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The Managing Editor, Sokoine University of Agriculture

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# Economic Viability of Improved Fodder Production in Iringa Region: Comparative Cost - Benefit Analysis of Different On-Farm Treatments

Mbwaga, A.I<sup>1\*</sup>, Mgeni, C.P.<sup>2</sup> and Kadigi, R.M.J.<sup>3</sup>

## Abstract

Inadequate fodder production and availability has been a challenge to the livestock farmers in Tanzania. This study assessed the economic viability of fodder production using on-farm treatments at ASAS farm in Iringa region. A Completely Randomized Design was employed to arrange 24 sub-plots (six treatments and four replications) in plots of 10m x 10m dimension making a 100m<sup>2</sup> which is equivalent to 0.025 acres. Sub-plots were spaced each at 0.5m apart from the adjacent plot by a 1m wide path around the plot's boundaries receiving different treatments of fertilizer. The total area for Rhodes's grass (*Chloris gayana*) study was 2835m<sup>2</sup>. The seeds were sown in each plot and fertilizers were applied in Treatment two -Cattle Farm Yard Manure (T2-CFYM), T3 (CFYM)+Nitrogen, Phosphorus, Sulphur, and Zinc (NPSZn), T4 (NPSZn), T5 (NPSZn)+Sulphate of Ammonium (SA) and T6 (NPSZn + Urea) while T1 remained as a control (no fertilizer). Through Microsoft Excel, Cost-Benefit Analysis was done to assess the economic viability of each treatment. The study findings revealed that Treatment 3 and Treatment 6 of the experiments yielded positive Net Present Values (NPVs) of TZS 346 601.3 and TZS 1 324 442; Benefit Cost Ratios (BCRs) of 1.46 and 1.72; and Internal Rates of Return (IRR) of 15% and 16%, respectively. It is concluded that the application of T3 and T6 to the Rhodes grass would improve fodder profitability. It is recommended that with the experiment, large and smallholder farmers may produce enough fodder for themselves and surplus for sale to other livestock keepers.

**Key words:** Production treatment, Fodder production, Rhodes, Cost-Benefit Analysis (CBA)

## 1 Introduction

Knowledge of economics of improved fodder production is essential for large and smallholder farmers involved in livestock keeping and the dairy sector. Due to economic benefits arising from the livestock sector and dairy industry, companies and individuals have invested in livestock keeping and milk production in Tanzania. According to FAO (2020), Tanzania is an agricultural country with nearly three-fourths of its population depending on crop production and livestock keeping for livelihood. The country has the

<sup>1</sup>Department of Economics and Statistics, Moshi Cooperative University, Tanzania.

<sup>2</sup>Department of Agricultural Economics and Agribusiness, Sokoine University of Agriculture, Tanzania.

<sup>3</sup>Department of Trade and Investment, Sokoine University of Agriculture, Tanzania

\*Corresponding Author: [aureliaissack@gmail.com](mailto:aureliaissack@gmail.com)

second largest livestock population in Africa standing at 39.9 million cattle, 99.6% of which are indigenous cattle breeds, 24.5 million goats, 8.5 million sheep, 3.2 million pigs, and 87.6 million chickens (URT, 2021). In general, the country has a competitive advantage in the livestock subsector due to the size of the aforementioned animals. This provides a huge opportunity for fodder production. However, according to URT (2019), the opportunity for commercial fodder production, within the dairy sector is largely unexploited.

The dairy industry is a potential subsector in Tanzania as it contributes 30% of domestic production in the livestock sector and about 1.2% of the national Gross Domestic Product (GDP) (URT, 2017). The total annual milk production is currently estimated to stand at 2.7 billion litres (URT, 2019). Apparently, milk production is still low in Tanzania largely due to increasing cost of production compared to the per capita milk consumption. The per capita milk consumption is 47 litres per year, which is far less than the World Health Organisation (WHO) recommendation of 200 litres (URT, 2019). The low milk production has been associated with problems such as animal health and reproductive problems, lack of good quality animal feed, insufficient quantities and limited supply of dairy cattle (Njombe *et al.*, 2011; Swai and Karimuribo, 2011; Kabirizi *et al.*, 2013; Abdisa, 2018). Lack of good quality feed is reportedly one of the major contributors of low milk production in Tanzania because large and smallholder dairy farmers do not often meet their all-year-round feed demand from on-farm production (Waziri and Uliwa, 2020) attributable to poor fodder production practises. This concern, partly constitutes the motivation for this study which assesses the economic viability of improved fodder production under different treatments.

Several studies have been conducted on dairy farming in Tanzania. For instance, a study by Notenbaert *et al.* (2020) that focused on environmentally sound intensification pathways for dairy development; a study by the Ministry of Livestock and Fisheries (MLF) (2019) on economics of livestock sector in Tanzania (URT, 2017) and a study by Njombe *et al.* (2011) that explored milk and fodder production identification in Tanzania. Generally, these studies have recommended production of fodders to livestock farmers so as to reduce the scarcity of fodders during dry seasons. For the farmers to increase milk production and their associated by-products, fodder production is important. Producing fodder and other feeds to animals may lead to an increase of 6 to 8 litres of milk per day (URT, 2019). Similarly, improved milk production may lower the cost per litre produced and this may reflect a stronger profit margin for commercial milk producers (Sikumba and Maass, 2015; URT, 2019). Considering this view, there have been different efforts by the government of Tanzania and other stakeholders (companies and individuals) to provide education and emphasis on fodder production (URT, 2016). Some of these companies include, among others, ASAS Dairies Farm Limited and Tanga

Fresh Limited in Iringa and Tanga regions, respectively. ASAS, in particular, went further to undertake experiments on different fodder production systems by applying different treatments (for example application of fertilizers) to measure the costs and benefit of fodder production. To that effect, the current study was designed to among other, determine the viability of fodder production being experimented at ASAS Dairies Farm Limited from different treatments.

The theory of Cost-Benefit Analysis (CBA) provides the theoretical basis of this study. CBA in economics is a very important, appropriate and popular method of appraising investments at micro and macro level (Papendiek *et al.*, 2016). CBA serves two purposes: first, it determines the soundness of investments; second, it forms the basis for comparing projects (Kashangaki and Ericksen, 2018). CBAs are expressed in monetary terms and are adjusted for the Time Value of Money (TVM) so that all flows of project costs over time are described on a typical basis in terms of their Net Present Value (FAO, 2016). This theory was adopted in this study because it is appropriate for analysing costs and benefits of an investment by comparing the same with alternatives. Adoption of this theory was based on such studies as Islam *et al.* (2017) that calculated profits in terms of gross returns, gross margin, net returns, and benefit cost ratio and concluded that fodder production along with dairy cattle was profitable and increased employment opportunities. A similar study by Lukuyu *et al.* (2013) used the CBA approach to determine gross returns, gross margin, and net returns and conclude that labour constitutes the highest cost of production for all different technologies. Other similar studies that employed CBA include Papendiek *et al.* (2016) and Kadigi *et al.* (2021).

## **2 Methodology**

### **2.1 Research Site Description and Selection Criteria**

In this study, on-farm experiments were carried out at ASAS Dairy (Matembo) Farm, located about 25km from Iringa Municipality. This farm receives an average of 600-1000 millimeters (mm) of rainfall per annum (Appendix 1). ASAS Dairy farm was selected for the study due to on-going experiments on fodder production trials aimed at determining the most economical fodder production technology that can be used by the farm (ASAS) and other dairy farmers in Tanzania.

### **2.2 Research Design and Sampling Procedures**

This was an experimental (Completely Randomised Design-CRD) study in which six treatments with four random replications were studied by looking at inputs costs used in each treatment to produce fodders (output) out



of other agronomic practises. The treatments were assigned to the experimental units at random such that each treatment appears in each plot and each plot receives respective treatment.

The experiment consisted of twenty-four (24) sub-plots resulting from six (6) treatments with four (4) replications arranged in a randomised plot of 100m<sup>2</sup>. The treatments included no fertilizer (used as a control), Cattle Farm Yard Manure (CFYM), Cattle Farm Yard Manure mixed with NPSZn, NPSZn mixed with Sulphate of Ammonium and NPSZn mixed with UREA. These treatments were applied on Rhodes's grass as selected forage to be established. Each subplot (replicate) had 10m x 10m dimension making a 100m<sup>2</sup> which is equivalent to 0.025 acres each spaced 0.5m apart from the adjacent plot. Each plot received different treatments of fertilizer and there was a 1m wide path around the plot's boundaries. The total area for Rhodes's grass study was 2 835m<sup>2</sup> for the layout (see Appendix 2).

## **2.3 Data Collection**

The experiment was carried out by ASAS in collaboration with researchers from the Sokoine University of Agriculture (SUA) from December 2020 to May 2021. The data collected include costs on seeds, hired labourers, manure, fertilizers, and transport while the fixed input costs were on land. These costs formed the basis for appraisal for each farming treatment for decision making. The sample was taken at the stage of flowering and the plants within each plot were cut with hand sickle to the ground level. Sub-samples averaging 350g fresh fodders from each treatment were weighed and taken to the laboratory for dry matter determination (Appendix 4). All the costs (variable costs such as labour, soil testing, transport, seeds, fertilizers and manure testing) were recorded throughout the experiment for analysis in Microsoft Excel.

## **2.4 Data Processing and Analysis**

Cost-Benefit Analysis (CBA) which is a discounted measure of project worthiness, that considers the Time Value of Money (TVM) was employed to determine viability of each block that received specified treatment. Net Present Value (NPV), Benefit-Cost Ratio (BCR) and Internal Rate of Return (IRR) were calculated and decisions were made by considering findings in each block (Appendix 3). The Rhodes grass production yields more grass in the second year of production until 6 years before removing all the grass in the farm (ILRI *et al.*, 2020), and for this study, 5 years were taken as a life span of the investment.

In Tanzania, interest rates decisions are taken by the Bank of Tanzania (BoT). As per Monthly Economic Review of July 2021 the BoT's official interest rate herein used as the discount rate was 5% (BOT, 2021). Social Discount Rate

(SDR) was very important to be determined in this study as it can take into account the spillover effect of the project. The European Commission (EC 2008) recorded a 5% SDR as a widely acceptable rate used as the opportunity cost of the capital. Moreover, in CBA, consideration of the country's inflation rate is inevitable; in April 2021, the inflation rate was recorded at 3.2% (BoT, 2021). For sensitivity analysis, the CBA was repeated using different discounting rates (3.2%, 5%, 8%, 9%, 10%, 11% and 12%). Because the interest rates change overtime, the sensitivity analysis was considered to examine how CBA changes under different discount rates (Appendix 2).

NPV was calculated using the formula in Equation (1)

$$NPV = \sum_{t=0}^n \frac{B_t - C_t}{(1+r)^t} \dots \dots \dots (1)$$

Where  $C_t$ =Cost in period t;  $B_t$ = benefit in period t, and r = discount rate in %

The investment is profitable or feasible if the calculated NPV is positive when the costs and benefits are discounted at the opportunity cost of capital and not feasible otherwise.

The Benefit Cost Ratio is calculated using the formula in Equation (2)

$$B/C \text{ ratio} = \frac{\sum_{t=0}^n \frac{B_t}{(1+r)^t}}{\sum_{t=0}^n \frac{C_t}{(1+r)^t}} \dots \dots \dots (2)$$

Where:  $B_t$ = benefit in period t;  $C_t$ =Cost in period t; r = discounted rate in % and t = investment period in years.

An investment with a BCR of 1 or greater is economically acceptable when the costs and benefits are discounted at the opportunity cost of capital.

The Internal Rate of Return was calculated using the formula in Equation (3)

$$IRR = r_1 + \left[ \{r_1 - r_2\} * \left( \frac{NPV_1}{NPV_1 - NPV_2} \right) \right] \dots \dots \dots (3)$$

Where  $r_1$ =lower discount rate,  $r_2$ =higher discount rate,  $NPV_1$ =Net Present value at lower discount rate,  $NPV_2$ =Net Present Value at a higher discount rate.

If  $NPV > 0$ , **Accept** the investment and If  $IRR > \text{cost of capital}$ , **accept** the investment.

### 3 Results and Discussion

#### 3.1 Costs of Rhodes Fodder Production from Different Treatments

In this study, the production costs included different variable costs such as land preparation, land valuation, hired labour, seeds and fertilizers for the six treatments each with an area of 400m<sup>2</sup>. The total variable costs of producing fodders were estimated to be TZS 163 324 in treatment one (T<sub>1</sub>); TZS 210 224 in treatment two (T<sub>2</sub>); TZS 216 984 in treatment three (T<sub>3</sub>); TZS 171 644 in treatment four (T<sub>4</sub>); TZS 175 228 in treatment five (T<sub>5</sub>), and TZS 180 484 in treatment six (T<sub>6</sub>). The variation of costs was based on different prices of inputs and other associated costs. Cost of seeds was TZS 20 000 per kg; NPSZn fertilizer, TZS 65 000 per 50kg; SA fertilizer, TZS 32 000 per 50kg and Urea fertilizer, TZS 6 500 per 5kg. Additional costs involved were soil and farm yard manure testing which amounted to TZS 81 750 and 81 000, respectively. Forage sample test at Tanzania Veterinary Laboratory Agency was TZS 420 000 for all forage samples and transportation cost was TZS 279 000 for the time of the experiment. Costs per treatment are as presented in Figure 1.

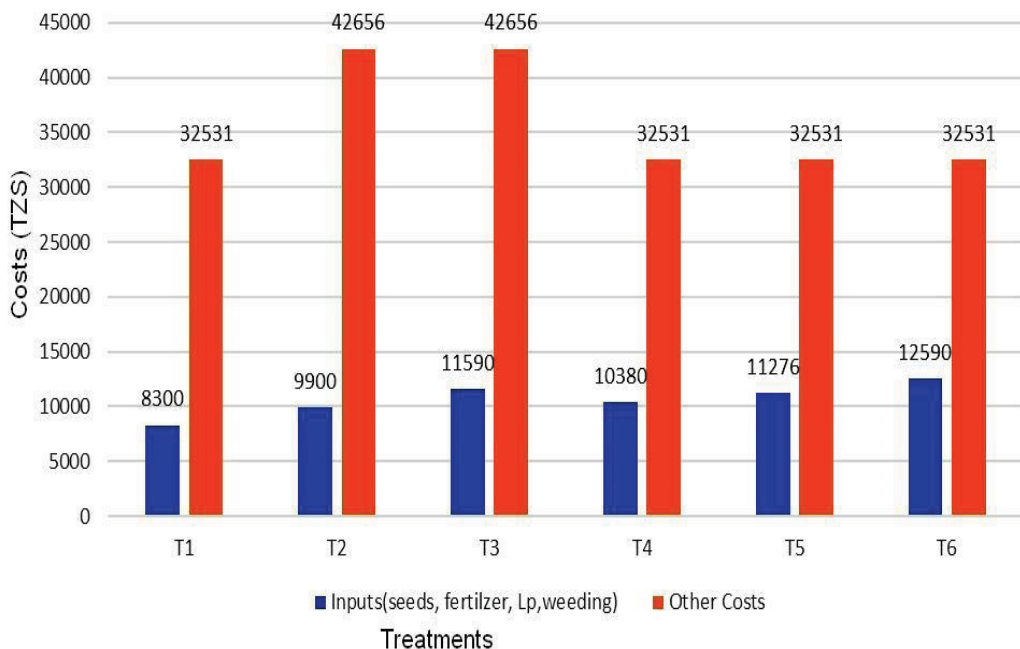


Figure 1: Variation of costs (TZS) by treatment: Plot of 10m x10m

Gross return was found to be different from all treatments for fresh, partially and totally dried fodder because of the differences in estimated yields and their respective prices. Therefore, the estimated yield price should not be the same for fresh, partially and totally dried fodders. However, a study conducted in Tanzania by Waziri and Uliwa (2020) shows that the price of Rhodes fodder (hay) was TZS 414 per kg, while a study by Lukuyu *et al.* (2016) shows the average price of fodder was TZS 3 500 per 15kg bale. Moreover, according to the SUA – Animal Science Department, the price of hay (Rhodes fodder) was 3 500 TZS per 15kg as of June, 2021. However, there was no enough information of prices for fresh forages in Tanzania even though smallholder farmers, during wet seasons, prefer to buy fresh forage and sometimes offer manure to producers to get fresh forage (Waziri and Uliwa, 2020). In this study therefore, the current market price was estimated to be TZS 233.33 per kg (hay).

### **3.2 Feasibility of using Different Fertilizers for Fodder Production (Two Cuts-Two Harvests per Year)**

The costs and benefits results based on plot level data were converted into costs and benefits for investing in one acre of fodder production. The CBA results for investing in one acre of land are presented in Figures 2 to 6 considering the discounting measurements for five years. In year zero, the investment costs tend to differ in all treatments due to the costs of fertilizers. For example, in T<sub>1</sub>, the investment costs were TZS 360 000 which include costs to acquire land, land preparation and costs of seeds while in T<sub>2</sub>, the investment costs were TZS 427 750, which include costs of additional fertilizer not included in T<sub>1</sub>, and therefore T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub> include all the costs in T<sub>1</sub> plus the costs of fertilizers which distinguish the treatments. Furthermore, the variable costs were high in year one for all treatments and this was because of labour costs which differ in all treatments.

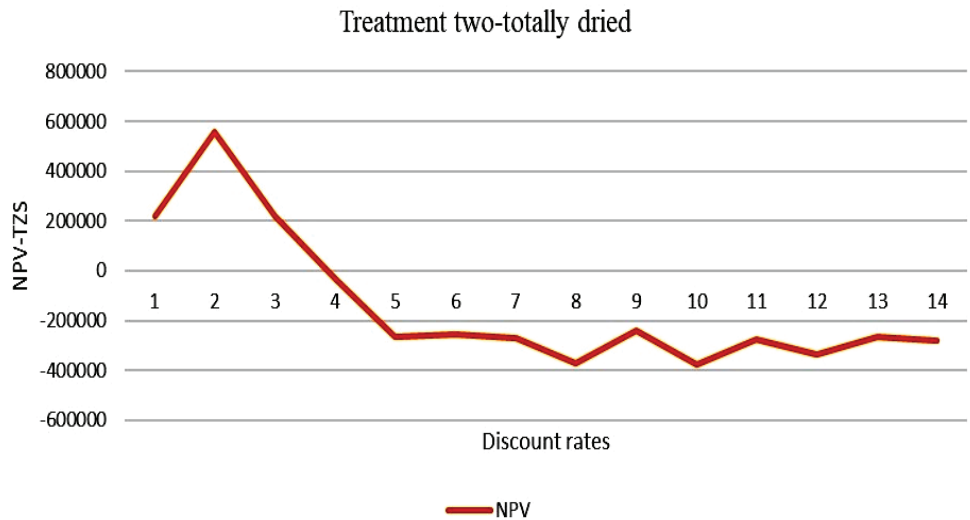


Figure 2: T<sub>2</sub> - A plot line of NPVs of T<sub>2</sub> at different discount rates per acre

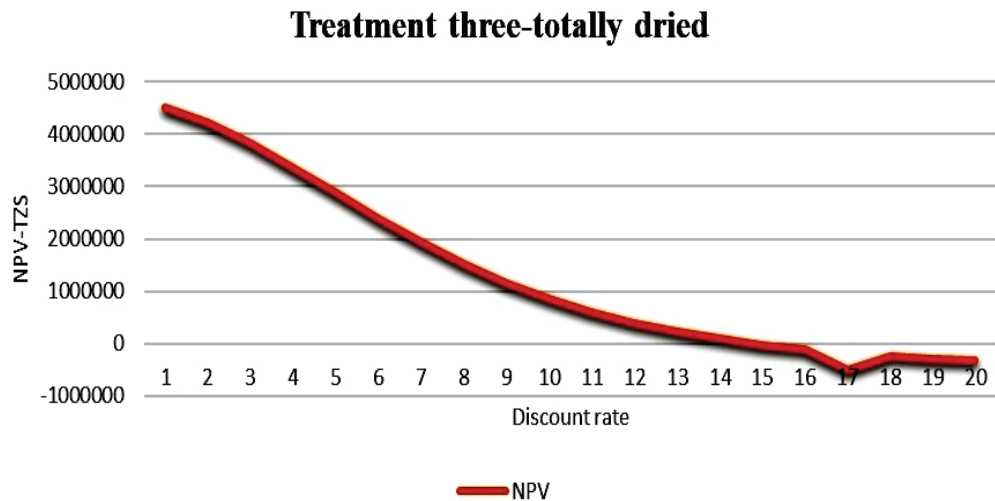
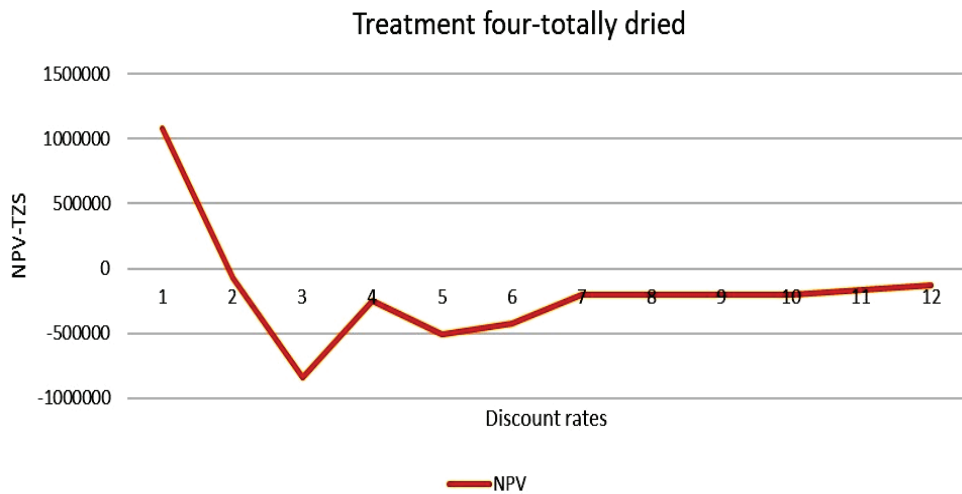
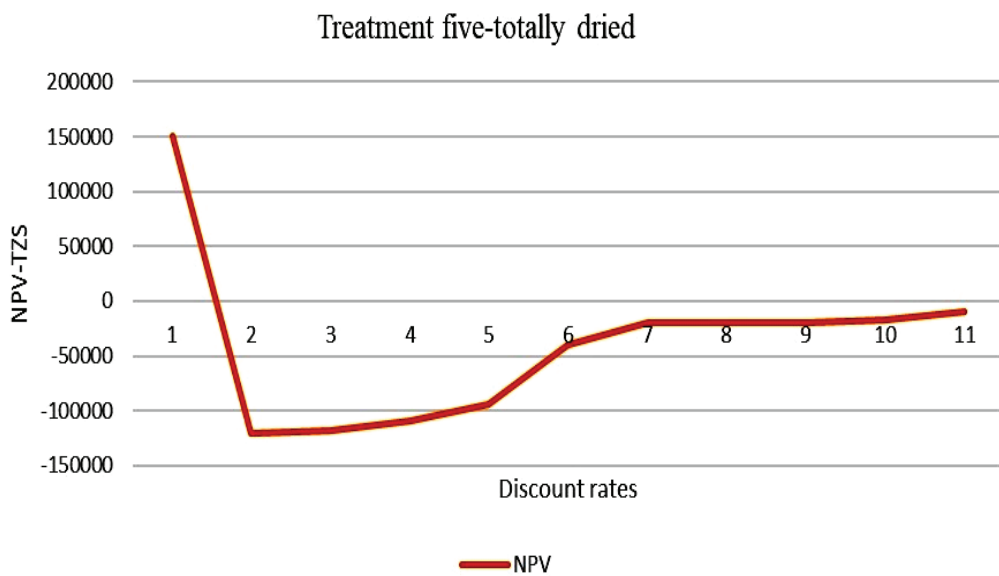


