**Determinants of Rice Commercialization Among Smallholder Farmers for Rice Production at Wembere Basin in Iramba District, Tanzania**

***ABSTRACT***

*The agricultural sector in Tanzania is contributing 30% of GDP and 65% of employment. The rice production of Tanzania accounts approximately 17% of total grain production, and the country has nearly achieved self-sufficiency in rice. Rice production is the most important sub-sector in Tanzania since it plays a crucial role in the creation of jobs, income generation, especially from rice exports, food security and poverty reduction. This paper examined the determinants of rice commercialization among smallholder farmers for rice production in Wembere basin in Iramba district, which guided by double hurdle model and* *Transaction Cost Theory (TCT). The research design was cross-sectional data collected in 2023 and 2024 from 117 sample sizes of rice farmer households selected through a simple random sampling technique and analysable to obtain Household Commercialization Index (HCI), coefficients and descriptive statistics. The finding results of this paper show that the level of rice commercialization level had (HCI=95.13%) in 2023 and (HCI=94.79%) in 2024 of rice production. While the multiple regression analysis for sex, age of household, education level, family size, market distance, price of rice purchased, bank loan use and use of improved seeds had a significant at 5% level (p<0.05). This indicates that parameters influence rice production participation and a high degree of commercialization and production.*

*Furthermore, the results reveal that households participating in agricultural commercialization would experience improved food security through increased crop diversity. This paper concluded that demographic, economic and institutional factors had a positive impact on commercialization and determined the level of agricultural commercialization for smallholder farmers so as to increase the notion of rice farming. The study recommends that there is a need for the government to support agricultural commercialization for facilitating bank loans and improved seed toward rice production.*

***Keywords:*** *Rice Commercialization, Rice Production, Farmers, Cragg’s Double Hurdle Model*

1. **INTRODUCTION**

“In the world, rice is the most significant food crop, and it has been considered to assist as a chief food basis for more than 50% of the world’s population for long years” (Zhang, Li, & Wang, 2023). “Globally, annual rice production has contributed to consumption and selling, and it is a good opportunity for domestic and international markets for economic development, mainly in China, India, Indonesia, and USA, and other countries; of the Trends in Global Rice Production in Food and Agriculture Organization of the United Nations” (FAO, 2023). “Globally, governments are facing a significant problem with food insecurity, which has emerged as one of the most crucial issues on the current international political agenda. According to the World Bank Global Report on Food Crises, 140 million people in Africa are thought to be suffering from severe food insecurity, with at least one in five of them going to bed hungry” (World Bank, 2022). “The commercialization of genetically modified (GM) crops has increased food production, improved crop quality, reduced pesticide use, promoted changes in agricultural production methods, and become an important new production strategy for dealing with insect pests and weeds while reducing the cultivated land area. This article provides a comprehensive examination of the global distribution of GM crops in 2023. It discusses the internal factors that are driving their adoption, such as the increasing number of GM crops and the growing variety of commodities. This article also provides information support and application guidance for the new developments in global agricultural science and technology” (Cheng, et al,2024).

“In sub-Saharan Africa (SSA), Rice (Oryza spp.) is one of the most important staple crops for food security and social stability in large parts of sub-Saharan Africa (SSA). Its consumption has been increasing more rapidly than any other staple crop” (Arouna et al.,2021). “This rapid increase is driven by high population growth, urbanization and changing consumer preferences in the region. Recently reaching one billion inhabitants, SSA has had the highest population growth rate in the world, with a mean increase of 2.5% per annum between 2007 and 2016” (The World Bank,2022; Oyeyode, et al., 2025). “During the same period, rice consumption has increased at a rate of 6% per annum and is expected to continue to grow in the foreseeable future” (FAO,2022). Gniza and Ouattara (2024) in Côte d’Ivoire heightened about the agricultural production is sometimes affected by Smallholder Farmers’ Perceptions of Climate Change and Multiple Adoption of Adaptation Strategies (Munthali, et al., 2025). Malawi's agricultural diversification and commercialization are widely seen as effective strategies for increasing household income, reducing poverty, and improving food and nutrition security. Our study examined the levels, drivers, challenges, and impacts of agriculture diversification and commercialization in Malawi using Malawi Rural Agricultural Livelihoods Survey (MRALS) data collected in 2019 and 2024. The findings indicate that while the level of diversification among farmers is moderate, there has been a decline in diversification between 2019 and 2024, potentially impacting farm resilience and resource allocation. Moreover, the study reveals significant variation in the level of commercialization among small-scale farmers in Malawi, with an average increase from 27% in 2019 to 35% in 2024, signifying progress towards more market-oriented farming practices.

