (1%), and small capacity of the machine (11.1%).

Regarding LSTs satisfaction by age and sex, farmers beyond 35 years were more satisfied than those 35 years and below. Meanwhile, male farmers were more satisfied by LSTs than females, because of their heaviness to carry or operate and cultural ties. Finally, the policy environment was supportive to the promotion of LSTs through public arrangements including Nanenane Shows and establishment of SIDO. However, the policy environment is challenged by (i) Limited awareness among stakeholders (ii) Limited funds in SIDO to carry enough promotion and support to small industries. Also, (iii) Small industries had limited fund for research and outreach activities.

5.2 Recommendations

This study recommends the following options to be worked upon to upscale the groundnut production in Tanzania.

I. Promotion of new LSTs needs to be enhanced (planters, groundnut shellers, and oil expellers), especially by SIDO.
II. Machinery assemblers need to improve their connection with farmers to monitor the performance of the LSTs especially the new ones (planters, groundnut shellers, and oil expellers) and receive feedback from farmers for further improvement.
III. Awareness creation among farming communities on eradication of poor cultural practices which hinder women, youth, and entire community to benefit from LSTs.
IV. Development organizations and government to allocate more funds for SIDO to increase their ability to widen outreach in the country.

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About

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a pioneering, international non-profit scientific research for development organization, specializing in improving dryland farming and agri-food systems. The Institute was established in 1972, by a consortium led by the Ford Foundation and the Rockefeller Foundation and with the support from the Government of India. ICRISAT works with global partners to develop innovative science-backed solutions to overcoming hunger, malnutrition, poverty and environmental degradation on behalf of the 2.1 billion people who reside in the drylands of Asia, Sub-Saharan Africa and beyond.

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