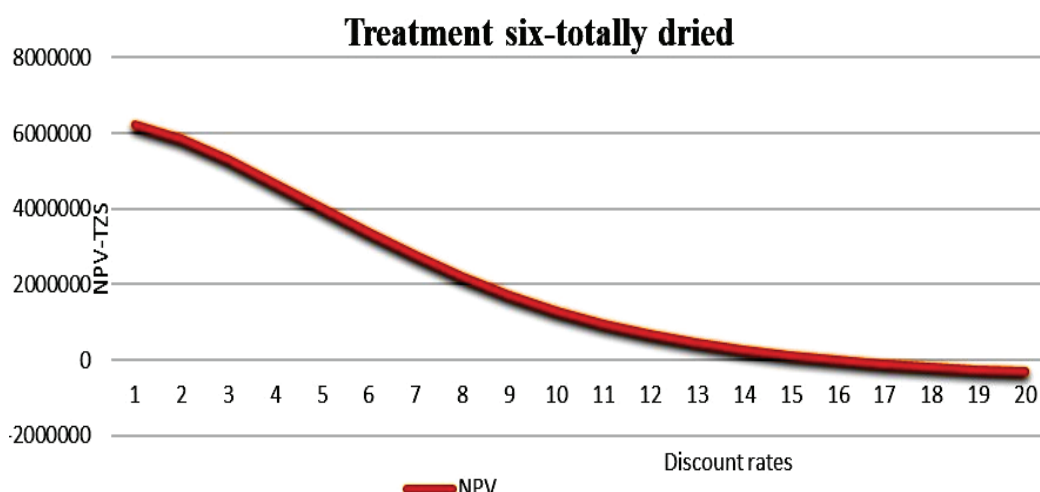
Figure 3: T<sub>3</sub> - A plot line of NPVs of T<sub>3</sub> at different discount rates per acre



**Figure 4: T<sub>4</sub> - A plot line of NPV s of T<sub>4</sub> at different discount ratesper acre**



**Figure 5: T<sub>5</sub> - A plot line of NPVs of T<sub>5</sub> at different discount ratesper acre**



**Figure 6: T6 – A plot line of NPVs of T6 at different discount rates per acre**

The findings indicated that in all treatments, the cost of seeds rarely changed and operating costs (variable costs) changed due to differences in the application of fertilizers from one treatment to another. For example, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub> were treated with a different type of fertilizer, thus, leading to variation in costs. Moreover, the Rhodes grass production outputs differ from all treatments (totally dried) as the estimation was based on the analysis of the one-acre farm size for each treatment. The T<sub>3</sub> and T<sub>6</sub> have potential advantages as the NPVs are positive, IRR is more than an 11% discounted rate which was used as a benchmark. Moreover, the BCR for T<sub>6</sub>, and T<sub>3</sub> are greater than one and this implies that based on BCR criteria, the investment was worth implementing. However, treatments T<sub>1</sub>, T<sub>2</sub>, T<sub>4</sub> and T<sub>5</sub> have BCR less than one and NPV negative at different discounted rates (8%, 9%, 10%, 11% and 12%) and therefore, were not feasible. At 3.2% and 5% discount rates, the NPVs were positive for T<sub>4</sub> and T<sub>5</sub>, respectively. This implies that T<sub>1</sub> was not feasible irrespective of discount rates used. Furthermore, the CBA indicates that the production treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub>) were feasible at a discount rate equal to the inflation rate (i.e.,  $r=3.2\%$ ) with positive NPVs (Appendix 3). The two production treatments (T<sub>3</sub> and T<sub>6</sub>) were viable even at a higher discount rate of 9%, yielding NPVs of TZS 694 549.2, TZS 1 211 366 per acre respectively. Overall, the results of comparisons of economic feasibility between the six production treatments indicated that the production treatments T<sub>3</sub> and T<sub>6</sub> were more profitable investments in terms of expected revenue than T<sub>1</sub>, T<sub>2</sub>, T<sub>4</sub> and T<sub>5</sub>.

If the farm management parameters and market prices of Rhodes grass hay remain constant, it is economical to produce fodder at a micro level or typical smallholder farmers who have about five acres of land (Kashangaki

and Ericksen, 2018; MLF, 2019; Waziri and Uliwa, 2020). Based on the results from the experiments which were used to estimate costs and benefits from an acre of land planted with fodder, harvested twice a year, smallholder farmers would profitably produce Rhodes grass by using either CFYM mixed with NPSZn or NPSZn mixed with Urea. Furthermore, smallholder farmers could get enough revenue/profits on the first year of cultivating the Rhodes grass (hay) and, therefore, they should pay attention to the improved fodders. At the macro level, the adoption of fodder farming over a five year investment would have economic viability to ASAS farms. The total benefits exceeded total costs in year one of implementation by implementing  $T_3$  and  $T_6$ . At the investment termination in year five, the total net benefit was TZS 1 037 147.37 and 1 391 818.45 for  $T_3$  and  $T_6$ , respectively but  $T_6$  was more profitable than other treatments and it is suitable for investment because  $T_6$  used the mixture of NPSZn and Urea which are considered to be the best fertilizers for the Rhodes grass production.

## **4 Conclusion**

The findings of this study showed positive NPVs for  $T_3$  and  $T_6$ , while  $T_1$ ,  $T_2$ ,  $T_4$  and  $T_5$  showed negative NPV (Appendix 3). In order to make a good decision and to see if the investment was viable, it was necessary to check on BCR and IRR. Similarly, the results indicated that for  $T_3$  and  $T_6$  the BCR was greater than one and IRR was greater than 11 percent. These findings implies that when hay is sold as totally dried at 233.33 TZS/kg within two seasons, smallholder farmers and ASAS farms will reap more benefits.

Findings from the six experimental plots show that dairy companies may produce enough fodder for themselves and extra fodder to sell to other livestock keepers. The experimental plots at ASAS Farm can be used as demonstration plots to enhance adoption of fodder production by smallholder livestock keepers in Iringa. Moreover, smallholder dairy farmers should embark on improved fodder production treatments (after receiving education and orientation on how to produce them through on-farm trials at ASAS Farm) to minimise shortage of fodder during dry seasons in the country. Fertilizer applications such as NPSZn, CFYM and Urea should be promoted to improve the quantity of Rhodes grass production.

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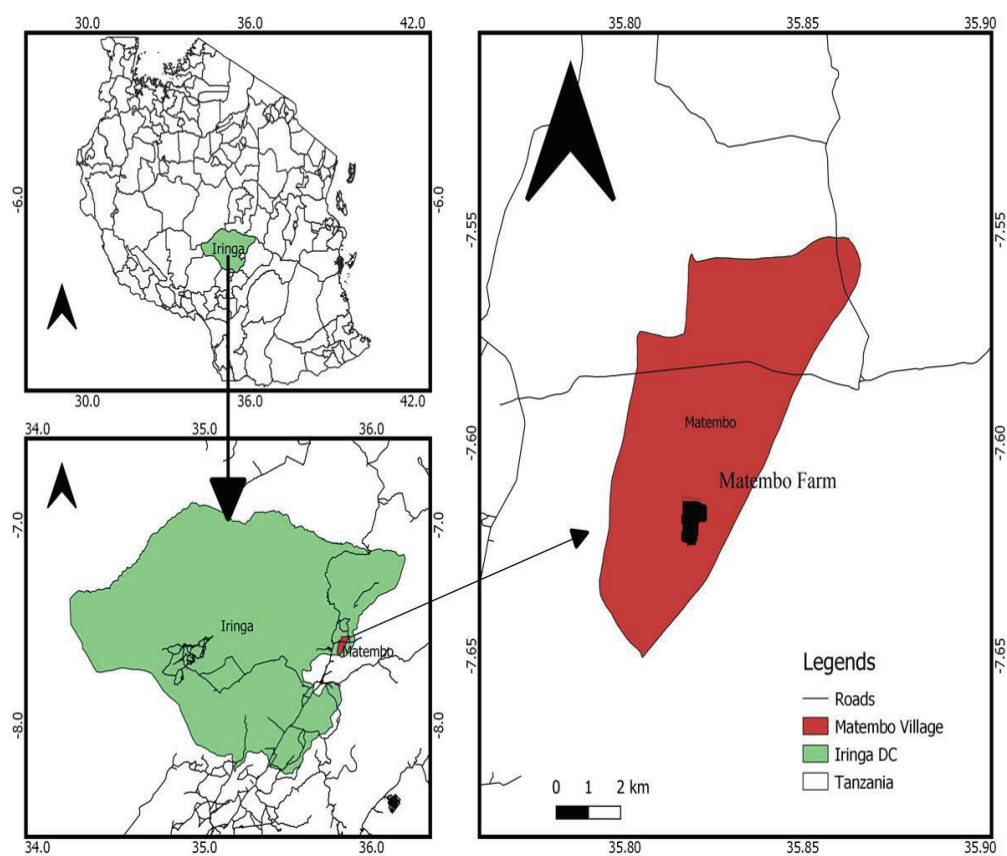
## References

- Abdisa, T. (2018). Mechanism of retained placenta and its treatment by plant medicine in ruminant animals in Oromia, Ethiopia. *Journal of Veterinary Medicine and Animal Health*, 10(6): 135-147.
- Bank of Tanzania, BOT (2020). Monthly Economic Review. <https://www.bot.go.tz/Publications/Regular/Monthly%20Economic%20Review/en/2021020412091680.pdf>
- European Commission, E. C. (2008). Guide to Cost Benefit Analysis of Investment Projects-Structural Funds, Cohesion Fund and Investment for Pre-Accession. Europe Commission, Directorate General Regional Policy. 257pp.
- FAO (2016). Handbook on Agricultural Cost of Production Statistics Guidelines for Data Collection, Compilation and Dissemination. [<https://www.fao.org/3/ca6411en/ca6411en.pdf>] site visited on 15/11/2020.
- FAO (2020). Tanzania at a Glance, FAO. [<http://www.fao.org/tanzania/tanzania-at-a-glance>] site visited on 15/11/2020.
- ILRI; CIAT; NARO; KIT; CGIAR; GIZ; BMZ; IFAD; SNV. (2020). Factsheets on forage species in East Africa. Nairobi (Kenya): Alliance of Bioversity International and CIAT. 16pp.
- Islam, S., Begum, J., Sarker, N.R. and Khatun, M. (2017). Economics of fodder production for dairying in selected areas of Bangladesh. *Journal of Animal Science*, 46(2): 140-149.
- Kabirizi, J., Zziwa, E., Mugerwa, S., Ndikumana, J. and Nanyennya, W. (2013). Dry season forages for improving dairy production in smallholder systems in Uganda. *Tropical Grasslands - Forrajes Tropicales*, 1(1): 212-214.
- Kadigi, W.R., Ngaga, Y.M. and Kadigi, R.M.J. (2021). Economic Viability of Smallholder Agroforestry and Beekeeping Projects in Uluguru Mountains, Tanzania: A Cost Benefit Analysis. *Open Journal of Forestry*, 11(2): 83-107.
- Kashangaki, J. and Ericksen, P. (2018). Cost-benefit analysis of fodder production as a low emissions development strategy for the Kenyan dairy sector. ILRI Project Report. Nairobi, Kenya: ILRI. 40pp.
- Lukuyu, B., Sikumba, G., Baltenweck, I. and Njehu, A. (2013). Costs and benefits analysis of feed technologies promoted by the East Africa Dairy Development Project (EADD): Study conducted in Rwanda, Uganda and Kenya. 19pp.
- Lukuyu, B., Romney, D., Ouma, R. and Sones, K. (2016). Feeding dairy cattle: A manual for smallholder dairy farmers and extension workers in East Africa. Retrieved from <https://cgspace.cgiar.org/handle/10568/478> site visited on 28/11/2020.

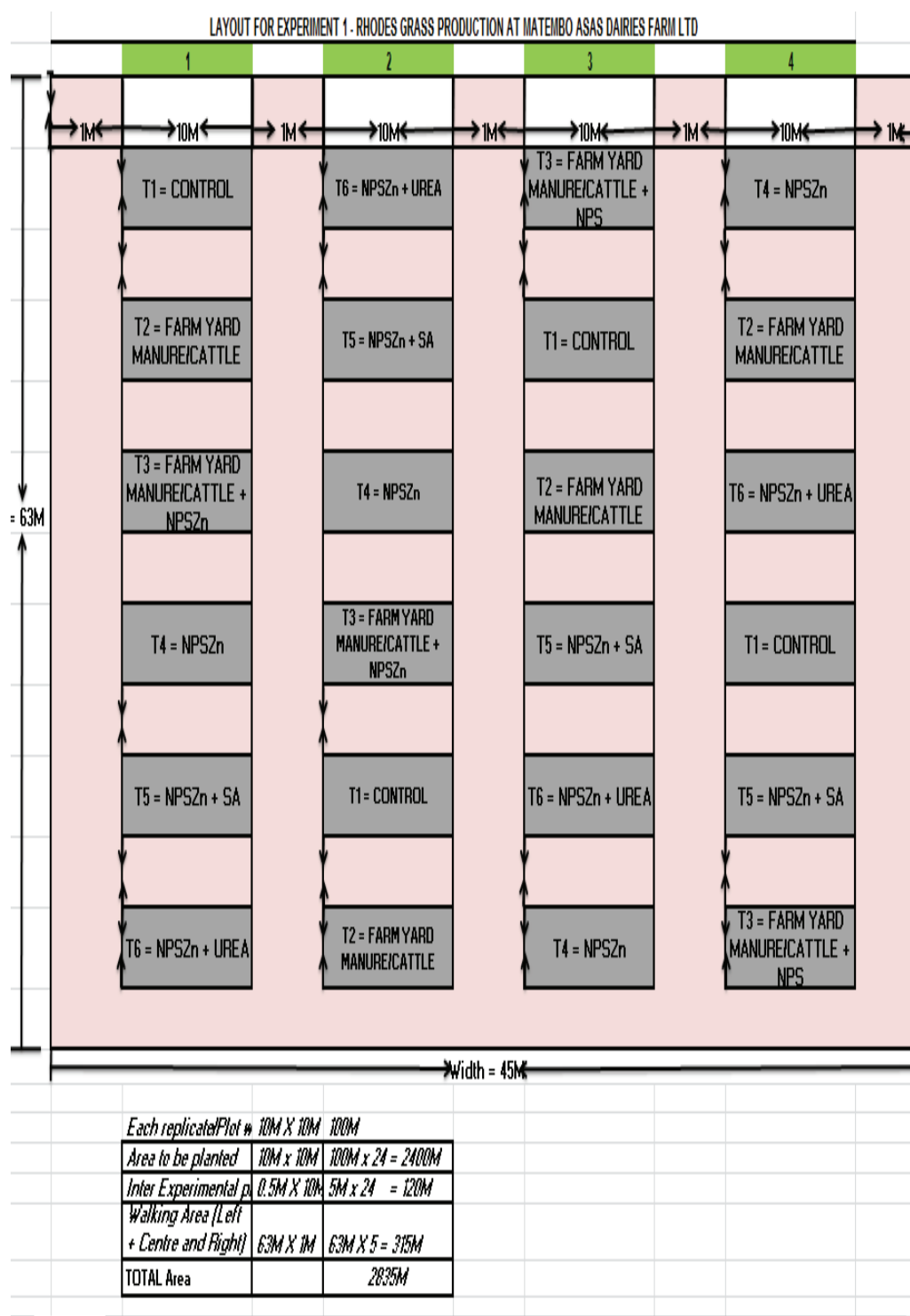
- Lukuyu, M., Njehu, A., Mwilawa, A. and Lukuyu, B. (2016). A study to understand fodder markets and fodder trading patterns in More MilkIT sites and other selected regions in Tanzania. [Research Gate "figure > Map-of-MilkIT-project-sites-in-Tanzania-s] site visited on 12/04/2021.
- MLF (2019). Tanzania Livestock Master Plan. Tanzania Ministry of Livestock and Fisheries (MLF) and the International Livestock Research Institute (ILRI) livestock master plan team. Nairobi, Kenya. 104pp.
- Njombe, A.P., Msanga, Y., Mbwapbo, N. and Makembe, N. (2011). The Tanzania Dairy Industry: Status, Opportunities and Prospects. A Conference paper presented at the 7th African Dairy Conference and Exhibition. Moven Pick Palm Hotel, 25-27 May 2020. pp. 25-27.
- Notenbaert, A., Jeroen, C.J., Groot, M.H., Birnholz, C., Birthe, K.P., Pfeifer, C. S., Fraval, M. L., Jamie, N., McFadzean, J.A.J., Dungait, J.M., Ran, Y., Barron, J. and Tiftonell, P. (2020). Towards environmentally sound intensification pathways for dairy development in the Tanga Region of Tanzania. *Regional Environmental Change*, 20: 1-14.
- Papendiek, F., Tartiu, V.E., Morone, P. and Venus, J. (2016). Assessing the economic profitability of fodder legume production for green biorefineries - a cost-benefit analysis to evaluate farmers profitability. *Journal of Cleaner Production*, 112: 3643-3656.
- Sikumba, G. and Maass, B.L. (2015). Effects of season and location on cattle milk produced and producer milk prices in selected villages of Tanga and Morogoro Regions, Tanzania. *Livestock Research for Rural Development*, 27(10).
- Swai, E. S. and Karimuribo, E. D. (2011). Smallholder dairy farming in Tanzania: Current profiles for developments. *Outlook on Agriculture*, 40(1): 21-27.
- URT (2017). Tanzania Livestock Analysis (2016/2017-2031/2032). Ministry of livestock and fisheries. 58pp.
- URT (2019). Livestock and Fisheries Commodity Value Chain Briefs. Ministry of Livestock and Fisheries, Tanzania. 15pp.
- United Republic of Tanzania (2016). Agricultural Sector Development Strategy -II Republic of Tanzania. 97pp.
- URT, United Republic of Tanzania (2021). Livestock Master Plan (2017/2018 - 2021/2022). [<https://webapps.ifad.org> > members > docs > EB-20...PDF] site visited on 20/12/2021.
- Waziri, M.D. and Uliwa, P. (2020). Supply and Commercial Viability of Forage in Tanzania. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, 66(1): 145-156.

## Appendices

### Appendix 1: Map of Tanzania showing Iringa region-Matembo Farm



## Appendix 2: Layout of the experiment



### Appendix 3: Comparison of Economic Viability between treatments (Totally Dried-sensitivity analysis)

#### Treatment 1

	Discount rate						
	3.2%	5%	8%	9%	10%	11%	12%
PVB	535120.1	395750.6	203870.1	155769.6	116586.9	85623.2	61780.9
PVC	1173843	1034727.5	338134.7	7178243	247456.7	574544.01	172801.04
NPV	-638723	-638977	-134265	-562055	-130869.8	-488921	-111020
BCR	0.456	0.383	0.321	0.217	0.4711	0.149	0.358

#### Treatment 2

	Discount rate						
	3.2%	5%	8%	9%	10%	11%	12%
PVB	1631025	1234651.8	735869	598052.21	482019.67	386417.27	308866.62
PVC	1410075	1261251.9	1106152	838244.54	857879.11	661307.20	647320.4
NPV	220950	-266600	-370283	-240192.3	-375859	-274890	-338454
BCR	1.15669	0.764	0.66	0.713	0.562	0.584	0.477

#### Treatment 3

	Discount rate						
	3.20%	5%	8%	9%	10%	11%	12%
PVB	4313650	3367494	2969149	1652947	2328777	1094480	886556.78
PVC	1645783	1434133	2012355	958398.2	1348033	747878.3	781721.66
NPV	2667867	1933361	956794	694549.2	980744.7	346601.3	104835.12
BCR	2.621	2.348	1.475	1.724	1.728	1.463	1.134108

#### Treatment 4

	Discount rate						
	3.20%	5%	8%	9%	10%	11%	12%
PVB	2302430	1788215	1054962	861655.6	698338.3	563208.3	453044.7
PVC	1463946	1280243	1572167	865705.7	1225665	681093.1	930831.4
NPV	1859230	1345015	-517205	-4050.11	-527327	-117885	-477787
BCR	1.573	1.397	0.67	0.995	0.569	0.827	0.487

#### Treatment 5

	Discount rate						
	3.2%	5%	8%	9%	10%	11%	12%
PVB	2429468	1892154	921011.7	606305.3	1124141	749008.7	489595.6
PVC	1591145	1387893	930546	727810.7	1666151	1303225	993751.1
NPV	838323	504261.2	-9534.26	-121505	-542010	-554216	-504155
BCR	1.527	1.363	0.989	0.833	0.68	0.575	0.493

Discount rate							
	3.2%	5%	8%	9%	10%	11%	12%
<b>PVB</b>	5837331	4563531	2251502	2425448	1496029	3163711	4026926
<b>PVC</b>	1772180	1541104	1022830	1214081	794301.4	1839289	2736813
<b>NPV</b>	4065151	3022427	1228673	1211366	701727.9	1324422	1290113
<b>BCR</b>	3.293	2.961	2.201	1.998	1.8	1.72	1.471

#### **Appendix 4: Results from The Laboratory for Dry Matter Determination**

**Table for fresh Biomass Yield t DM/ha**

	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>
Fresh Biomass	6.20	9.89	20.19	12.63	14.19	24.70

**Table for dry matter as fed t DM/ha**

	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>
Partially dry matter	2.19	3.93	7.40	4.93	5.16	9.10

**Table for Total Dry matter t DM/ha**

	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>
Total Dry matter	2.08	3.74	7.03	4.65	4.95	8.63

# Farmers' Willingness to Pay for Improved Cassava Cuttings Attributes in Rugombo District, Burundi

Ndayisaba, H.<sup>1\*</sup>, Shayo-Ngowi, R.A.<sup>1</sup> and Waized, B.M.<sup>1</sup>

## Abstract

This study used a Discrete Choice Experiment (DCE) to assess farmers' Willingness to Pay (WTP) for improved cassava cuttings attributes in Rugombo District, Burundi. The specific objectives of the study were to assess farmers' preferences for improved cassava cuttings attributes, their WTP for attributes of improved cassava cuttings, and factors influencing farmers' preferences and WTP for improved cassava cuttings attributes. Primary data were collected in Rugombo District, where cassava is intensively grown. From a list of cassava farmers, a systematic sampling method was employed to select 352 respondents for this study. The findings of this study indicate that farmers have strong preferences for higher yield and were willing to pay more for high yielding attribute (BIF 70) compared to other attributes like resistance to diseases (BIF 36), sweet taste (BIF 35), and early maturity time (BIF 18). Additionally, the study found that preferences and WTP for improved cassava cuttings attributes are influenced by farmers' education level, land ownership status, size of cultivated land, experience in producing cassava, project beneficiaries, and distance to the market. The study recommends to the Ministry of Agriculture and development partners involved in cassava cuttings multiplication in Burundi to consider the preferred attributes of cassava varieties in their interventions and actions.