“According to the Tanzania Development Vision (TDV) 2025, the country aspires to have a diversified and semi-industrialised economy that is comparable to typical middle-income countries. This was expected to be achieved by, among other things, transforming the economy from subsistence to commercial agriculture with high productivity, which generates high incomes and ensures food security” (URT, 2021). “In Tanzania, the agricultural sector accounts for approximately 30% of GDP and 65% of employment. For rice production, it accounts for approximately 17% of the total grain production, and the country has nearly achieved self-sufficiency in rice crops. Furthermore, rice production is the most important sub-sector in Tanzania since it plays a crucial role in the creation of jobs, income generation, especially from rice exports, food security and poverty reduction” (FAO, 2022; WB, 2023). “It is the most rapidly growing source of food in Africa and is of significant importance to food security and food self-sufficiency. It is a strategic crop mostly produced by smallholder farmers in various agro-ecological zones. About 92% of all rice produced in Tanzania is under upland and lowland rain-fed systems, while only 8% is under irrigation schemes” (FAO, 2023).

“To overcome various challenges facing the rice industry, the Tanzanian government has been struggling to take some measures to stimulate the sector” (Kadigi et al., 2020), such as the protectionist policy with an imposition of an import tariff of 75% in early 2005 followed by the formulation of policies and programs like the Ministry of Agriculture (2019) of the National Rice Development Strategy Phase II (2019–2030) of the United Republic of Tanzania. Current agricultural policy documents in Tanzania, National Agricultural Policy (NAP) in 2013, Agricultural Sector Development Strategy–2 (2015/16–2024/25) and Agricultural Sector Development Program–2 (2015/16–2024/25). On the other hand, these policies emphasise on application of fertilisers, improved seed, development of irrigation infrastructures and removal of the export ban. In the 2010s, the government of Tanzania, through the Ministry of Agriculture Food, Security and Cooperatives (MAFSC), had involved training extension staff and farmers in the System of Rice Intensification (SRI) management practices to scale up the country’s rice production. The SRI practices elaborated by Stoop et al. (2022) and the United Republic of Tanzania (2021) serve as the primary campaign tools used by the MAFSC aiming at upgrading rice yield per ha and in line with the national strategy of reduction of hunger and poverty by 2025.

**Table 1: Rice yield in Tanzania**



KilimoTrust (2014) emphasises that “efforts were made to protect Tanzania’s domestic rice markets, including the adoption of a 75% tariff on imported rice as part of the EAC’s Common External Tariff (CET), which all member states have adopted. Also, it is subjected to periodic exemptions in times of demonstrated scarcity to boost domestic production of rice” (Msafiri, 2021) from mainly Asian countries. Kenya, the Tanzanian neighbour country in the North, is the leading importer from outside the EAC, at over 300,000 tons per annum (FAO, 2022). Eighty per cent of the rice imported into Kenya comes from Pakistan (80%), Vietnam (10%) and Thailand (5%) (KilimoTrust, 2023). This example of the available trade statistics (FAOSTAT, 2024) indicates that within EAC and neighbouring countries, Tanzania exports rice to Kenya (35%), Rwanda (29%), Uganda (13%), South Sudan (6%), DRC (3.2%), Burundi (9%), Zambia (2.8%) and Malawi (2%).

“Emphases that rice is the second leading food crop and cash crop in Tanzania after maize” (Msafiri,