**Key words:** Improved cassava cuttings attributes, Willingness to Pay, Choice experiment, Burundi.

## 1 Introduction

Cassava (*Manihot esculenta*) is the main food crop in Sub-Saharan Africa, and the second most common staple food after maize (Assanvo *et al.*, 2017). It is also the third major crop in Burundi, after banana and beans (Bigirimana *et al.*, 2007). Cassava is easily grown with a low level of inputs (water and fertilizer), it is drought-resistant (Barratt *et al.*, 2006) and a high energy food (Li *et al.*, 2017), making it an important nutritional food to combat food insecurity (Vernier *et al.*, 2018). Moreover, cassava is used as human food and feed for cattle and raw material (starch, ethanol) in various agroindustries (Howeler *et al.*, 2013). Therefore, there is an opportunity for Burundi to tap the potential of cassava for improved livelihoods of local farmers.

Despite its importance, cassava production in Burundi is constrained by several challenges including informal sectors' dominance, the inaccessibility of clean and healthy planting materials and the traditional poor farming practices. Crop diseases compound the problem further, as indicated by recent statistics that cassava production has declined by 50% to 100% from 2015 to

<sup>1</sup>Department of Agricultural Economics and Agribusiness, Sokoine University of Agriculture, Tanzania

\*Corresponding Author : [blondinetta10@gmail.com](mailto:blondinetta10@gmail.com)



2019 due to Cassava Mosaic Disease (CMD) and Cassava Brown Streak Virus (CBSV) disease (PRODEMA, 2019). These challenges have attributed to low cassava productivity and food insecurity in Burundi (Okonya *et al.*, 2019). In response to these problems, a decentralized farmers' grouping approach has been used for the multiplication of improved cassava cuttings and free cuttings delivery in Burundi (Okonya *et al.*, 2019). But the Assessment of Crops and Food Supplies done in Burundi in 2018 revealed that the use and availability of improved cassava cuttings were very limited, with only two provinces out of 18 having 80 800 cassava cuttings grown. However, it is assumed that these efforts can only be impactful if the seed system becomes sustainable in terms of farmers' access to suitable variety and quantity of cassava cuttings. The question then is whether farmers can buy cassava cuttings and, if so, how much are they willing to pay? Traditionally, farmers in Burundi do not buy cuttings instead they rely mainly on their stocks or obtain them from other farmers. Cassava is also considered as a public good given its vegetative propagation, which creates little incentives as a business opportunity for private seed suppliers (David, 2003). Hence, it is believed that when improved cassava cuttings reach the market, there will be hope for sustainability.

There is a pool of literature that has focused on the adoption of cassava varieties. For example, a study done by Wossen *et al.* (2017) on adoption of cassava variety in Nigeria shows that farmers prefer attributes such as quality of flour, higher yield, big roots, earlier maturity time. Other studies conducted in Tanzania and Ghana to assess willingness to pay for cassava seeds among farmers (Maggidi, 2019; Baidoo and Amoatey, 2012), revealed that WTP for cassava seeds is influenced by age, land size cultivated, cassava varieties, livestock and family labor, access to information on proposed agricultural services, market access, distance to the market, land ownership matters, source of income and farmers' income level. Studies done on commercialization of certified cassava seeds as well as conservation of cassava varieties in Uganda show that a high quality of planting material, traditional knowledge on variety, cassava's capacity to be stored in the ground, and its quality when cooked are among factors that influence adoption of the varieties (Awio *et al.*, 2019; Nakabonge *et al.*, 2018).

In Burundi, there are a number of studies that have looked into cassava production aspects. For example, studies done by Bigirimana *et al.* (2011) and Bowmeester *et al.* (2012) recognized the existence of diseases and pests, while Okonya *et al.* (2019) show the quantity of cassava loss due to diseases and pests. Aloys *et al.* (2006) on the other hand demonstrates that cassava should be processed industrially, not traditionally, while Lambri *et al.* (2013) suggested several enhanced cassava cyanide reduction methods. None of the papers conducted in Burundi addressed the willingness of farmers to pay for cassava cuttings attributes despite the importance of the crop in the country. The



departure and contribution of this study is on the marketing knowledge particularly towards assessing farmers' preferences for improved cassava cuttings' attributes, farmers' WTP for improved cassava cuttings' attributes, and factors influencing farmers' preferences and WTP for the improved cassava cuttings' attributes by using DCE approach. Three research questions are addressed, namely: (i) Which cassava cuttings attributes are preferred by farmers when they decide to grow cassava? (ii) What is the economic value (WTP) of improved cassava cuttings attribute preferred by farmers? (iii) Is there existence of preference heterogeneity for improved cassava cuttings attributes and what are its determinants? It is essential to note that understanding farmers' preferences enable policy makers to know farmers' needs and respond by providing relevant and required technologies. Information on WTP will shed light on the maximum amount of money farmers can pay for the cassava cuttings and design appropriate marketing strategies to improve adoption.

## **2 Methodology**

### **2.1 Research Design and Sampling Procedure**

The research was conducted in the Rugombo District of Cibitoke Province (Northwest of Burundi), which was purposefully chosen as the study area. The area was chosen because it is one of the regions where cassava is intensively grown. It is also a region that has been seriously affected by CMD and CBSV diseases in the past years. This study employed a cross sectional data collection using an administered questionnaire. The collected information included farmers' socio-economic characteristics and preferences to cassava cuttings attributes. The target population in this study was cassava farmers who received cassava cuttings for free from the project (project beneficiaries) and those who did not get cassava cuttings from the project (non-project beneficiaries). A systematic sampling approach was applied by first, purposefully choosing Rugombo District. Secondly, stratification of the targeted population into project and non-project beneficiaries was done, for participants to be heterogenous. A sampling frame of 4 132 cassava farmers was obtained from Burundi Institute of Agronomic Science (ISABU). The sample size was determined using the formula developed by Krejcie and Morgan (1970) as follows:

$$n = \frac{N * x^2 * p * q}{d^2 * (N - 1) + (x^2 * p * q)} = 352 \dots \dots \dots (1)$$

Where n is the sample size,  $x^2$  is the table value of chi-square for one degree of freedom at the desired confidence level (at 95 percent confidence level,  $x^2 = 3.84$ ), N is the total number of cassava farmers, p is the population

proportion considered to be 0.5 to provide maximum sample size,  $q = (1-p) = 0.5$ , and  $d$  is the degree of accuracy expressed as a proportion ( $d = 0.05$ ).

Among 18 wards (strata) located in Rugombo district, 14 were selected. The weight of each stratum was obtained by dividing the strata population to the total population. Thus, the numbers of farmers interviewed for each stratum was obtained by multiplying the weight by the full sample size (352). Thirdly, systematic sampling followed by picking each 12<sup>th</sup> farmer from the list of each ward (Table 1).

**Table 1: Sampling procedure of the study**

True Wards	Total population	Weight	Weighted wards Sample size	Sampling interval per ward
Ruvumera	235	0.056873	20	12
Kagazi 2	553	0.133833	47	12
Kagazi 3	426	0.103098	36	12
Cibitoke	330	0.079864	28	12
Rukana	568	0.137464	48	12
Musenyi	291	0.070426	25	12
Gabiro	83	0.020087	7	12
Samu	158	0.038238	13	12
Gicaca	109	0.026379	10	12
Kiramira 1	253	0.061229	21	12
Kiramira 2	226	0.054695	19	12
Rusoro	386	0.093417	33	12
Munyika	228	0.055179	19	12
Mparambo	286	0.069216	24	12
	4 132	1	352	

## 2.2 Experimental Design and Analytical Method

### 2.2.1 Cassava Attributes Identification

The Focus Group Discussion (FGD) was used in this study to identify important cassava attributes level used in DCE. The researcher led the group discussion, accompanied by agronomists, and local representatives in the Rugombo district. The first discussion distinguished the project beneficiaries of improved cassava cuttings versus non-project beneficiaries; women and men were then separated into different groups. The rules for working in groups were proposed by the participants and the facilitators who stimulated the debate in the national/local language (Kirundi) to let participants feel free in responding.

The cassava farmers in FGD were asked general questions on cassava attributes and factors that they mostly consider when deciding to grow cassava in the study area; participants were then asked to rank the attributes in order of importance. The discussion started with a revised list of 14 cassava attributes to come up with the final set of attributes and their levels (disease resistant, drought resistant, roots yield, sensory-taste, roots size, starch content, maturity time, inputs price, hardness, softness, inputs needed, leaves yield, architecture, the color of the cassava). In addition, for each attribute, levels were given by International Institute of Tropical Agriculture (IITA) and ISABU, and cassava farmers confirmed other attributes levels.

Each group comprised four to eight people, and four groups were sufficient per ward if there was no new information. Moreover, the discussion time was between one to two hours to ensure an appropriate conversation time for each participant. The results were analyzed by reviewing all the responses given by the groups, highlighting the characteristics that were repeated many times by the participants. Finally, a list of five attributes were selected for the DCE, which were, i) resistance to diseases, ii) maturity time, iii) roots yields, iv) taste, and v) inputs price. Table 2 shows the attributes and their levels as employed in DCE.

**Table 2: Attributes and attributes' levels for DCE in Rugombo district**

Cassava attributes	Attributes Levels
Resistance to diseases	<ol style="list-style-type: none"> <li>1. Resistance to CMD and CBSV</li> <li>2. Susceptible to CMD and CBSV</li> </ol>
Roots yield	<ol style="list-style-type: none"> <li>1. 500 -600 kg/ Are (50-60 tons/ha)</li> <li>2. 100 – 340 kg/ Are (10-34 tons/ha)</li> <li>3. 30Kg/ Are (1-3 tons/ha)</li> </ol>
Maturity time	<ol style="list-style-type: none"> <li>1. 6 months</li> <li>2. 8 months</li> </ol>
Taste	<ol style="list-style-type: none"> <li>1. Sweet taste</li> <li>2. Bitter taste</li> </ol>
Price	<ol style="list-style-type: none"> <li>1. BIF 800/ 100 cuttings</li> <li>2. BIF 1,000/ 100 cuttings</li> <li>3. BIF 12,000/ 100 cuttings</li> </ol>

One cassava cutting = BIF 8, 10 or 12 where, BIF 1 = TZS 1.15; USD 1= BIF 2,002.27 (Exchange rate last updated February 23<sup>th</sup>, 2022: 12:19 UTC)  
100 cuttings are required for one Are 10, 000 cuttings are required for 1 hectare

## 2.2.2 Design and construction of a choice set

In developing a Choice Experiment (CE), the researcher established the relevant cassava attributes and their levels, and the number of possible cassava combinations was determined by SPSS software. There are  $72=(23*32)$  ways of combining the attributes and their levels used in the designing the CE. To make the decision cards more manageable for the farmers, orthogonal design in SPSS software was used to end up with 16 profiles. The orthogonal design profiles gave eight choice sets; each choice set was made up of two scenarios and an opt-out option. Choice cards were presented to 352 sampled respondents, each responding to 8 completed choices, each choice having three scenarios resulting to 8 448 observations (352 individuals \* 8 choices \* 3 options for each choice). Table 3 shows an example of choice set used in this study.

**Table 3: The choice set for the study experiment**

Attributes name	Profile 1	Profile 2	I don't prefer any option	Choice Tick of 1 Or 2
<b>Resistance to diseases</b>	Susceptible for CMD and SBCD	Resistance to CMD and SBCD		
<b>Roots yield</b>	Higher yield 500-600 kg/ Are (50-60 tons/ha)	Low yield 30Kg/ Are (1-3 tons/ha 30Kg/ Are)		
<b>Maturity time</b>	Maturity time: 6 months	Maturity time: 8 months		
<b>Taste</b>	Bitter taste (leaves are light green; leaf petiole is yellowish green)	Bitter taste (leaves are light green; leaf petiole is yellowish green)		
<b>Price</b>	BIF 800/ 100 cuttings	BIF 12,000/ 100 cuttings		

## 2.2.3 Model specification: Mixed logit model

Mixed logit model was used in this study to analyze the preferences, WTP for improved cassava cuttings' attributes and factors that influence preferences and WTP for improved cassava cuttings' attributes. McFadden (1974) developed the basic choice logit model known as multinomial logit or conditional logit model. A variety of logit models such as binary logit, nested logit, and mixed logit (MXL) have been developed and applied to inform policies in different fields. Mixed logit has been proven to be a very flexible model in random models (McFadden and Train, 2000), and it allows for random variation in preferences and unobserved correlation between factors over time (Hensher and Greene, 2002). The model incorporates preference heterogeneity in the sample by considering the coefficient as random rather

than fixed (Rockers *et al.*, 2012; Ryan *et al.*, 2012) and the model accounts for repeated choices by the same respondent by adjusting standard errors of utility estimates (Ryan *et al.*, 2012). The coefficients used in the model are interpreted as a relationship between the explanatory variables and the probability of choice.

Therefore, the utility decision maker  $n$  obtains utility from choosing alternative  $j$  is given by:

$$U_{nj} = V_{nj} + \varepsilon_{nj} \dots\dots\dots(2)$$

Where,  $V_{nj}$  is a function of observable attributes of the alternative  $X_{nj}$ , and the decision maker,  $Z_n$ .  $\varepsilon_{nj}$  is unknown and treated as random. The probability that decision maker  $n$  chooses alternative  $i$  is

$$P_{ni} = \Pr(U_{ni} > U_{nj}) \forall j \neq i \dots\dots\dots(3)$$

$$P_{ni} = \Pr(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}) \forall j \neq i \dots\dots\dots(4)$$

$$P_{ni} = \Pr(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj}) \forall j \neq i \dots\dots\dots(5)$$

By making the assumption that the random terms are independent and identically distributed type, the conditional logit model is obtained:

$$P_{ni} = \frac{\exp(\sigma_n V_{ni})}{\sum_{j=1}^J \exp(\sigma_n V_{nj})} \dots\dots\dots(6)$$

The representative utility is specified to be a linear in parameter function

$$V_{ni} = x'_{ni}\beta + z'_n\gamma_i \dots\dots\dots(7)$$

The conditional logit model assumes that respondents have the same preferences and it assumes equal proportional substitution between the alternatives:

$$\frac{\partial P_{ni}}{\partial x_{nj}} \frac{x_{nj}}{P_{ni}} = -x_{nj}^* P_{nj} \beta^* \dots\dots\dots(8)$$

Another consequence of conditional logit model is the Independence of Irrelevant Alternative properties where:

$$\frac{P_{ni}}{P_{nk}} = \frac{\exp(V_{ni}) / \sum_{j=1}^J \exp(V_{nj})}{\exp(V_{nk}) / \sum_{j=1}^J \exp(V_{nj})} = \frac{\exp(V_{ni})}{\exp(V_{nk})} \dots\dots\dots(9)$$

Therefore, mixed logit model solves these limitations (the random terms are independent and identically distributed, Independence of Irrelevant Alternative properties) by allowing the coefficients in the model to vary across decision makers; implying that decision makers may have varied preferences. The probability of a specific set of selections is calculated as follows:

$$P_{ni} = \int \frac{\exp(x'_{ni}\beta)}{\sum_{j=1}^J \exp(x'_{nj}\beta)} f(\beta|\theta) d\beta \dots\dots\dots(10)$$

Where,  $f(\beta|\theta)$  is density function of  $\beta$

Also, an individual can make several choices, and the probability of a particular sequence of choices is given by:

$$S_n = \int \prod_{t=1}^T \prod_{j=1}^J \left[ \frac{\exp(x'_{njt} \beta)}{\sum_{j=1}^J \exp(x'_{njt} \beta)} \right]^{Y_{njt}} f(\beta|\theta) d\beta \dots\dots\dots(11)$$

Where  $Y_{njt} = 1$  if individual chose alternative  $j$  in choice situation  $t$  and 0 otherwise

The  $\theta$  parameters can be estimated by maximizing the simulated log-likelihood (SLL) function:

$$SLL = \sum_{n=1}^N \ln \left\{ \frac{1}{R} \sum_{r=1}^R \prod_{t=1}^T \prod_{j=1}^J \left[ \frac{\exp(x'_{njt} \beta_n^{[r]})}{\sum_{j=1}^J \exp(x'_{njt} \beta_n^{[r]})} \right]^{Y_{njt}} \right\} \dots\dots\dots(12)$$

Where  $\beta_n^{[r]}$  is the  $r$ -th draw for individual  $n$  from the distribution of  $\beta$ .

Therefore, WTP is derived from a random utility model.

$$U_{ijk} = \alpha_1 + \beta_1 X_{1n} + \beta_2 X_{2n} + \dots\dots\dots \beta_m X_{mni} + \varepsilon_n \dots\dots\dots(13)$$

Where the betas  $\beta$  provide quantitative information on the strength of the preference for each attributes level and monetary value.  $\alpha$  is a choice-specific intercept for alternative  $j$ . Inclusion of the price allows estimating the monetary value of cassava cuttings' attributes. This can be estimated as the ratio of the value of the coefficient of interest to the negative cost of attributes.

$$MWTP = \frac{\partial U / \partial x_{ij}}{\partial U / \partial p_{ij}} = - \beta_i / \gamma_i \dots\dots\dots(14)$$

Where  $p_{ij}$  denotes the cost parameter or price of alternative  $j$ ,  $X_{ij}$ , denotes the other observed attributes of choice alternatives,  $\gamma_i$  is the coefficient for the cost parameter,  $\beta_i$  is the coefficient vectors for the other attributes.

The heterogeneity in the mean parameter can be obtained by the interaction of respondents' profiles, with random variables (Hensher *et al.*, 2005). Therefore, four attributes namely input price, resistance to diseases, sweet taste and low yield were not significant according to their standard deviation (Table 7 of results), and this means that they were random across individuals. Two other attributes namely higher yield, and earlier maturity were treated as non-random variables referring to their non-significance in standard deviation, and these two variables did not appear in the interaction with the respondents' profiles. The interaction between random cassava attributes and cassava farmers' characteristics were computed, by using STATA 15 software.

## 2.2.4 Description of variables used in the estimation

Table 4 presents cassava attributes levels that entered in the analysis of utility function of mixed logit model. The utility-maximizing alternative is the choice made by cassava farmers. The choice is a binary dependent variable, with 1 indicating the selected option, and 0 indicating the non-chosen option. Among the levels of five main attributes chosen after FGD; resistance to diseases, higher yield, early maturity time, and sweet taste were expected to increase utility. Disease resistance allows farmers to have cassava that is not infected to prevent the spread of disease and its devastating consequences on food security. High yield (50-60 tons/ha) and medium yield (10-34 tons/ha) allow farmers to increase production and income. Early maturity allows farmers to have crops on time, and also have time to replace cassava with other crops.

**Table 4: CE variable coding and expected signs**

Variables	Units	Expected sign (+/-)
<b>Resistance to diseases</b>	1= tolerant, (-1) = otherwise	+
<b>Yield</b>	1= higher yield (50-60 tons/ha) (-1) = medium yield (10-34 tons/ha) 0=low yield (1-3 tons/ha), 0 otherwise	+
<b>Maturity Time</b>	1= earlier maturity time, (-1) =later maturity time	+
<b>Taste</b>	1= Sweet taste, (-1) = Bitter taste	+/-
<b>Price of 100 cuttings</b>	Price in BIF	-

Similarly, susceptible to disease, low yield, and later maturity time are expected to decrease utility in cassava production function. Disease is spread by infected cuttings and by whitifies, the leaves could be yellow, mottled and distorted; it may cause a loss in yield. The low yield (30kg/Are) is the last level of cassava roots yield where a farmer can't maximize profit. Farmers admitted that eight months are enough for the cassava to mature and have hard cassava roots that can stay long underground, which helps to mitigate food insecurity shocks. Depending on an individual's preferences, the coefficient of cassava taste can be positive or negative. For instance, the sweet taste allows farmers to have cassava that is directly consumable and sold in the market after the harvest. Bitter cassava cannot be stolen from the field before harvest and it presents a good quality of flour and also cooked Earth ("*Ubuswage*"). The coefficient associated with the input price is expected to have a negative sign, as money is a limited resource, an increase in utilities occurs when the cost of related alternatives declines (Debertin, 2012).



To estimate the choice model, some attributes were entered in the estimation process as coded using various coding such as effects coding (for example, sweet taste = 1, bitter taste = -1) and other attributes entered in the estimation using the face value of their levels (for example, price of 100 cutting per are). Effect coding is used in estimating choice model as the utility associated with the base level will not get confounded with the overall utility associated with attribute levels of an alternative (Hensher *et al.*, 2005). Dummy coding is used for qualitative variables as shown in Table 5.

**Table 5: Description of variables used in the analysis**

Variables	Code /units	Expected signs (+/-)
Age	Number of years	+
Education	Number of years	+
Land ownership		
Own land	1= own land, 0 = otherwise	+
Rented land	1= Rented land, 0 = otherwise	-
Both own and rented land	1= both own and rented, 0= otherwise	+
Cassava land size	Number of Ares	+
Project membership	1= Yes, 0 = otherwise	+
Distance to the market	Number of kilometers	+

### 3 Results and Discussions

#### 3.1 Respondents' Profile

A total of 352 respondents were interviewed, of which the majority had primary level education (41.76%), followed by secondary school level (38.92%), while 17.6% of farmers had informal education. Only 1.7% of interviewed farmers had a university education level (Table 5). Education is the number of years of formal schooling of a household head, the level of education of an individual explains his adoption of innovation. The more an individual is educated, the less is likely to be poor, and then one can pay for improved cassava cuttings. Literacy level is expected to increase farmers' ability to understand, analyze, and positively perceive different issues.

The age of cassava farmers in the study area ranges from 19 to 92 years. The distribution reveals that 9.6% of cassava farmers were between the age of 65 and 92 years, 15.9% were between the age of 55 to 64 years, 23.2% were between the age of 45 and 54 years, 25.2% were between the age of 35 to 44 years, while 26.21% were between the age of 19 to 34 years (Table 5). This implies that the majority of respondents fall within the age range of 19 to 34 years (26.1%) which indicate that they are youth and productive. The average



age is 45 years, which is approximately the same with those found by the National Agriculture Survey done in Burundi in 2017 (ENAB, 2017), which also found the average household age is 43.7 for households led by women.

**Table 6: Respondents' profile**

	Frequency	Percent	
<b>Age</b>			
19-34	92	26.1	
35-44	89	25.2	
45-54	82	23.2	<b>Mean: 45</b>
55-64	56	15.9	
65-92	34	9.6	
<b>Education level</b>			
No formal education	62	17.61	
Primary	147	41.76	
Secondary	137	38.92	
University	6	1.7	
<b>Experience in Cassava farming (Years)</b>			
1 – 5	51	14.5	
6 – 10	55	15.6	
11 – 15	36	10.2	
16 – 20	64	18.2	
21 - 25	37	10.5	
More than 25	109	31.0	<b>Mean: 21 years</b>
<b>Cassava land size</b>			
Ares 1 – 10 ( <i>Irobo</i> )	103	29.3	<b>Mean 27Ares</b>
Ares 11 – 20 ( <i>Inusu</i> )	88	25	
Ares 21 – 30 ( <i>Inusu n'irono</i> )	51	14.5	
Ares 31 – 40 ( <i>Imetero</i> )	49	13.9	
Ares 41 - 50	35	9.9	
More than 51 Ares ( <i>Igito</i> )	26	7.4	
<b>Land ownership status</b>			
Own	240	68.2	
Rent land	75	21.3	
Own and rent land	36	10.2	
<b>Easy access to cuttings</b>			
Yes	100	28.41	
No	252	71.59	
<b>Source of cuttings</b>			
Farmers group	6	6.06	
Government extension services	6	6.06	
Cooperatives	8	7.07	
Inputs dealer	7	7.07	
Friends	72	72.73	
<b>Distance to the market (km)</b>			
0 - 2	118	33.5	
2.1- 3	140	39.8	<b>Mean: 3km</b>
3.1-6	94	26.7	

Farmers classify the land size into six categories; the area is measured in Ares where one acre is equal to 40.469 Ares; or one hectare is equal to 100

Ares (One Are is also equal to  $10\text{m} \times 10\text{m} = 100\text{m}^2$ ). About 29.3 % of respondents own between 1 to 10 Are categorized as Irobo; About 25.0% of farmers between 11 to 20 Ares called Inusu. Furthermore, approximately 14.5% of farmers own between 21 to 30 Ares called Inusu n'irobo while about 13.9% owns between 31 to 40 Are herein categorised as Imetero. About 9.9 % owns cassava land size between 41 to 50 Ares, while 7.4% of respondents have cassava land greater than 51 Ares called "Igito". Majority of farmers in the study area have cassava lands that fall between 1 and 10 Ares which is small compared to the mean land size of 27 Ares (Table 6). The implication of this is that most of farmers depend on small areas of land for cultivation of cassava crops. It was also observed that 31% of farmers had above 25 years of experience in cultivating cassava, 18.2% had between 16 and 20 years, 15.6% had between 6 and 10 years, 14.5% had between 1 and 5 years, and 10.2% had between 11 and 15 years, while 18.2% of respondents had between 16 and 20 years. The implication of this is that majority of interviewed cassava farmers have more than 25 years of experience, therefore they have been producing cassava for a long time, since the mean years of experience was 21 years (Table 6).

The land used in producing cassava in the study area is either own land, rented land, or both. About 68.2% of cassava farmers sampled have their land acquired through inheritance, purchase, or acquired as gift. About 10.2% have both own and rented land, while 21.3% use only the rented land to produce cassava. This implies that majority of respondents have their own land.

Among the cassava farmers who were interviewed, 71.58% of them admitted not to have access to improved cuttings. The majority of cassava farmers interviewed (72.73%) admitted using cassava cuttings obtained through neighbors and relatives. However, 28% of cassava farmers grow cassava cuttings obtained through farmers' groups, cooperatives, and inputs dealers (Table 6). These figures reflect the predominance of informal sources of cassava cuttings in the research area. In addition, the results revealed that 39.8% of respondents lives between 2.1 to 3 km from the market. About 33.5% of farmers lives less than 2 km, and 26.6% lives between 3.1 and 6 km. This implies that majority of respondent lives near the market since, the distance from the cassava farm to the market is on average 3 km (Table 6).

### **3.2 Farmers' Preferences for Improved Cassava Cuttings Attributes: Mixed Logit Model**

This study used the mixed logit model to assess farmers' preferences and WTP for cassava cuttings' attributes. The sign of each of the estimated parameters was coherent with the expected theoretical signs. For instance, the results in Table 7 show that the coefficient of the higher yield attribute was

positive and considerably greater than other coefficients estimated in the model (0.331), indicating the most preferred attribute among cassava farmers in the study area. This finding is in line with the findings by Bentley *et al.* (2017) and Teeken *et al.* (2018), who revealed that higher yield was the attribute most preferred by farmers in adoption of cassava seeds in Nigeria. The coefficient of the attribute resistance to diseases was positive with a magnitude of 0.170, indicating the second most preferred attribute is resistance to diseases. The result is consistent with the findings by Acheampong *et al.* (2018) who found that resistance to disease was an important cassava attribute during adoption of improved cassava variety in Ghana.

**Table 7: Farmers' preferences for cassava cuttings attributes, Mix Logit model**

Choices	Coefficient	Standard Error	P-value
Resistance to diseases	0.170**	0.077	0.027
Sweet taste	0.165***	0.032	0.000
Low yield	-1.144***	0.066	0.000
High yield	0.331***	0.081	0.000
Early maturity time	0.085**	0.038	0.023
Price of 100 cassava cuttings	-0.005***	0.000	0.000
CONST	-6.081***	0.248	0.000
<b>Standard deviation</b>			
Resistance to diseases	1.176	0.079	0.000
Sweet Taste	0.184	0.076	0.016
Low yield	0.627	0.077	0.000
High yield	0.008	0.234	0.974
Early maturity time	-0.004	0.072	0.960
Number of observations = 8,448			
LR chi2(5) = 328.20			
Log likelihood = -2205.794			
Prob > chi2 = 0.0000			

**Note:** \*\*\*, \*\* indicate that coefficients are statistically significant at 1% and 5% respectively, using p-value in the maximum likelihood estimation method

In addition, coefficient estimation results of sweet taste attribute show a positive relationship with a magnitude of 0.165, indicating that cassava farmers in the study area prefer cassava with sweet taste to bitter taste. When the coefficient of early maturity time attribute is considered, results indicate that it is positive and significant at 5%, with a magnitude of 0.085, meaning that farmers in the study area prefer cassava that matures faster (6 months) compared to late maturity time (8 months). This was the least preferred attribute by cassava farmers in the study area. These findings are consistent with Bentley *et al.* (2017); Nakabonge *et al.* (2017); Teeken *et al.* (2018); Wossen

*et al.* (2017) who found that early maturity was preferred by farmers during adoption of cassava in Nigeria and Uganda.

The low yield was significant at 1% with a negative coefficient, and the findings are as expected as a rational decision-maker will aim to maximize utility (McFadden, 1986). Cassava farmers prefer higher yields that would allow them to maximize their utility. Low yield was not desired as it was shown by its higher absolute magnitude (-1.144) compared to other attributes. On the side of the price of 100 cassava cuttings, negative and statically significant relationship was observed at 1% of the significance level. The negative sign of the price means that cassava farmers are less likely to choose cassava that is expensive, holding other factors constant. The absolute magnitude coefficient of the input price is very small at 0.005 indicating that a small price change did not affect the preference of other attributes. These findings are in line with the results by Kimathi *et al.* (2020), who found that a small change in potato input price did not affect the preferences of other potato attributes. The constant parameter is strongly significant and negative (-6.081), indicating a negative preference for no buy choice alternatives associated with zero utility, implying that cassava farmers selected the other two options, which were associated with different cassava levels.

Generally, the findings in Table 7 show that preferred improved cassava cuttings' attributes by farmers in the study area are higher yield, resistance to diseases, sweet taste, earlier maturity time, and cassava cuttings with low price.

### **3.3 Farmers' WTP for Improved Cassava Cuttings' Attributes**

The values in Table 8 represents the purchasing price in Burundian Francs (BIF) of 100 cassava cuttings that is required for one Are with a general space of 1m\*1m as recommended by the Burundian Ministry of Agriculture. The exchange rate used is BIF 1 = TZS 1.15 or USD 1= BIF 2,002.27 (Updated February 23<sup>th</sup>, 2022: 12:19 UTC). The values represent the mean, minimum and maximum amount (mean WTP, low bouderies, and upper bouderies) that respondents are willing to pay for improved cassava cuttings attributes. The MWTP that is used for interpretation of the results, is the ratio of attribute parameter estimate to the parameter estimate of the cost parameter holding other factors constant.

**Table 8: WTP (in BIF) for improved cassava cuttings attributes**

	Resistance to diseases	Sweet taste	Low yield	Higher yield	Early maturity time
MWTP	36	35	-241	70	18
Low boundaries	4	21	-271	40	2
Upper boundaries	69	48	-210	103	39

Farmers were willing to pay BIF 70 for higher yielding cassava cuttings attributes rather than medium yield. Similarly, they are willing to pay BIF 36 for resistant to diseases cassava cuttings attributes rather than susceptible for diseases attribute. BIF 35 is the monetary value that cassava farmers are willing to sacrifice to receive cassava cutting attributes with a sweet taste rather than bitter taste. Farmers are also willing to sacrifice BIF 18 to receive short period maturity time cassava cuttings rather than a long maturity period attribute. The results are similar to Kimathi *et al.* (2020), who found that Kenyan youth attribute a higher monetary value to the higher yield and resistance to disease potatoes attributes.

### 3.4 Factors Influencing Farmers' Preferences and WTP for Improved Cassava Cuttings Attributes

Findings from the interaction effect of random cassava attributes (Table 9) with respondents' profiles indicated that the number of years in school have a negative and significant interaction with the price (-0.000\*\*\*) but a positive and significant interaction on resistance to diseases (0.052\*\*). This implies that, households that are more educated were likely to choose the cassava cuttings alternative in the CE with low prices and resistance to diseases attributes. This is because educated farmers may be at better position to conceptualize the advantages and benefits of using improved cassava cuttings resistant to diseases by minimizing costs and having a high yield. Additionally, both owned and rented land shows a positive interaction with price (0.002\*\*\*) and significant negative interaction with a sweet taste (-0.313\*\*\*). This means that respondents who had both owned and rented land were more likely to choose the cassava cuttings alternative in the CE with bitter taste and with higher input price. This should be the case because farmers who have their own land may utilize it to experiment with different varieties compared to those who use the leased land only. The results converge with Awio *et al.* (2019) who found that owning land enhances the acceptability of new agriculture technology with investment on a long-term basis in Uganda.

The findings also revealed a positive and significant interaction between cassava farm size and price (0.000\*\*\*) but a negative interaction with low yield (-0.015\*\*\*). This means that farmers with large cassava land were willing to pay

more for inputs and they were not more likely to prefer the alternative in the CE with low yield. These findings converge with Ulimwengu and Sanyal (2011) who also found that farmers' WTP for agriculture services in Uganda increase as their land increases. Other existing literature demonstrated that farmers who have a small area for crop production often do not have the means to invest in new technology, and farmers who have a large farm size benefit from economies of scale, adopt improved variety and observe good economic practice (Mwalongo *et al.*, 2020).

Experience in cassava farming shows significant negative interaction with sweet taste (-0.009\*). This means that farmers who have more experience in producing cassava in study area prefer cassava cuttings that is bitter than sweet. This can be due to their familiarity with growing cassava as they prefer cassava with a bitter taste for good cassava flour but also due to its low risk of being stolen or harvested before the effective harvesting period. Uddin *et al.* (2016) also found that age and higher experience in farming were among determinants of WTP for agriculture technology in Bangladesh.

**Table 9: Interaction of respondents' profile with random attributes**

Choice	Coefficient	Standard Error	P-value
<b>Age</b>			
Inputs price	0.000	0.000	0.104
Resistance to diseases	-0.001	0.013	0.923
Sweet taste	0.004	0.005	0.437
Low yield	-0.006	0.010	0.504
<b>Education</b>			
Inputs price	-0.000	0.000	<b>0.000</b>
Resistance to diseases	0.052	0.022	<b>0.018</b>
Sweet taste	-0.013	0.009	0.151
Low yield	-0.016	0.016	0.309
<b>Owned land</b>			
Inputs price	0.000	0.000	0.650
Resistance to diseases	0.345	0.281	0.219
Sweet Taste	-0.127	0.117	0.276
Low Yield	0.048	0.211	0.820
<b>Both Owned and Rented Land</b>			
Inputs price	0.002	0.000	<b>0.000</b>
Resistance to diseases	0.379	0.238	0.110
Sweet taste	-0.313	0.096	<b>0.001</b>
Low yield	-0.173	0.176	0.327
<b>Cassava farm size</b>			
Inputs price	0.000	0.000	<b>0.000</b>
Resistance to diseases	0.004	0.004	0.369
Sweet taste	-0.000	0.002	0.983
Low yield	-0.015	0.003	<b>0.000</b>
<b>Experience in farming cassava</b>			
Inputs price	-0.000	0.000	0.143

Choice	Coefficient	Standard Error	P-value
Resistance to Diseases	0.022	0.013	0.099
Sweet taste	-0.009	0.005	<b>0.089</b>
Low yield	0.005	0.010	0.607
<b>Project beneficiaries</b>			
Inputs price	-0.000	0.000	0.158
Resistance to Diseases	0.673	0.155	<b>0.000</b>
Sweet taste	0.067	0.062	0.281
Low yield	-0.373	0.114	<b>0.001</b>
<b>Distance to the market</b>			
Inputs price	-0.000	0.000	<b>0.000</b>
Resistance to diseases	-0.031	0.075	0.682
Sweet taste	0.079	0.030	<b>0.009</b>
Low yield	-0.132	0.055	<b>0.017</b>
CONST	-6.627	0.269	0.000
Number of observations = 8,448			
LR chi2(5) = 306.47			
Log likelihood = -2064.5098			
Prob > chi2 = 0.0000			

When the interaction of project members with cassava cuttings attributes is considered, findings show a positive and significant interaction with resistance to diseases (0.673\*\*\*) and significant negative interaction with low yield (-0.373\*\*\*). This means that cassava farmers, who were beneficiaries of a project, received improved cassava cuttings for free before, preferred cassava cuttings that are resistant to disease with a higher yield. Being part of project beneficiaries helps to solve problems linked to information asymmetry by providing to farmers knowledge and skills for the increasing adoption of new agricultural technology. This result is similar to those of Wossen *et al.* (2015) who concluded that being a project beneficiary and having access to credit provides respectively social capital and facilitates the acquisition of essential assets related to seed uptake in Ethiopia.

Furthermore, the distance to the market where farmers do sell their cassava produce shows a positive interaction with sweet taste (0.079\*\*\*) but a negative interaction with price (-0.000\*\*\*), and low yield (-0.132\*\*). This suggests that households living far from the market prefer input sold at lower price but which can provide higher yield and with sweetest taste. The results of this study are similar to those of Ulimwengu and Sanyal (2011) who found that market access was among factors that influence WTP for agriculture services in Uganda.



## **4 Conclusion and Recommendations**

### **4.1 Conclusion**

The focus of this study was to assess farmers' WTP for improved cassava cuttings attributes in Rugombo District, Burundi. FGD was used for cassava cuttings prioritization, while a DCE was carried out, along with a cassava farmer survey. Mixed logit model was used to assess preferences, WTP, and source of heterogeneity for cassava cuttings attributes.

Basing on the findings from DCE, farmers in the study area mostly prefer cassava cuttings with higher yield attribute, followed by resistance to diseases, sweet taste and early maturity attributes. A higher monetary value on WTP was shown on cassava cuttings with higher yield and resistance to diseases attributes. Cassava farmers were also willing to pay for sweet taste cassava cuttings and those with shorter maturity time. Interaction of respondents' profile with random cassava cuttings attributes show that preferences and WTP for cassava cuttings attributes are influenced by education level, land ownership status, cassava land size, level of experience in producing cassava, being a project beneficiary, and distance to the market where cassava is sold.

### **4.2 Recommendations**

Basing on the findings of this study, the following recommendations are suggested: The Ministry of Agriculture and private actors engaged in the multiplication of cassava cuttings in Burundi need to consider the attributes (higher yield, resistance to diseases, sweet taste, and early maturity attributes) preferred by cassava farmers in their intervention and action of improving cassava production in the country. Factors that influence preferences and WTP for improved cassava cuttings attributes (education level, land ownership status, cassava land size, level of experience in producing cassava, being a project beneficiary, and distance to the market) should be taken into consideration in promoting the use of agriculture technology in the study area. Also, the study recommends that farmers should be encouraged to adopt improved cassava cuttings as one way of improving their livelihoods and food security.

Moreover, the study recommends that, seed producers should look forward to establish sites in rural areas where farmers will have access to improved cassava cuttings.

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## References

- Acheampong, P. P., Owusu, V. and Nurah, G. (2018). How does farmer preference matter in crop variety adoption? The case of improved cassava varieties' adoption in Ghana. *Open Agriculture*, 3(1): 466-477.
- Almekinders, C.J., Walsh, S., Jacobsen, K.S., Andrade-Piedra, J.L., McEwan, M.A., de Haan, S., Kumar, L. and Staver, C. (2019). Why interventions in the seed systems of roots, tubers and bananas crops do not reach their full potential. *Food Security*, 11(1): 23-42.
- Aloys, N. and Hui Ming, Z. (2006). Traditional cassava foods in Burundi - A review. *Food Reviews International*, 22(1): 1-27.
- Assanvo, J.B., Agbo, G.N., Coulin, P., Monsan, V., Heuberger, C., Kati-Coulibaly, S. and Farah, Z. (2017). Influence of microbiological and chemical quality of traditional starter made from cassava on "attiéké" produced from four cassava varieties. *Food Control*, 78: 286 - 296.
- Awio, T., Alacho, F., Ijala, A. R., Ogwang, S.B., Aseere, G., Okello, G. and Otim-Nape, G.W. (2019). Pioneering commercialization of certified cassava seed production: Impacts on sustainable cassava production, income and wealth creation in Uganda. *International Journal of Agricultural Technology*, 5(1): 16 -23.
- Baidoo, I., and Amoatey, H. (2012). Willingness to pay for improvement in the agricultural activities of some six selected villages in west Akim district of Ghana (emphasis on cassava). *International Journal of Development and Sustainability*, 1(2): 326-337.
- Barratt, N., Chitundu, D., Dover, O., Elsinga, J., Eriksson, S., Guma, L., Haggblade, M., Haggblade, S., Henn, T.O. and Locke, F.R. (2006). Cassava as drought insurance: Food security implications of cassava trials in Central Zambia. *Agrekon*, 45(1): 106 - 123.
- Bigirimana, S., Bizimana, S., Barumbanze, P., Busungu, C. and Legg, J.P. (2007). Monitoring and diagnostic survey of cassava mosaic virus disease (CMD) in Burundi. *Plant Pathology*, 61(2).
- Bigirimana, S., Barumbanze, P., Ndayihanzamaso, P., Shirima, R. and Legg, J. P. (2011). First report of cassava brown streak disease and associated Ugandan cassava brown streak virus in Burundi. *New Disease Reports*, 24(26): 2044-0588.
- Bentley, J.W., Olanrewaju, A.S., Madu, T., Olaosebikan, O., Abdoulaye, T., Assfaw Wossen, T. and Tokula, M. (2017). Cassava farmers' preferences for varieties and seed dissemination system in Nigeria: gender and

- regional perspectives. IITA Monograph, Ibadan: IITA. [https://cgspace.cgiar.org › handle] site visited 12/09/2021.
- Debertin, D. L. (2012). *Agricultural Production Economics: The Art of Production Theory*. [https://uknowledge.uky.edu › agecon\_textbooks] site visited on 18/04/2021.
- David, S. (2003). *Developing sustainable seed supply systems*. [http://ciat-library.ciat.cgiar.org › highlight5.PDF]. Site visited 12/09/2021.
- ENAB 2015 - 2017, Enquête nationale agricole du Burundi (Burundi National Agricultural Survey) [https://bi.chm-cbd.net/fr/implementation/documents-envir-biodiv/enabi-campagne-2016-2017] site visited on 15/09/2021.
- Hensher, D.A., Rose, J.M., Rose, J.M. and Greene, W.H. (2005). *Applied Choice Analysis: A Primer*. Cambridge university press. 766pp.
- Hensher, D. A. and Greene, W. H. (2002). *The mixed logit model: The state of practice and warnings for the unwary*. Institute of Transport Studies, the University of Sydney and Monash University. [https://www.researchgate.net › publication › 24207689...] site visited on 18/04/2021.
- Howeler, R., Lutaladio, N. and Thomas, G. (2013). *Produire plus avec moins: Le manioc. Guide pour une intensification durable de la production*. Organisation Des Nations-Unies Pour L'alimentation Et L'agriculture. Rome, Italy. 128pp.
- Kimathi, S. (2020). *Preferences and Willingness to Pay. Supporting and Scaling Up Youth Agripreneurship in Kenya*. 54pp.
- Lambri, M., Fumi, M.D., Roda, A. and De Faveri, D.M. (2013). *Méthodes de traitement améliorées pour réduire la teneur totale en cyanure des racines de manioc du Burundi*. Journal africain de biotechnologie 12(19).
- Li, S., Cui, Y., Zhou, Y., Luo, Z., Liu, J. and Zhao, M. (2017). *The industrial applications of cassava: Current status, opportunities and prospects*. Journal of the Science of Food and Agriculture, 97(8): 2282–2290.
- Maggidi, I. (2019). *Cassava value chain: Willingness to pay for improved cassava planting material in coastal and Lake Victoria areas of Tanzania*. Unpublished dissertation submitted to Sokoine University of Agriculture, Tanzania for an award of Masters of Arts in Project Management and Evaluation. 193pp.
- McFadden, D. (1974). *Conditional logit analysis of qualitative choice behavior*. In Zarembka, P. (1974). eds. *Frontier in Econometrics*, 105-142.
- McFadden, D. (1986). *The choice theory approach to market research*. Marketing science 5(4): 275-297.
- McFadden, D. and Train, K. (2000). *Mixed MNL models for discrete response*. Journal of applied Econometrics 15(5): 447- 470.
- Mwalongo, S., Akpo, E., Lukurugu, G.A., Muricho, G., Vernooy, R., Minja, A. and Varshney, R. (2020). *Facteurs influençant les préférences et*

- l'adoption de variétés d'arachide améliorées parmi les agriculteurs en Tanzanie. *Agronomie* 10 (9): 1271.
- Nakabonge, G., Samukoya, C. and Baguma, Y. (2018). Local varieties of cassava: Conservation, cultivation and use in Uganda. *Environment, Development and Sustainability* 20(6): 2427-2445.
- Okonya, J.S., Ocimati, W., Nduwayezu, A., Kantungeko, D., Niko, N., Blomme, G., Legg, J.P. and Kroschel, J. (2019). Farmer reported pest and disease impacts on root, tuber, and banana crops and livelihoods in Rwanda and Burundi. *Sustainability* 11(6): 15 - 92.
- Rockers, P.C., Jaskiewicz, W., Wurts, L., Kruk, M.E., Mgomella, G.S., Ntalazi, F. and Tulenko, K. (2012). Preferences for working in rural clinics among trainee health professionals in Uganda: a discrete choice experiment. *BMC health services research* 12(1): 1-13.
- Ryan, M., Kolstad, J., Rockers, P. and Dolea, C. (2012). User guide with case studies: how to conduct a discrete choice experiment for health workforce recruitment and retention in remote and rural areas. Book user guide with case studies. City: World Bank. [[https://www.who.int › hrh › DCE\\_UserGuide\\_WEBPDF](https://www.who.int › hrh › DCE_UserGuide_WEBPDF)] site visited on 12/04/2021.
- Teeken, B., Olaosebikan, O., Haleegoah, J., Oladejo, E., Madu, T., Bello, A. and Tufan, H. A. (2018). Cassava trait preferences of men and women farmers in Nigeria: implications for breeding. *Economic Botany*, 72(3): 263-277.
- Train, K.E. (2009). *Discrete choice methods with simulation*. Cambridge University Press. 383pp.
- Uddin, E., Gao, Q. and Mamun-Ur-Rashid, M.D. (2016). Crop Farmers' Willingness to Pay for Agricultural Extension Services in Bangladesh: Cases of Selected Villages in Two Important Agro-Ecological Zones. *The Journal of Agricultural Education and Extension*, 22(1): 43-60.
- Ulimwengu, J. and Sanyal, P. (2011). Joint estimation of farmers' stated willingness to pay for agricultural services. *International Food Policy Research Institute Discussion Paper*, 1070.
- Vernier, P., N'zué, B. and Zakhia-Rozis, N. (2018). *Le manioc, entre culture alimentaire et filière agro-industrielle*. éditions Quae. 208pp.
- Walker, T. S. and Alwang, J. (2015). Crop improvement, adoption and impact of improved varieties in food crops in sub-Saharan Africa. Cabi. [<https://dx.doi.org › ...>] site visited on 15/10/2021.
- Wong, L.P. (2008). Focus group discussion: A tool for health and medical research. *Singapore Medical Journal* 49(3): 256-60.
- Wossen, T.T.B. and Di Falco, S. (2015). Social capital, risk preference and adoption of improved farm land management practices in Ethiopia. *Agricultural Economics* 46: 1-18.
- Wossen, T., Girma, G., Abdoulaye, T., Rabbi, I., Olanrewaju, A., Alene, A. and Manyong, V. (2017). *The Cassava Monitoring Survey in Nigeria*. IITA. Ibadan: Nigeria. 66pp.

# Effects of Formal Education and Agricultural Extension on Rice Productivity in Kilombero Valley of Morogoro Region: Implication for Agro-industrial Development in Tanzania

Mdoe, N.S.Y<sup>1\*</sup>, Mlay, G.<sup>1</sup>, Isinika, A.C<sup>2</sup>. and Boniface, G.<sup>3</sup>

## Abstract

Formal education and extension services are important for farmers to increase use of productivity enhancing inputs and practices and thereby increase supply of agro-industry raw materials as well as food for industrial workers. This paper uses the Agricultural Policy Research for Africa (APRA) survey data from 537 households in ten villages of Mngeta Division in Kilombero valley, Morogoro region, to determine the effects of formal education and agricultural extension services on rice productivity. Descriptive statistics are used to compare rice yields achieved by different categories of farmers while logarithmic regression analysis is used to determine if the focus variables of formal education and extension had significant effect on rice yield. *Ceteris paribus*, the descriptive statistics show higher rice yield level for farmers with formal education and access to extension services compared to farmers without formal education and access to extension services. However, logarithmic regression results indicate that extension had a significant effect on rice yield while formal education had insignificant effect on variation of rice yield. Other factors with significant effect on rice yield were labour input, age of household head, farm size category, type of tillage implement used and use of inorganic fertilizer. Although the coefficient of formal education in the regression results is not statistically significant, the positive sign shows that its practical or economic significance should not be ignored because formal education opens the mind of the farmer to knowledge while extension gives the farmer skills and better understanding of improved farming practices and keeps the farmer abreast with changes in agricultural innovations. Based on these findings it is recommended that the on-going government efforts to industrialize Tanzania should go hand in-hand with efforts to increase agricultural productivity. The efforts to increase productivity should focus on: (i) improving access to extension services, (ii) promoting use of modern tillage implements through establishment of centres where farmers can hire tractor services and including youth and small-scale farmers in policies and strategies geared to increase rice productivity and production.

**Key words:** Formal education, agricultural extension, productivity, agro-industrial development, Kilombero Valley-Tanzania

<sup>1</sup>Department of Agricultural Economics and Agribusiness, Sokoine University of Agriculture, Tanzania

<sup>2</sup> Institute of Continuing Education, Sokoine University of Agriculture, Tanzania

<sup>3</sup> Independent researcher based in Morogoro, Tanzania.

\*Corresponding Author: [nsymdoe@gmail.com](mailto:nsymdoe@gmail.com)

## 1 Introduction

Existing literature associates slow progress in agro-industrialization in sub-Saharan Africa (SSA) with low agricultural productivity. Agriculture creates forward linkages with agro-based industries through supply of its output as inputs or raw materials into agro-industries. Also, agriculture has strong backward production linkages with industries through demand for inputs such as fertilisers and pesticides as well as capital goods such as agricultural machinery and equipment, which are crucial for raising agricultural productivity. The forward and backward linkages can only be sustained if agriculture is productive. Apart from use of productivity enhancing technologies, farmers' education and extension services are among factors that combine with technology to influence agricultural productivity (Gebrehiwot, 2017; Danso-Abbeam *et al.*, 2018; Raidimi and Kabiti, 2019). The importance of education in the improvement of agricultural productivity stems from the fact that formal education opens up a farmer's mind to knowledge and keeps them abreast with changing innovations (Alamet *et al.*, 2009; Oduro-Oforiet *et al.*, 2014; Paltasingh, 2018). Meanwhile, extension service is important for enabling farmers to obtain 'know how' to adopt new methods of farming in order to increase their yields (Gêmoet *et al.*, 2013; Danso-Abbeam *et al.*, 2018; Tomaet *et al.*, 2018). Extension services also improve farmers' managerial and technical skills through facilitation and coaching (Owens *et al.*, 2003; Mbise, 2016; Danso-Abbeam *et al.*, 2018; Raidimi and Kabiti, 2019).

The effects of education and extension on agricultural productivity are widely documented. However, the evidence from the literature on the effects is mixed with studies reporting significant or insignificant positive relationship. Alene and Manyong (2007), Asadullah and Rahman (2009), Bayyurt and Yilmaz (2012), Abdulai and Huffman (2014), Fielike and Bardsley (2014), Oduro-Ofori *et al.* (2014), Ferreira (2018), Paltasingh and Goyari (2018), and Ninh (2020) report significant positive relationship between education and agricultural productivity while Narayanamoorthy (2000), Wadud and White (2000) and Coelli *et al.* (2002;2007) report insignificant positive relationship between education and agricultural productivity. In the case of Tanzania, Isinika (2007) similarly reported insignificant positive relationship between education and returns to investment in agricultural research, a necessary factor for improving agricultural productivity, but the coefficient for extension was positive and highly significant. On the contrary, Hasnah and Coelli (2004) found strong negative relationship between education and agricultural productivity. Likewise, available empirical evidence on effects of extension services on agricultural productivity is not conclusive. On the one hand Owens *et al.* (2003), Elias *et al.* (2013), Mbise (2016), Gebrehiwot (2017) and Danso-Abbeam *et al.* (2018) report significant positive effect while Evanson and Mwabu (2001) and Alene and Zeller (2005) report insignificant positive effect



of extension service on agricultural productivity. Reasons given for the significant or insignificant effect of extension service on agricultural productivity include (i) quality of extension service provided in a particular country in terms of timeliness of delivery, accuracy of delivery, relevance to the farmer's environment and ease of understanding of the extension messages (Angoloet *al.*, 2013; Danso-Abbeam, 2018;); (ii) extension approach used in a country. These approaches include but not limited to top down; participatory; demand-led; group versus individual targeting; private sector and free/paid extension services (Saliuet *al.*, 2009; Olayemi *et al.*, 2021; Sennuga and Olusegun, 2021); and access to productivity enhancing agricultural technologies (Mwangi and Kariuki, 2015; Donkor *et al.*, 2016; Ranjika-Walkisinghe *et al.*, 2017; Koutsouris, 2018; Masere, 2021). Poor access to productivity enhancing technologies will inhibit the effectiveness while good access will enhance the effectiveness of extension services in increasing agricultural productivity. The mixed evidence from the literature implies that it is hard to generalise about these variables, suggesting that country/location specific studies are required in order to enrich the existing literature and provide policy recommendations that are relevant to the situation in the country/location of interest. This paper examines the effects of formal education and extension services on rice productivity in Kilombero valley, Tanzania. The joint effect of the two variables is also examined.

## **2 Methodology**

### **2.1 Analytical Framework**

#### **2.1.1 Descriptive analysis**

Descriptive statistics including measures of central tendency (mean, median), dispersion (standard deviation) and t-test are used to compare rice yields achieved by: male versus female headed households, households headed by farmers with and without formal education, households with access versus those without access to extension services, small versus medium scale farmers, households using modern farm implements versus those using hand hoe and other variables hypothesised to influence rice yield such as use of purchased seed, fertiliser and herbicides. An independent t-static was used to test the hypothesis that there is no significant difference in rice yield between different categories of households that produced rice in 2016/17 farming season.

#### **2.1.2 Econometric analysis**

Analysis on the effect of focus variables which are formal education and access to extension service on rice yield was implemented on the basis of production theory. A Cobb Douglass production function relating rice yield to

levels of inputs used is presented in equation 1

$$Y_i = A_i S_i^{\beta_1} L_i^{\beta_2} H_i^{\beta_3} e^{\varepsilon_i} \quad (1)$$

Where  $Y_i$  = rice yield in t/ha for the  $i^{\text{th}}$  farmer

$S_i$  = Quantity of seed in kg/ha used by  $i^{\text{th}}$  farmer

$L_i$  = Total labour in man-days used by  $i^{\text{th}}$  farmer

$H_i$  = Quantity of herbicide in l/ha used by  $i^{\text{th}}$  farmer

$\varepsilon_i$  = Disturbance term associated with  $i^{\text{th}}$  farmer;  $\varepsilon_i | S, L, H \sim N(0, \sigma^2)$

$A_i$  = a parameter reflecting the efficiency of transforming the inputs into output (paddy) by  $i^{\text{th}}$  farmer. The efficiency will vary across plots and farmers, reflecting heterogeneity in plot and farmer characteristics. However, farmer characteristics remain the same across plots.

$\beta_1$  to  $\beta_3$  are partial elasticities of production ( $0 < \beta_i < 1$ )

Logarithmic transformation of equation 1 leads to equation 2;

$$\ln Y_i = \ln A_i + \beta_1 \ln S_i + \beta_2 \ln L_i + \beta_3 \ln H_i + \varepsilon_i \quad (2)$$

The efficiency of transforming the inputs into paddy is influenced by various factors namely: (i) use of hired labour, type of seed used, use of inorganic fertilizer; (ii) household head characteristics, which influence management practices, access to resources and risk aversion behaviour. The household head characteristics considered are: sex, age and level of education; (iii) extension; (iv) type of farmer based on farm size, and; (v) type of tillage implement used. These variables were modelled as shown in Table 1. Education and access to extension service are the focus variables hypothesised to have positive effect on rice yield. The other variables were included in the model as control variables because they could also affect rice yield.

Therefore  $\ln A_i$  can be presented as in equation 3;

$$\ln A_i = \theta_0 + \theta_1 \text{Fem}_i + \theta_2 \text{Ed}_i + \theta_3 \text{Age}_i + \theta_4 \text{Tfm}_i + \theta_5 \text{Ps}_i + \theta_6 \text{Ft}_i + \theta_7 \text{Mec}_i + \theta_8 \text{Ex}_i + \tau_i \quad (3)$$

Where:

Fem = A dummy variable assigned a value of 1 if the head was a female and 0 if a male.

Ed = A dummy variable assigned a value of 1 if household head had formal education and 0 otherwise.

Age = A dummy variable assigned a value of 1 if the head is a youth (up to 35 years) and a 0 if the head was elderly (above 35).

Tfm = A dummy variable assigned a value of 1 if medium scale farmer and a 0 if small scale farmer.



Ps = A dummy variable assigned a value of 1 if purchased seed was used and 0 otherwise.

Ft = A dummy variable assigned a value of 1 if inorganic fertilizer was used and 0 otherwise.

Mec = A dummy variable assigned a value of 1 if modern tillage implements (traction or tractor power or both) were used for tillage and 0 if only hand hoe was used.

Ex = A dummy variable assigned a value of 1 the rice farmer had access to extension service and 0 otherwise.

$\tau_i$  = is a disturbance term and  $\tau_i | , \dots ) \sim \text{normal}$  with zero mean and constant variance.

Replacing  $\ln A_{ij}$  by its expression in 3, the final equation which was estimated is presented in equation 4<sup>1</sup>

$$\ln Y_i = \theta_0 + \theta_1 Fem_i + \theta_2 Ed_i + \theta_3 Age_i + \theta_4 Tfm_i + \theta_5 Ps_i + \theta_6 Ft_i + \theta_7 Mec_i + \theta_8 Ex_i + \beta_1 \ln S_i + \beta_2 \ln L_i + \beta_3 \ln H_i + \gamma_i \quad (4)$$

Where Y is a composite error term equal to  $\epsilon + \tau$

Table 1 presents a summary of the variables in equation 4 including the expected signs of the coefficients.

**Table 1 :Independent variables and the expected signs**

Variable	Extended name	Expected sign
Fem	Sex of household head (hhd) =1 if female and =0 if male	+/-
Ed	Status of formal education of hhd= 1 if at least primary and =0 if none	+
Age	A dummy variable =1 if youth (up to 35 yrs) =0 if elderly (above 35 yrs)	+/-
Tfm	Type of farmer =1 if medium scale and =0 if small scale	+/-
Ps	Source of seed =1 if pursed and =0 otherwise	+
Ft	Use of inorganic fertilizer =1 if was used and =1 of was not used	+
Mec	Use of modern tillage implements =1 and =0 if only hand hoe	+
Ex	Access to extension service=1 if yes and =0 if no	+
S	Quantity of seed in kg/ha	+
L	Amount of labour in man days per hectare	+
H	Amount of herbicide in litres per hectare	+

<sup>1</sup> Interpreting the coefficients based on equation 4: the first part before the inputs is linear (it is based on log-lin functional form), while the part with inputs is based on log-log functional form. For the log-lin part, the coefficients associated with dummy variables are transformed as  $\exp(\text{coefficient}) - 1$  \* 100 and reflect a relative change in percent with respect to the reference group. Lastly for the inputs, (log-log part) the coefficients reflect a percent change of mean yield given a one percent change of an input, holding other factors unchanged.

## 2.2 Data

The paper uses data collected in October 2017 for the Agricultural Policy Research for Africa (APRA) from 537 commercial rice farmers. The data comprises of 463 small scale farmers (SSF) and 74 medium scale farmers (MSF) in 10 villages in Mchombe, Mngeta and Chita wards of Mngeta Division in the Kilombero Valley (KV). The SSF, defined to have up to 25 acres (10 hectares) of agricultural land (Jayne *et al.*, 2016), were selected randomly from lists of SSF constructed with the assistance of key informants from each of the 10 villages. The MSF, defined as those with more than 25 acres (10 hectares) of agricultural land (Jayne *et al.*, 2016) were selected randomly from lists of MSF constructed with the assistance of key informants from each of the 10 sample villages.

## 3 Results and Discussion

### 3.1 Descriptive Results

Of the two variables of interest, an independent t-test shows that only extension has a significant effect on rice yield variation. On average, farmers who had access to extension achieved significantly higher rice yield ( $p < 0.01$ ) than farmers without extension service in the 2016/17 farming season. Meanwhile, no significant difference was found in the mean rice yield between farmers with and without formal education (Table 2).

Variables other than education and extension with significant effect on yield are farm size category (small versus medium), type of tillage implement used, use of inorganic fertiliser and herbicide use (Table 2). On average, yields achieved by small scale farmers during the 2016/17 farming season were significantly higher ( $p < 0.05$ ) than those achieved by medium scale farmers, implying that small scale farmers were more productive than medium scale farmers. This finding supports the findings of existing empirical studies showing an inverse relationship between farm size and land productivity across Asia and Africa (Binswanger-Mkhize and McCalla 2010; Kadapalli and Bagalkoti 2014, Larson *et al.* 2014, Msangi *et al.*, 2021; Hazell 2020). Regarding the type of tillage implement used, farmers who used modern tillage implements (ox-plough and/or tractor) during the 2016/17 farming season achieved significantly higher yields ( $p < 0.01$ ) than farmers who used the traditional hand hoe. This finding is in line with the findings reported by Reza and Khan (2013) and Mdoe *et al.* (2020).

Rice is one of the most *labour-intensive crops* although the intensity depends on the rice farming system practiced. The System of Rice Intensification (SRI) is considered to have *higher* labour requirement than the traditional rice farming system (Kahimba *et al.*, 2014, Ches and Yamaji, 2016, Toungos, 2018). The high labour requirement compels farmers to hire labour to supplement family labour especially during weeding and harvesting. In

2016/17 farming season, 73.7% of the sampled farmers used hired labour to complement family labour. Farmers who used hired labour obtained significantly higher rice yields ( $p < 0.01$ ) than farmers who did not (Table 2). This suggests that hired labour was more productive than unpaid family labour as farmers who hired labour were able to undertake two or more weeding rounds per plot therefore improving yields while farmers who could not afford to hire labour failed to cope with the demand for weeding, and hence their yields were lower due to weed infestation. That is why there were a lot of substitutions of herbicides for hired labour, the rate of substitution being higher among female headed households in 2019 since they often faced more family labour constraints (Isinika *et al.*, 2020). With the exception of rice seeds, significant yield differences were found between farmers who used yield enhancing inputs and those who did not use them. According to Table 2, farmers who used inorganic fertiliser achieved significantly higher yields ( $p < 0.01$ ) than those who did not use it. This finding supports the findings by Misiko *et al.* (2011), Yengoh (2012), Sheahan *et al.* (2013) and Komarek *et al.* (2018). Of all the crop inputs, seed is a key input for production of any crop. Thus the need for using *quality improved seed to increase yield and crop production* cannot be overemphasized. In Kilombero valley, most rice farmers use either own seeds from previous year's harvest or purchased seeds mostly from neighbours. In most cases, the own seeds are local seeds although some farmers preserve harvested hybrid varieties of rice for seeds in the next farming season. On the other hand, purchased seeds are supposed to be seeds of improved rice varieties which are supposed to be purchased every farming season. Irrespective of the rice variety, farmers using own seeds from previous year's harvest are likely to obtain lower rice yield than farmers using purchased seed. Unfortunately most (78.3%) of the sampled farmers used own seeds preserved from the previous year's harvest. Independent t-test indicates insignificant mean difference between farmers who used purchased seeds and those who used own seeds preserved from the previous rice harvesting seasons in the 2016/17 farming season (Table 2). This suggests that the purchased seeds which were expected to be improved seeds with high yielding potential were fake seeds. They were sold as improved seeds but they could be traditional seeds or hybrid seeds preserved from previous years' harvest or seeds which had expired. Sale of counterfeit, adulterated, or otherwise low quality inputs is becoming a serious problem in Tanzania (Shao and Edward, 2014; Ngirwa, 2019). Use of fake rice seeds is among the constraints facing rice farmers in Tanzania as reported by Nkuba *et al.* (2016) and Kangile *et al.* (2018).

**Table 2: Results of descriptive analysis**

Variable	N	Rice yield (tons/ha)		Mean difference	Sed	T-Stat	P-Value
		Mean	Median				
Sex of household head:							
Male	443	2.43	2.38				
Female	62	2.38	2.28	0.05	0.18	0.0257	0.729
Age of household head:							
Youths (35 years and below)	121	2.54	2.56				
Older farmers (Above 35 years)	384	2.37	2.22	0.21	0.13	1.625	0.105
Education of household head:							
With Formal	448	2.45	2.41				
Without formal	57	2.20	2.17	0.25	0.19	1.317	0.503
Access to extension:							
Has access	222	2.76	2.59				
No access	283	2.16	2.12	0.60***	0.12	5.151	0.000
Farm size category:							
Medium scale	90	2.11	1.86				
Small scale	415	2.49	2.47	- 0.38**	0.15	-2.483	0.013
Tillage implements used:							
Modern	451	2.47	2.47				
Hand hoe only	54	1.98	1.51	0.49***	0.19	2.612	0.009
Use of hired labour:							
Used	372	2.6	2.5				
Didn't use	133	1.9	1.9	0.68***	0.17	5.17	0.000
Use of inorganic fertilizer:							
Used	74	3.24	3.09				
Didn't use	429	2.28	2.22	0.96***	0.20	4.860	0.000
Use of herbicide:							
Used	308	2.50	2.40				
Didn't use	195	2.30	2.31	0.20*	0.12	1.754	0.08
Type of seed used:							
Purchased	109	2.57	2.52				
Own seed	394	2.38	2.28	0.19	0.14	1.317	0.507

### **3.2 Regression Results: Effect of Formal Education and Extension on Rice Yield in Kilombero Valley**

The net effect of education and extension was estimated by controlling for other factors including production inputs. According to results presented in Table 3, factors with significant influence on rice yield were age of household head, extension, farm size category, type of tillage implement used, use of inorganic fertiliser and quantity of labour used. All the three production inputs had the expected signs but only labour had a significant effect on rice

yield ( $p < 0.1$ ). The partial elasticity estimate of 0.02 for labour implies that a one percent increase in labour would increase mean rice yield per hectare by about 0.02 percent, holding other factors unchanged. As expected the two focus variables (education and extension) have positive signs, implying that formal education and access to extension services enhance rice yield. However, it is important to note that the coefficient of formal education was not significant while the coefficient of extension was positive and highly significant. This can be due to the fact that majority of the sample farmers had attended primary education and hence it is not a major source of variation in productivity performance among farmers. Also it can be due to the fact that success in improving agricultural productivity hence commercialisation depends largely on enhancing farmers' technical and managerial skills rather than the level of formal education (Gêmoet *et al.*, 2013; Danso-Abbeam *et al.*, 2018, Toma *et al.*, 2018).

Using the formula under footnote 1 in the methodology section, we can infer the following from the factors with significant effect on yield efficiency: Access to extension which is the main focus of this study, increased mean rice yield by about 16.5 percent under ceteris paribus condition. The mean rice yield among young farmers was higher than that of older farmers by about 11.4 percent, holding other factors the same, while the mean rice yield of medium scale farmers was lower than that of small scale farmers by about 17.1 percent under ceteris paribus conditions. The use of inorganic fertilizer increased mean rice yield by about 22.1 percent holding other factors unchanged, while use of modern tillage implements increased mean rice yield by about 18.5 percent compared to use of hand hoe only maintaining other factors unchanged.

**Table 3: Determinants of rice yield in Kilombero Valley**

Independent variable	Coefficient	Robust se	T	$p >  t $
Constant	0.2728	0.2112	1.29	0.197
Sex of hh (fem=1)	0.0214	0.0619	0.35	0.730
Education of hh (ed=1)	0.0041	0.0535	0.08	0.939
Age of hh (youth=1)	0.1079***	0.0392	2.75	0.006
Type of farmer (MSF=1)	-0.1881***	0.0526	-3.58	0.000
Purchased seed (Ps=1)	0.0047	0.0423	0.11	0.912
Inorganic fertilizer (Ft=1)	0.2002***	0.0523	3.83	0.000
Mechanization status (Mec=1)	0.1700***	0.0598	2.84	0.005
Extension (ex=1)	0.1525***	0.0350	4.36	0.000
Ln S (log of seed)	0.0367	0.0318	1.15	0.250
Ln L (log of labour)	0.0782***	0.0213	3.67	0.000
Ln H (log of herbicide)	0.0156	0.0244	0.64	0.523
n=502; F=6.43 Prob >F=0.000; R <sup>2</sup> =0.15				

## **4. Conclusions and Recommendations**

The objective of the paper was to determine the effect of formal education and extension on rice yield (productivity). The findings show higher rice yield level for farmers with access to extension services compared to farmers without access to extension services, mean yield being higher by about 15 percent under *ceteris paribus* conditions. However, in the case of education, while a correct positive sign was maintained, no significant effect was observed between farmers with formal education and those without formal education under *ceteris paribus* conditions. The lack of statistical significance does not imply absence of practical or economic significance since while statistical significance is dependent on the magnitude of a coefficient and standard error, practical/economic significance is dependent on the size of the coefficient and the sign (Wooldridge, 1985 pg. 135). In our specific case, the effect of education is very low, being only 0.4 percent above farmers without formal education, which is not surprising since formal education in the sample was primary education. Other factors with significant effect on rice yield were labour input, age of household head, farm size category, type of tillage implement used and use of inorganic fertiliser. The paper concludes that although the coefficient of formal education in the econometric results is not statistically significant, it does not mean formal education has no economic or practical significance. Formal education is important, it opens up the minds of farmers to knowledge while extension whose coefficient is significant gives the farmer skills and better understanding of improved farming practices and keeps the farmers abreast with changes in agricultural innovations. Based on the findings it is recommended that the on-going government efforts to industrialize Tanzania should go hand in-hand with efforts to increase agricultural productivity and thereby supply industrial raw materials and food for industrial workers. The efforts to increase productivity should include the following:

- (i) Enhancing farmers' access to extension services for promoting use of yield enhancing inputs such as improved seeds and fertilizer as well as use of improved farming practices such as optimum spacing and timely weeding.
- (ii) Promoting use of modern tillage implements through establishment of centres where farmers can hire tractor services and;
- (iii) Including youth and small-scale farmers in policies and strategies geared towards increasing agricultural production instead of targeting medium scale farmers only.



## References

- Abdulai, A. and Huffman, W. (2014). The adoption and impact of soil and water conservation technology: An endogenous switching regression application. *Land Economics*, 9 (1): 26-43
- Alam, G.M., Hoque, K.E., Khalifa, T.B., Siraj, S. B. and Ghani, M.F.B.A. (2009). The role of education and training on agricultural economic and national development of Bangladesh. *African Journal of Agricultural Research*, 4(12):1334-1350
- Alene, A. and Manyong, V. (2007). The effects of education on agricultural productivity under traditional and improved technology in Northern Nigeria: An endogenous switching regression analysis. *Empirical Economics*, 32 (1): 141-159
- Alene, A.D. and Zeller, M. (2005). Technology adoption and farmer efficiency in multiple crops production in eastern Ethiopia: A comparison of parametric and non-parametric distance functions. *Agricultural Economics Review*, 8 (1): 5-17
- Asadullah, M.N. and Rahman, S. (2009). Farm productivity and efficiency in rural Bangladesh: The role of education revisited. *Applied Economics*, 41 (1): 17-33
- Bayyurt, N. and Yilmaz, S. (2012). The impacts of governance and education on agricultural efficiency: An international analysis. *Procedia-Social and Behavioural Sciences*, 58: 1158-1165
- Binswanger-Mkhize, H. and McCalla, A.F. (2010). The changing context and prospects for agricultural and rural development in Africa. In P. Pingali and R. Evenson (Eds.), *Handbook of agricultural economics*, 4: 3571-3712.
- Ches, S. and Yamaji, E. (2016). Labor requirements of system of rice intensification (SRI) in Cambodia. *Paddy and Water Environment*, 14:335-342
- Danso-Abbeam, G., Ethiakpor, D. S. and Aidoo, R. (2018). Agricultural extension and its effect on farm productivity and income. Insights from northern Ghana. *Agriculture and Food Security*, 7:74.
- Donkor, E., Owusu-Sekyere, E., Owusu, V. and Jordaan, H. (2016). Impact of agricultural extension service on adoption of chemical fertilizer: Implications for rice productivity and development in Ghana. *NJAS - Wageningen Journal of Life Sciences*, 79: 41-49.
- Elias, A., Norhimi, M., Yasunobu, K. and Ishida, A. (2013). Effect of agricultural extension program on smallholders' farm productivity: Evidence from three peasant Associations in highlands of Ethiopia. *Journal of Agricultural Science*, 5 (8): 163-180.
- Evanson, R.E. and Mwabu, G.M. (2001). The effects of agricultural extension on farm yields in Kenya. *African Development Review*, 13 (1): 1-23.



- Ferreira, T. (2018). Does education enhance productivity in smallholder agriculture? Causal evidence from Malawi. Stellenbosch Economic Working Paper WP05/2018. [www.ekon.sun.ac.za/wpapers/2018/wp052018] site visited on 22/2/2022.
- Fielike, S.J. and Bardsley, D.K. (2014). The importance of farmer education in South Australia. *Land Use Policy*, 39: 301-312.
- Gebrehiwot, K.G. (2017). The Impact of agricultural education on farmers' technical efficiencies in Ethiopia: A stochastic frontier production function approach. *South African Journal of Economics and Management Sciences*, 20 (1): 2017.
- Gêmo, H. R., Stevens, J. B., Chilonda, P. (2013). The role of a pluralistic extension system in enhancing agriculture productivity in Mozambique. *South African Journal of Agricultural Extension*, 41 (1), January 2013.
- Hasnah, E.F. and Coelli, T. (2004). Assessing the performance of a nucleus estate and smallholder scheme for oil palm production in Western Sumatra: a stochastic frontier analysis. *Agricultural Systems*, 79 (1): 17-30
- Hazell, P. (2020). Importance of Smallholder Farms as a Relevant Strategy to Increase Food Security. In: Gomez, Y. Paloma, S., Riesgo, L., Louhichi, K. (eds), *The Role of Smallholder Farms in Food and Nutrition Security*. Springer, Cham.
- Isinika, A.C. (2007). Evaluating Agricultural Research and Extension in Tanzania: The Production Function Approach. In P. Anandajayasekeram, M. Rukuni, S. Babu, F. Liebenberg and C. L. Keswani, *Impact of Science on African Agriculture and Food Security*. CABI International: pp. 127-136 [DOI: 10.1079/9781845932671.0127] site visited on 18/2/2022.
- Kadapalli, R.G. and Bagalkoti, S. (2014). Small Farms and Agricultural Productivity. A Macro Analysis. *International Journal of Social Science Studies*, 2(3).
- Kahimba, F.C., Kombe, E.E. and Mahoo, H.F. (2014). The Potential of System of Rice Intensification (SRI) to Increase Rice Water Productivity: A Case of Mkindo Irrigation Scheme in Morogoro Region, Tanzania. *Tanzania Journal of Agricultural Sciences*, 12 (2): 10-19.
- Koutsouris, A. (2018). Role of Extension in Agricultural Technology Transfer: A Critical Review. In: Kalaitzandonakes, N., Carayannis, E., Grigoroudis, E., Rozakis, S. (eds) *From Agri-science to Agribusiness. Innovation, Technology, and Knowledge Management*. Springer, Cham [https://doi.org/10.1007/978-3-319-67958-7-16] site visited on 28/5/2022.
- Jayne, T.S., Chamberlin, J., Traub, L., Sitko, N., Muyanga, M., Yeboah, F.K., Anseeuw, W., Chapoto, A., Wineman, A., Nkonde, C. and Kachule, R. (2016). Africa Changing Farm Size Distribution Patterns: The Rise of Medium Scale Farms'. *Agricultural Economics*, 47(2016): 197-214.

- Kangile, R.J., Gebeyehu, S. and Mollel, H. (2018). Improved rice seed use and drivers of source choice for rice farmers in Tanzania. *Journal of Crop Improvement*, 32 (5): 622-634.
- Komarek, A.M., Koo, J., Wood-Sichra, U. and You, L. (2018). Spatially-explicit effects of seed and fertilizer intensification for maize in Tanzania. *Land Use Policy*, 78: 158-165
- Larson, D., Otsuka, K., Matsumoto, T. and Kilic, T. (2012). Should African rural development strategies depend on smallholder farms? An exploration of the inverse-productivity hypothesis. *Agricultural Economics*, 45(3):
- Masere, P. (2021). Influence of public agricultural extension on technology adoption by small-scale farmers in Zimbabwe, *South African Journal of Agricultural Extension*, 49 (2): 25-42
- Misiko, M., Tittone, P. and Giller, K.E. et al. (2011) Strengthening understanding and perceptions of mineral fertilizer use among smallholder farmers: evidence from collective trials in western Kenya. *Agriculture and Human Values*, 28: 27-38
- Mbise, M. (2016). The impact of extension services on agricultural production: a case of maize in Ludewa District of Njombe Region, Tanzania. RUFORUM Working Document Series No. 14 (4): 105-111. [<http://repository.ruforum.org>] site visited on 18/2/2022.
- Mdoe, N., Mlay, G., Isinika, A., Boniface, G. and Magomba, C. (2020). Effect of Choice of Tillage Technology on Commercialisation and Livelihood of Smallholder Rice Farmers in Mngeta Division, Kilombero District, Tanzania, Working Paper 37, Brighton: Future Agricultures Consortium [<https://www.future-agricultures.org/publications/>] site visited on 18/2/2022.
- Msangi, H.A, Mdoe, N.S.Y. and Ndyetabula, D.W. (2021). Examining the inverse relationship between farm size and efficiency in Tanzania's agriculture. *Eastern and Southern Africa Journal of Agricultural Economics and Development*, 11(2): 1-17.
- Mwangi, M. and Kariuki, S. (2015). Factors determining adoption of new agricultural technology by smallholder farmers in developing countries. *Journal of Economics and Sustainable Development*, 6 (5).
- Narayanamoorthy, A. (2000). Farmers' education and productivity of crops: a new approach. *Indian Journal of Agricultural Economics*, 55 (3): 511-519.
- Ninh L.K. (2020). Economic role of education in agriculture: Evidence from rural Vietnam. *Journal of Economics and Development*, 1(2): 110 - 133.
- Nkuba, J., Ndunguru, A., Madulu, R., Lwezau, D., Kajiru, G., Babu, A., Chalamila, B. and G. and Ley, G. (2016). Rice value chain analysis in Tanzania: Identification of constraints, opportunities and upgrading strategies. *African Crop Science Journal*, 24 (1): 73 - 87.
- Ngirwa, C.C. (2019). A mobile based system for pesticide authenticity verification: A case of Tanzanian market. Unpublished Master's in

- Information and Communication Science and Engineering. Nelson Mandela African Institution of Science and Technology. [<http://dspace.nm-aist.ac.tz/handle/123456789/255>] site visited on 21/2/2022.
- Oduro-ofori, E., Prince, A.A. and Alfreda, A.N.A. (2014). Effects of education on agricultural productivity of farmers in the Offinso Municipality. *International Journal of Development Research*, 4 (9): 1951-1960
- Olayemi, S.S.; Ope-Oluwa, A.A. and Whiteley, A.C. (2021). Evolution of agricultural extension models in Sub-Saharan Africa: A critical review. *International Journal of Agricultural Extension and Rural Development Studies*, 8 ((1):29-51
- Owens, T., Hoddinott, J. and Kinsey, B. (2003). Impact of agricultural extension on farm productivity in resettlement areas of Zimbabwe. *Economic Development and Cultural Change*, 51 (1): 337-357
- Paltasingh, K.K. and Goyari, P. (2018). Impact of farmer education on farm productivity under varying technologies: Case of paddy growers in India. *Agricultural and Food Economics*, 6.
- Raidimi, E.N. and Kabiti, H.M. (2019). A review of the role of agricultural extension and training in achieving sustainable food security: A case of South Africa. *South African Journal of Agricultural Extension*, 47(3): 120-130.
- Ranjika-Walisinghe, B., Ratnasiri, S., Rohde, N. and Guest, R. (2017). Does agricultural extension promote technology adoption in Sri Lanka. *International Journal of Social Economics*, 44(12).
- Reza, M.S. and Khan, M.H. (2013). Impact of Farm Mechanization on Productivity and Profitability of Rice Farm in Rajshahi District. *Bangladesh Journal of Political Economy*, 29 (1): 169-188.
- Saliu, J.O., Obinne, P.C. and Audu, S.I. (2009). Trends in agricultural extension services in Africa: Option for new approaches. *Journal of Agricultural Extension and Rural Development*, 1(3): 071-076.
- Sennuga, O.S., Alo, A. and Olusegun, S. (2021). Agricultural extension theories and practice in Sub-Saharan Africa: A critical review. *The Journal of Agricultural Science*, 1(1):20-28
- Shao, D. and Edward, S. (2014). Combating Fake Agro-Inputs Products in Tanzania using Mobile Phones. *International Journal of Computer Applications*, 97(17): 21-25.
- Sheahan, M., Black, R. and Jayne, T. S. (2013). Are Kenyan farmers under-utilizing fertilizer? Implications for input intensification strategies and research. *Food Policy*, 41: 39-52.
- Toma, L., Barnes, A.P., Sutherland, L.A., Thomson, S., Burnett, F. and Mathews, K. (2018). Impact of information transfer on farmers' uptake of innovative crop technologies: a structural equation model applied to survey data. *Journal Technology Transfer*, 43: 864-881.

- Toungos M.D. (2018). System of Rice Intensification: A Review. *International Journal of Innovative Agriculture and Biology Research* 6 (2): 27-38
- Wadud A and White B (2000). Farm household efficiency in Bangladesh: A Comparison of stochastic frontier and DEA methods. *Applied Economics*, 31(13): 1665-1673.
- Wooldridge, J. M. (2013). *Introductory Econometrics: A Modern Approach*. Mason, OH: South-Western, Cengage Learning [www.cengagebrain.com] site visited on 25/5/2022.
- Yengo, G.T. (2012). Determinants of yield differences in small-scale food crop farming systems in Cameroon. *Agriculture and Food Security*, 1(19).

# Employment Creation through Social Networks in Emerging Urban Centres of Rural Tanzania

Nyaki, S.A.<sup>1</sup>, Kilima, F.T.<sup>2</sup> and Larsen, M.N.<sup>3</sup>

## Abstract

*Development of non-farm businesses in Emerging Urban Centres (EUCs) is pivotal in increasing employment opportunities to resource curtailed rural population. This paper aims to examine how businesses use social networks to recruit labour and how the size of their social network influences employment creation in EUCs. A survey of 459 and 296 randomly selected businesses in Ilula and Madizini EUCs respectively was done in 2017 and was supported by information from 38 key informants. Descriptive analysis revealed that strong and weak social network ties were instrumental in recruiting labour. Crop value chains (tomato in Ilula and paddy in Madizini) generated a ripple of employment opportunities in businesses like wholesale, trading, manufacturing, and construction through multiplier effect. Left censored Tobit regression revealed that the likelihood of creating more employment opportunities in Madizini and Ilula was improved by increasing the size of business network and forging linkages with well-networked businesses. Thus, just as social networks are revealed to play a major role in recruiting labour and employment opportunities around EUCs, they are also important in supporting future employment creation prospects. This is important in rural areas where informal sector is dominant. Employment creation efforts should therefore be capitalised along major crop value chains which provide forward and backward linkages to wholesale, crop trading, manufacturing, and construction business sub-sectors.*

**Key-words:** Emerging Urban Centres, Social networks, Employment creation, Tanzania.

## 1 Introduction

The importance of businesses on employment creation has been widely documented (Henrekson and Johansson, 2010; Rotar *et al.*, 2019). In the developing world, small businesses account for the majority of the employment opportunities created. According to ILO (2019), businesses account for an average of 70 percent of all employment created globally, the highest proportions (90 percent) being in low-income countries and 58 percent among high-income countries. Most of these jobs are in agriculture, industry and manufacturing, and service sectors (Fragkos and Paroussos, 2018; Wang and Chanda, 2018). In sub-Saharan Africa and in Tanzania about 44 percent and 58 percent of working population are into non-farm business, respectively

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<sup>1</sup>Department of Agricultural Economics and Agribusiness, Sokoine University of Agriculture, Tanzania

<sup>2</sup>Department of Economics and Statistics, Moshi Cooperative University, Tanzania

<sup>3</sup>Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark

\*Corresponding Author: [stepheniseth@gmail.com](mailto:stepheniseth@gmail.com)

(Diao *et al.*, 2018; Nagler and Naude, 2014). About 42 percent of the total employment is created in rural areas of sub-Saharan Africa (Nagler and Naude, 2017).

As economic transformation is taking pace in the rural areas of sub-Saharan Africa, particularly Tanzania where rural population is growing and the share of farm employment is declining, majority of rural population struggle to find non-farm business/employment mainly around EUC (Lazaro *et al.*, 2019; Steel *et al.*, 2019). However, access to necessary capital, business information and employment opportunities for rural residents is more constrained relative to the town/cities. Behind these hurdles Kristiansen (2003) clarifies that rural businesses employ their social networks like friends, family and trade partners to obtain capital, recruit labour and obtain market information. Social networks are identified to influence information, capital and labour flow to serve economic activities such as business investments (Gee *et al.*, 2016; Goyal, 2016). Inherent social relations which are stronger in rural areas have been a vehicle for rural labour to obtain jobs and recruit productive labour into non-farm businesses. However, there is a limited empirical literature which describe how social networks have aided resource constrained individuals in rural areas to obtain labour and employment opportunities.

A large body of literature aligned with social network analysis (Bian *et al.*, 2015; Xiong *et al.*, 2017) has documented social networks as a key tool to signal or transfer and shape labour recruitment in both the formal and informal sectors. Hällsten *et al.* (2017), and Hensvik and Skans (2016) argue that social networks have been influential in conveying information about employment opportunities to both employers and workers. Social networks through provision of information, goods and services, capital and labour (Mabadu, 2014; Nolan *et al.*, 2017) are thus presumed to play a significant role in recruiting labour and influencing business development in small towns. This study is motivated and is in line with the government Employment Policy of 2008, especially on increasing employment particularly in rural areas where individuals and firms are highly constrained by unsupportive business and employment climate (URT 2008; 2010). Thus, a realisation of social networks as instrument to aid employment creation meanwhile circumventing inhibiting factors is of a crucial importance to this study.

This paper examines the role of social networks in employment creation among businesses in EUCs of Ilula and Madizini townships in Tanzania. Specifically, it examines the role of strong and weak social network ties in recruiting/allocating temporary and waged employees to businesses. It also examines potential effect of social networks on employment creation. The analysis tests the hypothesis that the size and influence of business owner's



social networks characteristics have no significant effect on employment creation among businesses in the EUCs.

Social networks are often discussed from a relational point of view with a greater focus on the strength of ties (conceptualized as strong and weak ties) an actor maintains, which in turn dictates the amount and quality of resources they receive from the network. Regarding labour allocation, strong network ties are mostly those with family, relatives and friends, while weak network ties are linked to occupational acquaintances, partners and institutions – these are acclaimed to play an instrumental role in employment creation (Granovetter, 2018). However, literature has a mixed view on who plays a leading role in influencing employment creation. According to Granovetter (1973) and Brady (2015), weak ties have been proved instrumental in effecting employment creation, while strong ties like family and friends are perceived to be less effective. This is based on the argument that strong ties tend to involve actors who are less connected to individuals with relevant information to facilitate employment creation. In contrast, weak ties, which are normally based on occupational acquaintances, involve actors who are spatially linked than strong ties. Weak ties are reported to be used by migrants to find work, particularly in urban areas, where strong or close ties of family and friendship might be rare (Lancee, 2016). While weak ties are considered beneficial in accessing distant and non-redundant (new) information, Kim and Fernandez (2017), and Kramarz and Skans (2014) show that weak ties are less likely to share information about job opportunities than the strong ties. These conflicting views, however, emerge from the heterogeneity of populations and perspectives (Gee *et al.*, 2017). By contrast, most of these studies target uniform populations like students and formal institutions like companies (Barbulescu, 2015).

Meanwhile, the discussion of social networks dwelt on relational aspect (Kim and Fernandez, 2017; Tian and Liu, 2018) network attributes, like the size and influence of such relations measured by degree and eigenvector centrality, are presumed to be instrumental in inducing employment creation and subsequent business development. Kuépié *et al.* (2015), for instance, have shown that expanding business network connections resulted in an increase in firm profits among small businesses in West Africa. This was however, conditional on the actor a firm is linked to. Berrou and Combarnous (2011) further show that expanding one's size of social network broadens the scope of one's resources, especially in accessing information and finance, both of which are vital to improving business performance and employment creation. The impact of social networks on businesses is acclaimed to be realized if businesses struggle to broaden their connections, as networks tend to favour the well-connected rather than well-qualified actors (Tenikue and Walther, 2014). This network configuration is important in guaranteeing the acquisition



of better resources, business development and subsequent employment creation (Arregle *et al.*, 2015). Thus, while network size and the relevance of the connected nodes emerge as key components, establishing their effect on employment creation is important.

The current discussion around employment creation reveals notable differences with respect to definitions and applications. The total employment created by a sector or business is perceived to be a combination of direct, indirect and induced employment (Kweka *et al.*, 2003). Direct employment refers to wage employment. Indirect employment entails hiring a service for an entity, while induced employment occurs through expenditure on consumption of income generated from direct and indirect employment. Thus, the actual amount of employment created is a product of sector multipliers and direct employment (Kweka *et al.*, 2003). However, in small-town settings where the informal sector is dominant, multiplier indices can hardly paint the actual situation (Mendez-parra, 2015). Other studies, such as Henley (2007), and Henrekson and Johansson (2010), have examined employment creation from a self-employment perspective, which largely targets small businesses or entrepreneurs (see also Parker, 2004 and Cowling *et al.*, 2004). The perspective was connected to the argument that a transition from being a sole trader to having shareholders and employees provides a significant economic contribution to employment creation.

The effect of social networks on employment creation has been analysed differently across the literature. Brady (2015) modelled social network size and strength based on the frequency of interactions however, this approach differs from a standard measurement of network strength as suggested by Granovetter (1973). According to Granovetter (1973) the strength of ties relies on the time, intimacy, emotional intensity, and reciprocal services that characterize it. Burns *et al.*, (2010) conversely employed mean neighbourhood characteristics as a proxy for social networks, which might introduce omission biases. Network size as measured by the number of ties (degree) and influence, given the degree of connections with neighbouring nodes, are presumed to be the best way to measure the bases of business owners' social networks. In this study, these methods are therefore used to determine the effect of social networks on employment creation in small towns.

## 1.2 Theoretical Framework

The paper employs social network theory, which is contextualized as a social system that focuses on relationships between the entities that make up a system, which are called actors or nodes (Borgatti *et al.*, 2013). The relationships between these actors are represented as ties or links. The type of

relationship that an actor or business has, whether strong or weak, depends on time, emotions and intimacy, and the reciprocal sharing of services (Granovetter, 1973). These interactions play a crucial role in the success of an enterprise. The relationship between weak and strong ties and its contribution to labour market studies is drawn from the theory of social capital as a component of the general social network. According to Lin (1999), social capital is defined as investment in social relations with expected returns. It also encapsulates trust, norms and shared values (Brady, 2015). In this study a network view of social capital as a relational good is employed to explain how the type, size and influence of their social connections might affect employment creation.

## **2 Methodology**

### **2.1 Study Sites**

The study was done in Ilula and Madizini EUCs. The two EUCs were selected amongst four EUCs (Ilula, Kibaigwa, Madizini, and Igowole) from Rural Urban Transformation (RUT<sup>1</sup>) project. This was because the EUCs have registered rapid economic growth in the last decade creating employment opportunities mainly around tomato, paddy, and sugarcane crop value chains. Geographically, Ilula and Madizini EUCs are in the rural parts of Iringa and Morogoro regions respectively (see Figure 1). Ilula is in Kilolo District, about 50 kilometres East of Iringa Regional Offices, while Madizini is in Mvomero District, about 92 kilometres North of Morogoro Regional Offices. Satellite and Google maps were used to delineate areas of the EUC with high settlement/built-up areas and zones where most businesses were located. Ilula EUC is made up of Ilula and Nyalumbu wards, while Madizini EUC is part of Mtibwa ward.

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<sup>1</sup>Rural-Urban Transformation (RUT): Economic Dynamics, Mobility and Governance of Emerging Urban Centres for Poverty Reduction is a collaborative project between School of Agricultural Economics and Business Studies of Sokoine University of Agriculture and Department of Geosciences and Natural Resource Management (DGNRM), Geography Section, of University of Copenhagen. RUT is designed to primarily contribute to Tanzania as well as DANIDA's priority to reduce poverty.



manufacturing and processing, which included businesses like tailoring, tomato- and paddy-processing, brickmaking and manufacture and carpentry; and transportation, which comprised trucking, motorcycles (*"bodaboda"*) and tricycle businesses.

Each business owner was asked to name a maximum of eight people with whom they frequently traded and shared information in 2016. The survey was conducted to ensure spatial coverage of all kinds of businesses in the EUCs' marked areas with the aim of uncovering the existing business networks and employment creation status. A total of 459 businesses in Ilula and 296 businesses in Madizini were surveyed, and the scope of the study was limited to business-to-business ties and businesses within the EUCs' respective boundaries.

In order to supplement the information on networks obtained by means of the questionnaire, qualitative data were also collected through key informant interviews and focus-group discussions. Interviews were conducted with the Township and/or Ward administration, elders, financial institutions (including banks and other financial intermediaries such as SACCOS<sup>1</sup> and VICOBA<sup>2</sup>), Tanzania Revenue Authority, Mtibwa Sugar Company, Mvomero and Kilolo District offices, business associations and Township Trade Officers. Focus-group discussions were carried out with members of business associations, including two *"bodaboda"* groups and two furniture manufacturing groups, as well as one youth group. All interviews were conducted with the aid of semi-structured interview guides that contained questions related to the historical development of the businesses, labour movements and employment-creating ventures that were fast developing in the EUCs.

## **2.4 Analytical Methods**

The paper employs descriptive statistics, multivariate analysis, and content analysis to analyse both quantitative and qualitative information. Descriptive statistics employed were frequencies, means and standard deviation. To examine the likelihood of employment creation, a log-transformed left-censored Tobit model of employment creation was estimated. The explained variables included total employment, which was obtained by aggregating own employment with the number of waged employees, unpaid family labour and indirect employment. Owning a business was also regarded as employment created for the business owner. This is because an ability to

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<sup>1</sup> The Savings and Credit Co-operative Society is an informal financial intermediary receiving savings and providing credit to the registered members of a community.

<sup>2</sup> Village Community Banks are informal savings and lending institutions which mainly supplies the credit demands of low-income community members.

establish a business venture is considered employment creation as it optimizes the use of one's own labour, apart from being formally employed. Indirect employment was computed as the sum of employment created through hiring processes, including casual labour to transport, load, unload, and storing goods. Other forms of indirect employment included people hired to provide security services and act of hiring office space. The total employment data was observed to be left-skewed, as a large proportion of businesses operated as sole proprietors. This study adopted an estimate proposed by Carson and Sun (2007), whereby a log-normal variant of the standard Tobit model to obtain the maximum likelihood estimators was introduced, assuming a non-zero threshold of one. The model measures the likelihood of creating employment based on its inherent owner, business, farm, and network characteristics.

The independent variables that entered a log-variant Tobit equation were the logarithms of weighted degree centrality and eigenvector centrality, introduced to the model as indicators of the size and influence of EUC social networks. Weighted degree centrality was obtained by weighting combined buying and selling networks. Degree centrality is a measure of the number of ties a node has relative to the total number of ties in the entire network. Eigenvector centrality measures the influence or importance of a node based on its connections in the network. The influence of a node is based on a comparison of its degree centrality relative to the degree centrality of its adjacent nodes (Borgatti *et al.*, 2013). Bonacich and Lloyd (2001) developed a beta centrality measure  $C_{CB}$  with a parameter  $\alpha$  for adjusting the importance of a node's degree vis-à-vis parameter  $\beta$  for adjusting the importance of the centrality of nodes in the neighbourhood between node  $i$  and  $j$ . This is shown in equation 1:

$$C_{CB} = \sum_{j \in N(i)} \alpha + [\beta C_{BC}(j)]$$

$$= \alpha \log(i)_n + \beta \sum_{j \in N(i)} C_{BC}(j) \dots \dots \dots (1)$$

Other regressors were age of the business owners, sex, marital status, household size (the number of people living under the same roof), education measured in terms of years of schooling, a dummy for agriculture that determined whether a respondent cultivated any crop in 2016, and a dummy for the ownership of other business. Business-specific variables were dummies for service, trading, workshop, manufacturing, stock value and business turnover (average sales per day). The log-transformed model was estimated in STATA software using the maximum likelihood estimator while taking care of



possible estimation problems. Potential model diagnostics like collinearity and a normality test were undertaken, and no problem was observed. Regression results are reported using robust standard errors. Content analysis was done thematically using NVIVO 12. Thematic areas were intended to identify fast-growing business ventures following an already established list of business categories. The analysis also identified businesses that employed significant numbers of people with respect to their age and/or sex and lastly identified the factors that might limit employment creation among the businesses studied. Organisation and analysis of social network information was done using Gephi software (Bastian, *et al.*, 2009).

### **3 Results and Discussion**

#### **3.1 Business, Agricultural and Employment Characteristics**

Despite operating non-farm businesses, descriptive analyses availed crop farming to be practised by majority EUC business owners. Table 1 shows that, majority of the businesses (55 percent in Ilula and 53 percent in Madizini) were involved in farming the main crops in the area, namely tomatoes in Ilula and paddy/rice in Madizini. In Ilula, tomato was the key cash crop, cultivated by 30 percent of the surveyed businesses. Paddy/rice was observed as a key cash crop cultivated by 37 percent of the businesses studied in Madizini. Maize was also cultivated by many business owners (56 percent) as a key food crop in both EUCs. Farming process was also used as a funding option for non-farm businesses. This underscores the primal importance of the farm sector and non-farm sector interdependence thus, creating forward and backward linkages. Linkages which tend to be stronger around EUCs which act as areas of agglomeration and value addition through processing, and service centres. The discussion is supported by Reardon *et al.* (1994), and Tacoli and Agergaard (2017) who substantiate that farm business has been essential to non-farm businesses and they have been coexisting in small towns as they provide income and ensure food availability.

It was further revealed that 66 percent and 62 percent of businesses in Ilula and Madizini respectively did not have any waged employees, though more employment opportunities were created indirectly through the services demanded by the businesses. These opportunities were mainly created by hiring transport (30 percent in both EUCs), cullies (21 percent in Ilula, mostly in the tomato chain business), security (20 percent in Ilula and 25 percent in Madizini), as well as storage and renting spaces. Most waged employees were also males with basic primary education working under informal contractual arrangements. Majority of businesses operated without waged employees largely due to their inability to pay full-time wages and the economic uncertainties and high level of informality that most small are subject to. This is supported by Parker (2004) discussion who substantiated that many small

businesses particularly in developing countries prefer to be small due to uncertainties of expansion and unreadiness to employ extra labour. Informality is also reported by the ILO (2019) as being high among small businesses, this being a constraint on continued business development and employment creation.

**Table 1: Business owners' farm-level and employment characteristics**

	Category	Description	Ilula		Madizini	
			n	%	N	%
<b>Farm-level characteristics</b>	Cultivated crop(s)	No	207	45.1	138	46.6
		Yes	252	54.9	158	53.4
	Crops cultivated	Tomatoes	107	30.1	4	1.8
		Maize	200	56.3	129	57.8
		Paddy	3	0.8	83	37.2
		Beans	27	7.6	4	1.8
		Sunflowers	18	5.1	3	1.3
<b>Employment characteristics</b>	Employment status	Without employees	304	66.2	185	62.5
		With employees	155	33.8	111	37.5
	Indirect employment	Transport	359	30.3	189	29.8
		Cullies (loading and unloading)	255	21.6	83	13.1
		Security	242	20.5	163	25.7
		Storage	111	9.4	17	2.7
		Rent for the shop or stall	216	18.3	183	28.8
	Employee's sex	Male	120	76.1	82	75.2
		Female	37	23.9	27	24.8
	Employee's education	Primary education	90	58.8	62	57.4
		Secondary education	38	24.8	24	22.2
		Both primary and secondary	24	15.7	13	12.0
		College education	1	0.7	9	8.3
	Payment arrangements	Weekly	8	5.2	4	4
		Monthly	59	38.6	70	70
		After completion	16	10.5	10	10
		Daily	70	45.8	16	16
	Contract arrangements	Formal contract	14	9.1	14	12.6
		Informal/verbal contract	128	83.1	92	82.9
		No contract agreements	12	7.8	5	4.5

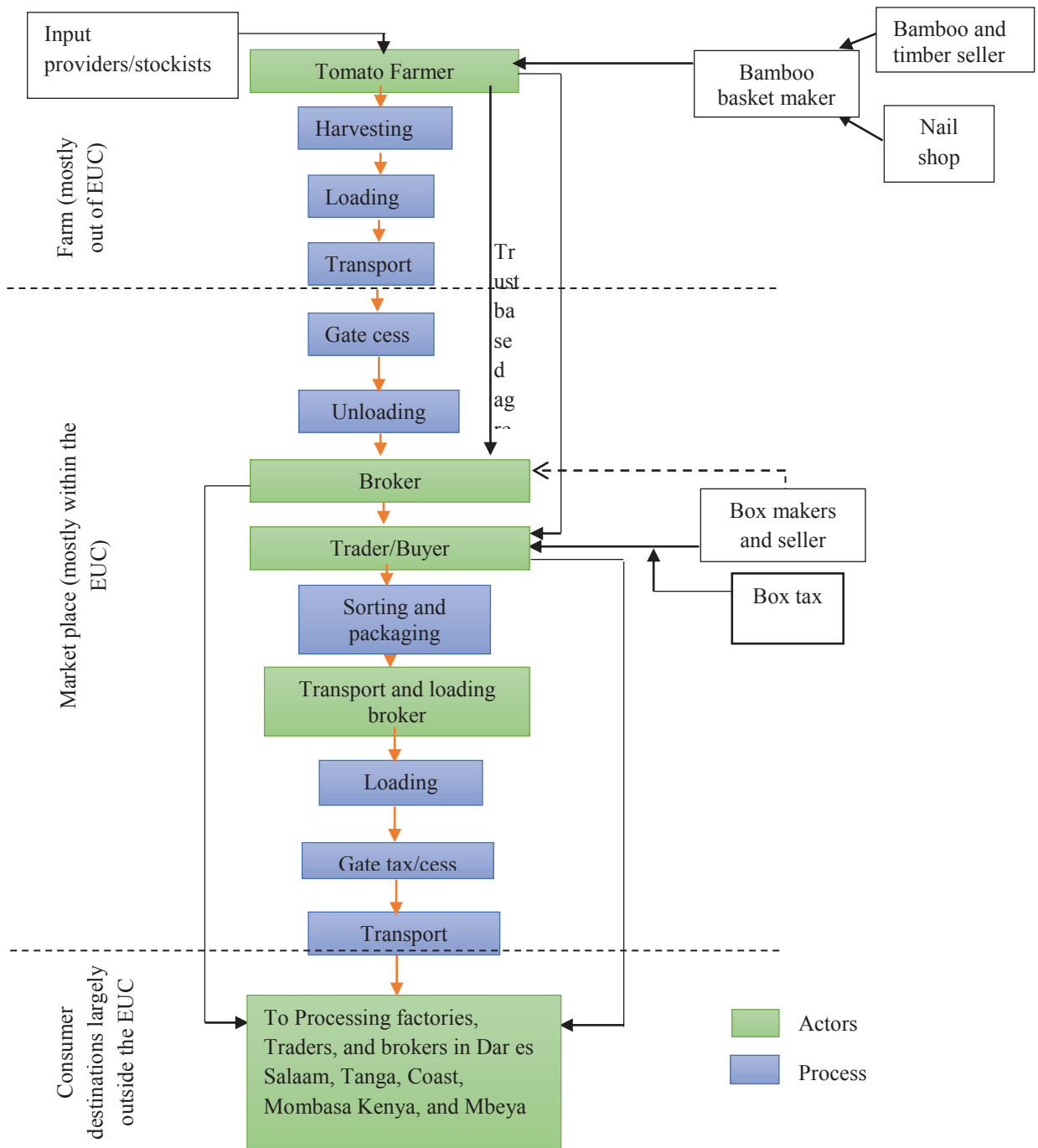


### **3.2 Employment Creation across Different Business Categories**

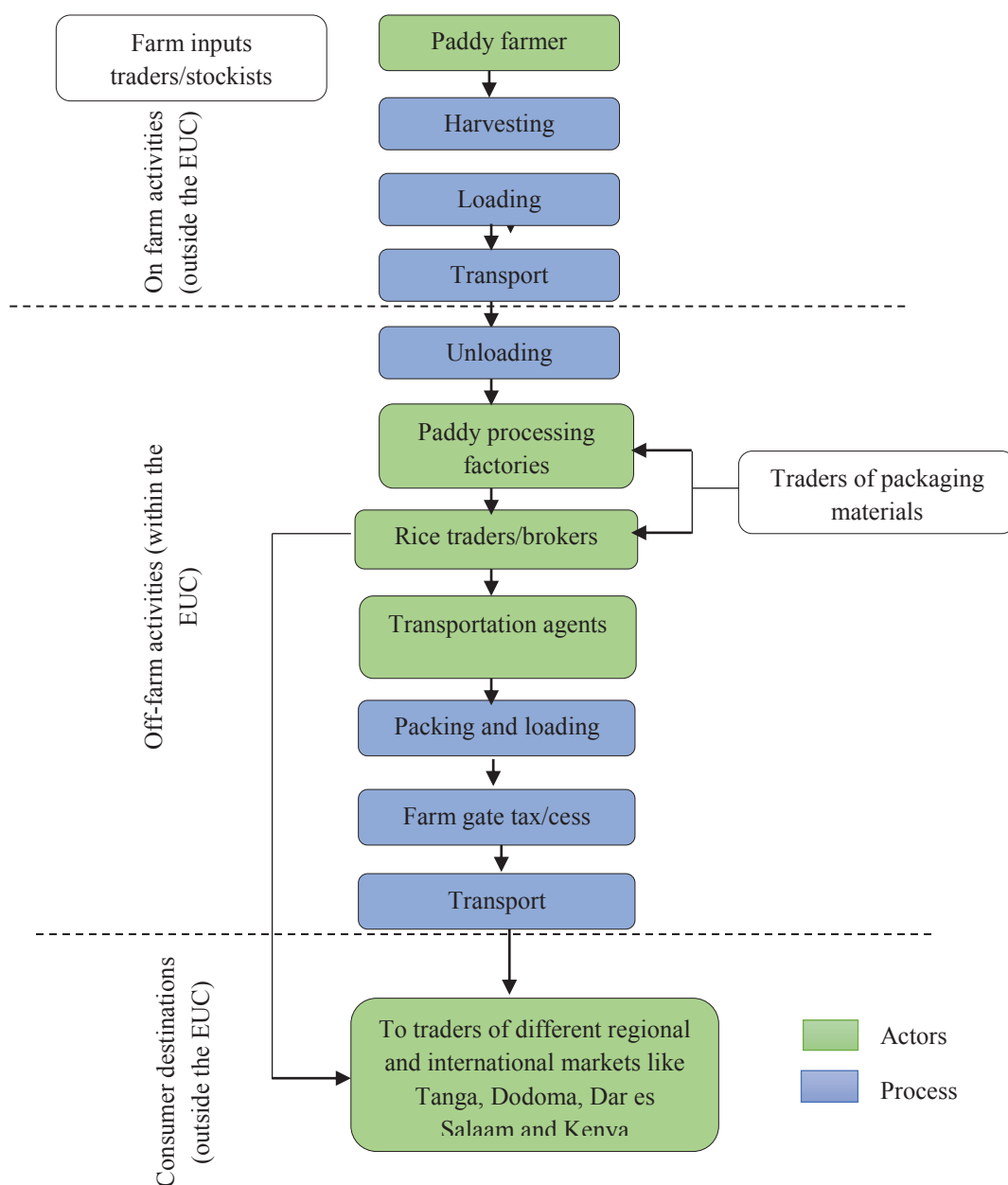
As most of the businesses (mainly in Ilula) were engaged in economic activities related to the tomato value chain, most of the employment opportunities were created around and linked to the tomato sector (Figure 2). For instance, the tomato value chain created employment opportunities around input provision where there are stockists; crate makers where they bought nails and other materials from hardware stores; cullies who did the loading and unloading, and sorting or grading of tomatoes; transporters using motorcycles, tricycles, and trucking business; other employment opportunities developed around the TASAF market were food vendors, restaurants, bars, mobile money services, pool table, retail shops, and stores. Similarly, paddy/rice business in Madizini created numerous employment opportunities from input supply and different on-farm activities to off-farm activities in transportation, processing, and loading/offloading activities. Others are activities which attracted business investment in mobile money and banking services, repair shops, hospitality, and food services (Figure 3).

Among the businesses with high employment potential in the EUCs were production of packaging materials in Ilula which on average employed eight waged employees as well as construction-based businesses and food-crop vending that employed an average of five and four individuals, respectively (Table 2). In Madizini, timber-related businesses like carpentry, and hotel services employed an average of seven and three employees, respectively. Food-crop trading and wholesale and retail in Ilula and food processors, mainly paddy/rice processors and traders of food crops in Madizini, were observed to employ an average of nine to eleven people. Wholesale and retail trading, crop-traders, food-processors, and construction businesses were also identified as indirectly employing more labour, especially through the demand for transportation, cullies, and security services.

Generally, businesses in Ilula and Madizini respectively created a total of 3 655 and 1 693 employment opportunities where 1 121 and 511 were hired directly (direct employment), while 2 750 and 1 236 were hired indirectly (indirect employment). This makes a ratio of 6 and 8 hired labour for each business in Ilula and Madizini, respectively. The number of hired labour varied depending on the season where it increased during the harvesting and decreased thereafter. Kok and Berrios (2019) in a similar way learned that 70 percent of direct and indirect employment is accounted by small businesses.



**Figure 2: Tomato business flow diagram representing businesses, actors, process, flow of goods within the tomato value chain and employment opportunities created along the chain in Ilula EUC**



**Figure 3: Paddy/rice business flow diagram representing businesses, actors, process, flow of goods within the paddy/rice value chain and employment opportunities created along the chain in Madizini EUCE**

**Table 2: Business categories and the amount of direct and indirect employment created**

Business category	Business type	n =	Ilula				n =	Madizini			
			Direct Employment Mean	S. Dev	Indirect Employment Mean	S. Dev		Direct Employment Mean	S. Dev	Indirect Employment Mean	S. Dev
Service	Food and Drink	46	2.6	1.9	5.6	5.4	28	2.7	2.5	3	1.7
	Art, Musical and Video	2	1	0	5		1	1		1	
	Hotel Amenities	7	4.3	0.8	5.6	1.7	3	3.3	3.2	3.5	2.1
	Cleaning and Beauty	1	2		3		11	1.4	0.7	1.4	0.7
	Transport	69	4.3	0.8	5.6	1.7	17	3.3	3.2	3.5	2.1
	Other services	4	1	0	3.3	2.3	13	1.3	0.5	1.6	0.5
Shops and Trading	Food crops Trading	94	4.8	6.3	11.7	11.8	38	2.4	4.9	9.3	9.1
	Farm Inputs	16	1.9	1.6	7.4	5.2	2	2	1.4	5.5	2.1
	Clothing, Fabrics and Footwear	23	1.1	0.5	4.7	3.9	36	1.2	0.5	4.1	2.3
	Hardware, Motor/parts, and Electronics	19	4	6.1	8.2	6.2	23	2.2	1.9	6	4.6
	Wholesale/Retail	4	3.5	3.8	10.3	5.6	6	3	1.3	6	2.8
	Vending Stall	76	1	0.3	7.7	9.5	14	1	0	4.2	3.9
	Retail shop	33	1.5	0.8	6.6	7.4	67	1.3	0.7	5	9.3
	Other Trading	14	1	0	1.2	0.4	5	1.4	0.9	2.4	0.9
	Workshop	11	2.7	3	7.9	4.8	5	3.2	2.3	2	1.4
	Packaging Materials	11	7.8	5.9	8.2	4.8	0				
Workshop, manufacturing, and processing	Timber Processing and Products	10	3	2.2	7.8	7.6	7	3.1	1.9	5.9	3.8
	Food Processing	16	3.2	1.1	6.2	4.4	4	3	2.3	7.3	10.5
	Construction and Materials	2	5	5.7	16	4.2	0				
	Iron Works	0	2.6	1.9	5.6	5.4	4	2.7	2.5	3	1.7
	Tailoring/Sewing Works	2	1	0	5		12	1		1	

### 3.3 Role of Social Networks in Recruiting Labour

While many business categories created more employment via indirect means, strategies to recruit this labour relied largely on their social networks. Strong and weak network ties were central in recruiting and obtaining labour-related information like work experience and wages in the EUCs. As shown in Table 3, majority of business owners in Ilula (about 90 percent) and Madizini (46 percent) reported using their strong ties of friendship networks to obtain information when searching for permanent (waged) and temporary (casual) labour. As part of strong network ties, family networks were also reported by 62 percent and 31 percent of business owners in Ilula and Madizini. Regarding the strategy used to hire workers who were in employment at the time of the survey, business friends (occupational acquaintances) were the preferred means in both Ilula and Madizini, besides business unrelated friendship

networks. The results thus underscore that both strong and weak social ties, are important in influencing labour recruitment in both EUCs because of the deep social attachments that have value for the information and resources they provide. This could also be a result of the mix of migrants and local people with diverse tribal and ethnic networks, which Lancee (2016) have also proved to constitute informal arrangements of labour recruitment. These findings are also consistent with the work by Calvó-Armengol and Jackson (2007), and Mayer (2011) in which actors tended to trust information provided by their close ties and business partners in their neighbourhoods.

One manufacturer of tomato boxes (wooden crates) mainly used for packing tomatoes who also worked as tomato trader was quoted saying that:

*“... I normally get people to make boxes from other box makers in Ilula, and sometimes workers recommend their friends as being hard-working and productive. It is the same with workers we hire for sorting and packing tomatoes, as some works are performed by a group of people through their leader, and I hire them based on recommendations I get from my colleagues (tomato traders, here regarded as business friends) ...”* (interview done with a tomato box/crate maker in Ilula, March, 2017)

Formal procedures of screening and recruiting labour were also reported to be common among large and/or formal businesses in the EUCs. This confirms the finding that the provision of information related to labour issues across businesses linked through weak ties was common between businesses within similar categories, especially those located in the neighbourhoods.

**Table 3: Social network methods of recruiting labour in Ilula and Madizini EUCs**

Category	Description	Ilula		Madizini	
		n	%	n	%
Contacts for sourcing temporary labour	Family/Relatives	158	35.0	40	26.1
	Friends	289	63.9	59	38.6
	Personal efforts	3	0.7	18	11.8
	They come themselves	2	0.4	36	23.5
Contacts for sourcing waged labour	Family/Relatives	137	39.8	31	27.0
	Friends	204	59.3	50	43.5
	Personal efforts	1	0.3	14	12.2
	They come themselves	2	0.6	20	17.4
Sources of current employees	Family/Relatives	88	15.9	36	18.8
	Friends	259	46.9	61	31.9
	Business friends	161	29.2	32	16.8
	Government leaders	40	7.2	5	2.6
	They came themselves	4	0.7	47	24.6
	Personal efforts	0	0.0	10	5.2

### 3.4 Social Networks and Employment Creation

To determine the role of social networks in supporting employment creation in the EUCs, a left censored Tobit regression was estimated. The findings from a maximum likelihood estimators of the Tobit model revealed that having a robust social network increases the likelihood that employment will be created in both EUCs. As illustrated in Table 4, a one percent increase in network influence (eigenvector scores) was observed to increase the likelihood of creating employment among Ilula businesses by 22 percent. Moreover, a one percent increase in the size of social networks as measured by weighted degree increased the likelihood of creating employment among Madizini businesses by 35 percent. This reflects the fact that expanding the number of network connections increased the chances that a business would perform better, which points to the creation of more employment opportunities by means of a multiplier process. This conforms with Kuépié *et al.* (2015) and Mano (2010) who expounded that large size of network connectivity assures business operations and hence increases demand for resources and labour

However, a one percent increase in the influence of social networks among Madizini businesses decreased the likelihood of employment creation by 13 percent, which negates the theoretical expectations where having actors

with high weighted degree centrality in the neighbourhood is expected to increase business performance and subsequently employment creation. This could be attributed by: i) lack of a significant linkage of non-farm business and crop related (paddy/sugarcane) businesses within the business network in Madizini EUC. That is because paddy and sugarcane lacked large number of value chain-related activities that open job opportunities, like other high value crops for instance tomatoes. This result agrees with Temu and Temu (2006) who also deduced that high value crops are more linked to broad value chain activities which create chances for growth of non-farm businesses. This is additionally supported by Nyaki *et al.* (2022) where, in relation to paddy trading business, tomato trading businesses exerted influence on many other businesses in the EUC. ii) Poor network connectivity where Nyaki *et al.* (2022) show that the Madizini business network is weakly connected.

The analysis further revealed that in Ilula, male-owned businesses were more associated with a decrease in employment creation (by 34 percent) than female owned businesses. Conversely, a percentage increase in household size in Madizini increased the likelihood that additional labour would be employed by 21 percent. This could be explained by the fact that where most businesses are run by a family, each additional member of the household is expected to work for the businesses, which implicitly increase employment. Experience of running a business was also observed to be important in supporting employment creation in both EUCs. Specifically, having run a business in the past among businesses in Ilula and having another business in operation among business owners in Madizini increased their likelihood of creating employment opportunities by 24 and 30 percent, respectively.

Investment in food-crop trading, and manufacturing and processing businesses were respectively observed to be the ventures creating the most employment with a likelihood of 41 and 53 percent in Ilula and 42 percent in Madizini relative to service-based operations. Conversely, running a transportation business decreased the likelihood of creating employment in both EUCs compared to service businesses. In Ilula and Madizini, a percentage increase in business stock size led to an increase in the likelihood of creating employment by 23 and 8 percent, respectively. Similarly, a percentage increase in sales turnover in Ilula increased the likelihood that employment would be created by 9 percent.



**Table 4: Employment creation in Ilula and Madizini using log likelihood estimates of a Tobit model**

	Coef.	Madizini Robust Std. Err	Coef.	Robust Std. Err
Log network Influence	0.223	0.069***	-0.132	0.064**
Log network size	-0.136	0.124	0.352	0.134***
Log age	0.229	0.296	-0.032	0.207
Log education	0.231	0.186	0.138	0.179
Log household size	-0.039	0.132	0.212	0.105**
Sex	-0.342	0.134**	-0.067	0.112
Log business experience	-0.084	0.073	0.088	0.064
Owns another business	0.040	0.119	0.246	0.141*
Had businesses before	0.301	0.121**	-0.024	0.117
Food-crop trading	0.414	0.202**	0.426	0.170**
Wholesale and retail trading	-0.079	0.207	-0.111	0.127
Manufacturing	0.533	0.248**	0.196	0.170
Transport	-1.867	0.293***	-1.325	0.377***
Tomato/Paddy-growing	0.216	0.131*	0.054	0.119
Log stock	0.233	0.043***	0.087	0.039**
Log sales turnover	0.090	0.036**	-0.009	0.042
Constant	-2.919	1.121	-1.371	0.862
Sigma	0.888	0.044	0.772	0.057
Number of observations	350		215	
F (16,334)/ (16,199)	30.35		4.82	
Prob>F	0.000		0.000	
Pseudo R2	0.233		0.151	
Log pseudolikelihood	-423.405		-246.949	

Note: \*, \*\* and \*\*\* denotes that the coefficients are significant at 10%, 5% and 1%; respectively.

Source: author's compilation.

An interview with leaders of business associations in Ilula and Madizini revealed that the employment opportunities that were created varied greatly depending on the seasonality of the dominant crop produced. A chairperson of Madizini's business association reported that:

*"... in the harvest season we normally receive a large number of migrants who come to trade crops and for other business activities. A large influx of people is also observed in periodic markets (also known as gوليو), and more job opportunities arise because most people who are farmers will come to spend money, they get from selling their produce. They mostly buy household*

*consumable goods, clothing and building materials, which creates jobs in transportation, hospitality (hotels, lodges and guest houses and restaurants). During the planting of paddy less money is spent, as most of it is channelled back to the farm ..."* (interview with a chairperson of Madizini business association in Madizini, July, 2017).

His explanations conform with empirical evidence on employment created by means of an indirect multiplier effect of increased consumption due to changes or increase in personal incomes.

#### **4 Conclusions and Policy Implications**

The objective of this paper has been to analyse the role of social networks in influencing labour recruitment to EUC businesses and their subsequent effects on employment creation. A key deduction from the study is that farm production is still important among majority of business owners in the EUCs, and it has a major role in creating employment in the EUCs. Amid a large informal sector with many small businesses, a number of employment opportunities were created both directly and indirectly, the scale which was high in harvesting/high season. Social networks of weak and strong ties were central in recruiting and finding labour for these businesses.

A major deduction was that the prospects of creating more employment opportunities relied largely on the scope of one's social networks and influence/linkage of crop/farm and non-farm businesses. Thus, to sustain future employment creation around EUCs in the rural areas where agriculture has a major influence, broadening of social networks for non-farm business around the crop value chain is a requisite.

Thus, rural areas of Tanzania require progressive strategies to support employment creation particularly for the farm reliant growing rural population. With no formal institutional arrangements, the study recommends that strengthening extended social networks alongside promoting business formalisation should be an important entry to promoting employment creation. This also calls for increased public and private sector collaboration in supporting crop value chain development around EUCs as the sustainability of EUCs business and prospects of increasing rural employment creation relies on the crop sector stability.

## References

- Arregle, J.L., Batjargal, B., Hitt, M.A., Webb, J.W., Miller, T. and Tsui, A.S. (2015). Family Ties in Entrepreneurs' Social Networks and New Venture Growth. *Entrepreneurship: Theory and Practice* 39(2): 313-344.
- Barbulescu, R. (2015). The Strength of Many Kinds of Ties: Unpacking the Role of Social Contacts Across Stages of the Job Search Process. *Organization Science* 26(4): 1040-1058.
- Bastian, M., Heymann, S. and Jacomy, M. (2009). Gephi: An open source software for exploring and manipulating networks. BT - International AAAI Conference on Weblogs and Social. In: International AAAI Conference on Weblogs and Social Media. San Jose, California, U.S.A. 3(1): 361-362.
- Berrou, J.P. and Combarous, F. (2011). Testing Lin's Social Capital Theory in an Informal African Urban Economy. *Journal of Development Studies* 47(8): 1216-1240.
- Bian, Y., Huang, X. and Zhang, L. (2015). Information and favoritism: The network effect on wage income in China. *Social Networks* 40: 129-138.
- Blanchflower, D.G. (2000). Self-employment in OECD countries. *Labour Economics* 7(5): 471-505.
- Bonacich, P. and Lloyd, P. (2001). Eigenvector-like measures of centrality for asymmetric relations. *Social Networks* 23(3): 191-201.
- Borgatti, S.P., Everett, M.G. and Johnson, J.C. (2013). Analyzing Social Networks. (J. Seaman and A. Horvai, Eds.) (Vol. 1): SAGE Publications Ltd, Los Angeles, U.S.A. 320pp.
- Brady, G. (2015). Network social capital and labour market outcomes: Evidence for Ireland. *Economic and Social Review* 46(2): 163-195.
- Burns, J., Godlonton, S. and Keswell, M. (2010). Social networks, employment and worker discouragement: Evidence from South Africa. *Labour Economics* 17(2): 336-344.
- Calvó-Armengol, A. and Jackson, M.O. (2007). Networks in labor markets: Wage and employment dynamics and inequality. *Journal of Economic Theory*, 132(1): 27-46.
- Carree, M. and Klomp, L. (1996). Small Business and Job Creation: A Comment. *Small Business Economics* 8(4): 317-322.
- Carson, R.T. and Sun, Y. (2007). The Tobit model with a non-zero threshold. *Econometrics Journal* 10(3): 488-502.
- Cowling, M., Taylor, M. and Peter, M. (2004). Job Creators. *The Manchester School* 72(5): 601-617.
- Davis, S.J., Haltiwanger, J. and Schuh, S. (1996). Small business and job creation: Dissecting the myth and reassessing the facts. *Small Business Economics* 8(4): 297-315.

- Diao, X., Magalhaes, E. and Mcmillan, M. (2018). Understanding the role of rural non-farm enterprises in Africa's economic transformation: Evidence from Tanzania. *The Journal of Development Studies*, 54(5), 833-855.
- Fairlie, R.W. and Robb, Æ. A.M. (2009). Gender differences in business performance: evidence from the Characteristics of Business Owners survey. *Small Business Economics* 33: 375-395.
- Fragkos, P. and Paroussos, L. (2018). Employment creation in EU related to renewables expansion. *Applied Energy* 230: 935-945.
- davisGallagher, C. and Robson, G. (1995). Small Business and Job Creation Myths - an Even Further Dissection of the Davis, Haltiwanger and Schuh Working Paper. *International Small Business Journal: Researching Entrepreneurship* 13(2): 64-67.
- Gee, L.K., Jones, J. and Burke, M. (2016). Social Networks and Labor Markets: How Strong Ties Relate to Job Finding on Facebook's Social Network. *Journal of Labor Economics* 35(2): 485-519.
- Gee, L.K., Jones, J.J., Fariss, C.J., Burke, M. and Fowler, J.H. (2017). The paradox of weak ties in 55 countries. *Journal of Economic Behavior and Organization* 133: 362-372.
- Goyal, S. (2016). Social networks in economics. In: J. Scott and P. J. Carrington (Eds.), *The SAGE Handbook of Social Network Analysis* (1st ed.). SAGE Publications Ltd. London, United Kingdom. pp. 67-79.
- Granovetter, M. (2018). *The Sociology of Economic Life*. Routledge. London, United Kingdom. 594pp.
- Granovetter, M.S. (1973). The Strength of Weak Ties. *American Journal of Sociology* 78(6): 1360-1380.
- Hagglblade, S., Hazell, P. and Reardon, T. (2010). The Rural Non-farm Economy: Prospects for Growth and Poverty Reduction. *World Development* 38(10): 1429-1441.
- Hällsten, M., Edling, C. and Rydgren, J. (2017). Social capital, friendship networks, and youth unemployment. *Social Science Research* 61: 234-250.
- Henley, A. (2007). Entrepreneurial aspiration and transition into self-employment: evidence from British longitudinal data. *Entrepreneurship and Regional Development* 19(3): 253-280.
- Henrekson, M. and Johansson, D. (2010). Gazelles as job creators: a survey and interpretation of the evidence. *Small Business Economics* 35(2): 227-244.
- Hensvik, L. and Skans, O. N. (2016). Social Networks, Employee Selection, and Labor Market Outcomes. *Journal of Labor Economics* 34(4): 825-868.
- ILO. (2019). *Small matters: Global evidence on the contribution to employment by the self-employed, micro-enterprises and SMEs*. Geneva, Switzerland. 58pp.
- Kayastha, P., Rauniyar, G. and Parker, W. (1997). Determinants of off-farm employment in eastern rural Nepal. *Australian Agricultural and*

- Resource Economics Society (AARES). Christchurch, New Zealand. pp. 1–14.
- Kim, M. and Fernandez, R. M. (2017). Strength matters: Tie strength as a causal driver of networks' information benefits. *Social Science Research* 65: 268–281.
- Kongolo, M. (2010). Job creation versus job shedding and the role of SMEs in economic development. *African Journal of Business Management* 4(11): 2288–2295.
- Kok, J.D. and Berrios, M. (2019). Small matters: Global evidence on the contribution to employment by the self-employed, micro-enterprises and SMEs.: International Labour Organization (ILO). Geneva, Switzerland. 58 pp
- Kramarz, F. and Skans, O.N. (2014). When strong ties are strong: Networks and youth labour market entry. *Review of Economic Studies* 81(3): 1164–1200.
- Kristiansen, S. (2003). Linkages and Rural Non-Farm Employment Creation : Changing Challenges and Policies in Indonesia (ESA Working Paper No. No. 03-22). Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. 53pp.
- Kuépié, M., Tenikue, M. and Walther, O.J. (2015). Social networks and small business performance in West African border regions. *Oxford Development Studies* 2015: 1–19.
- Kweka, J., Morrissey, O. and Blake, A. (2003). The economic potential of tourism in Tanzania. *Journal of International Development* 15(3): 335–351.
- Lancee, B. (2016). Job search methods and immigrant earnings: A longitudinal analysis of the role of bridging social capital. *Ethnicities* 16(3): 349–367.
- Lin, N. (1999). Building a Network Theory of Social Capital. *Connections* 22(1): 28–51.
- Mabadu, R. (2014). The Role of Social Networks in the Creation and Development of Business among African Immigrants in Madrid Area (Spain). *Journal of Small Business and Entrepreneurship Development* 2(3): 27–46.
- Mano, Y. (2010). Local and Personal Networks in Employment and the Development of Labor Markets: Evidence from the Cut Flower Industry in Ethiopia. *World Development* 39(10): 1760–1770.
- Mayer, A. (2011). Quantifying the effects of job matching through social networks. *Journal of Applied Economics* 14(1): 35–59.
- Mendez-parra, M. (2015). Using a social accounting matrix to calculate output and employment effects in Tanzania. Dar es Salaam, Tanzania: United Kingdom Agency for International Development. London, United Kingdom. 12pp.

- Nagler, P., Naudé, W. and Naude, W. (2014). Non-farm enterprises in rural Africa: New empirical evidence. World Bank Policy Research Working Paper, (7066). New York, United States. 52pp.
- Nagler, P. and Naudé, W. (2017). Non-farm entrepreneurship in rural sub-Saharan Africa: New empirical evidence. *Food Policy* 67: 175-191.
- Nolan, J., Rowley, C. and Warner, M. (2017). Key Debates in Business Networks in East Asian Capitalisms. *Business Networks in East Asian Capitalisms* 357: 1-14.
- Parker, S.C. (2004). *The Economics of Self-Employment and Entrepreneurship*. Cambridge university press Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo. Cambridge, U.K. 342pp.
- Reardon, T., Crawford, E. and Kelly, V. (1994). Links between non-farm income and farm investment in African households: adding capital market perspectives. *American Journal of Agricultural Economics* 76(5): 1-15.
- Robson, G. and Gallagher, C. (1993). The Job Creation Effects of Small and Large Firm Interaction. *International Small Business Journal: Researching Entrepreneurship*, 12(1): 23-37.
- Rotar, L.J., Pamić, R.K. and Bojnec, Š. (2019). Contributions of small and medium enterprises to employment in the European Union countries. *Economic Research-Ekonomska Istraživanja*, 32(1): 3296-3308.
- Schreyer, P. (2000). High-growth firms and employment (STI Working Paper Series). OECD Science, Technology and Industry Working Papers 2000/03. Organisation for Economic Co-operation and Development (OECD). Paris, France. 49pp.
- Tacoli, C. and Agergaard, J. (2017). Urbanisation, rural transformations and food systems The role of small towns. IIED, London, United Kingdom. 29pp.
- Temu, A. E. and Temu, A. A. (2006). High Value Agricultural Products for Smallholder Markets in Sub-Saharan Africa: Trends, Opportunities and Research Priorities Prepared for (How can the poor benefit from the growing markets for high value agricultural products?). International Center for Tropical Agriculture. Cali, Colombia. 37pp.
- Tenikue, M. and Walther, O. (2014). Small businesses performance in West African border regions: Do social networks pay off? (CEPS/INSTEAD Working Papers No. 2014-06). Luxembourg Institute of Socio-Economic Research (LISER). Luxembourg City, Luxembourg. 32pp.
- Tian, F.F. and Liu, X. (2018). Gendered double embeddedness: Finding jobs through networks in the Chinese labor market. *Social Networks* 52: 28-36.
- United Republic of Tanzania (URT), (2008). National Employment Policy 2008. Ministry of Labour, Employment and Youth Development. Dar es Salaam. 58 pp.

- United Republic of Tanzania (URT), (2010). National Strategy for Growth and Reduction of Poverty (NSGRP) II. Ministry of Finance and Economic Affairs. Dar es Salaam. 170 pp.
- Wang, T. and Chanda, A. (2018). Manufacturing growth and local employment multipliers in China. *Journal of Comparative Economics* 46(2): 515–543.
- Xiong, A., Li, H., Westlund, H. and Pu, Y. (2017). Social networks, job satisfaction and job searching behavior in the Chinese labor market. *China Economic Review* 43: 1–15.



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