2021). “Its annual production is estimated to be 2.2 million metric tons, accounting for about 3/4 of the total rice produced in East Africa, making the country the top producer in the region” (URT, 2022). “Insisted that, the rice sub-sector is a significant source of food nutrition, employment and income for many households in Tanzania and a potential source of foreign exchange earnings to the country” (Msafiri, 2021). “In large, the government of Tanzania is continue implementing several value-added initiatives programs including the 2019-2030 National Rice Development Strategy towards enhancing rice production and trade competitiveness. The smallholder rice farmers need to purchase sufficient agricultural inputs. Thus, there is a need for enough money, which is not easily accessible” (Girabi & Mwakaje,2013). “Several studies have been conducted around Tanzania and the world to address the issue of crop commercialization and rice production among smallholder farmers” (Kassie& Zeweld, 2022; FAO, 2023; WB, 2022). However, no such study has been conducted in Tanzania, specifically Wembere basin in Iramba District, where there are a good number of smallholder rice farmers. Therefore, this study intended to bridge this knowledge gap on the problem of factors facing the smallholder farmers of rice on commercialization and production performance

“Smallholder commercialization is a part of the greater change. It can be seen as a pathway to the structural transformation of the overall economy in which farms shift from highly subsistence-oriented production towards more specialised and advanced production system that is based on comparative advantage among smallholder farmers. Policy and strategy intervention is necessary to enhance the functioning of input and output markets, improve service provision and development of infrastructure so that the goal of structural transformation can be achieved smoothly” (Barrett et al., 2022). “Despite the increasing food crops commercialization, the agricultural sector in Tanzania has been experiencing various weaknesses, including low productivity and erosion of the natural resource base” (URT,2021). “This growing concern about declining agricultural production in Tanzania seems to suggest that the process of food crop commercialization has not enhanced agricultural production” (FAO, 2023). “The government of Tanzania views the increased commercialization of food crops as an important element and effective to increase income and improve the living standards in rural areas. However, scant evidences suggest that commercialization of food crops creates a dilemma for smallholders whether to sustain their households with food or focus on production for the market. Using a case study of a highly commercialised smallholder farming district of Iringa in the southern highlands of Tanzania, this paper assessed circumstances under which commercialization of food crops could lead to household food insecurity among smallholders. Specifically, it investigated the effects of low productivity of commercialised food crops, affordability of food at the market prices for households with income from selling their own food products, shifting away from traditional crops, and specialisation and its effects on food security among smallholders”. (TDV, 2025).

“In Tanzania agricultural commercialization is sought by governments and development partners because it has been associated with agricultural intensification and productivity improvements” (Djurfeldt et al., 2019). “This is expected to raise farmers’ income from rising marketed surplus and lead to subsequent livelihood improvement. However, agricultural commercialization is highly dynamic and affected by a wide range of biophysical, technological, socio-cultural, economic, institutional and policy-related factors. These factors change over time, and the changes may have positive or negative impacts on agricultural commercialization and livelihoods. The negative impacts are more pronounced among women and other vulnerable resource-poor people”. (Louw et al., 2008; Gupta, Vemireddy and Pingali, 2019; Pingali et al., 2019).

In spite of the numerous organisations that have promoted agricultural commercialization, it appears that there is still a wide gap between domestic demand and supply of rice in the country. Smallholder farmers in the country, particularly those in Wembere basin in Iramba district, Tanzania still produce rice at subsistence level despite having the comparative advantage of producing the commodity in large quantities. Not much has been done to explore the potentials and drivers of commercialization, specifically for rice production to increase productivity, to the best of the researcher’s knowledge. Therefore, this paper aims to examine the determinants of commercialization for rice production. Rice commercialization is associated with examining the determinants of commercialization for rice production in Tanzania in the case of Wembere basin in Iramba district, Tanzania. The findings from this study contribute to the existing empirical literature on who is most affected by rising agricultural commercialization and, therefore, demand for a policy that ensures the inclusion of food security among smallholders in Tanzania as well as similar countries in Sub-Saharan Africa (SSA). Also recommended policy discourses around agricultural commercialization tend to separate producers into different types of farms (small farms, large farms) growing different types of crops (food crops, cash crops) specifically for rice production with simple distinctions made between subsistence and commercial agricultural process.

**2. LITERATURE REVIEW**

**2.1. Craigg Double Hurdle Model**

The Cragg Double Hurdle Model is widely used to examine factors affecting rice production and commercialization, particularly among smallholder farmers. This model allows for the examination of two distinct decisionsThe participation decision and the Intensity decision, so as to determine whether a farmer decides to engage in rice production or commercialization. Also to indicate the level or extent of rice production/commercialization once participation occurs. The study was addressed by using the Craigg double hurdle model. Craigg's double hurdle method was used in assessing the determinants of commercialization and the extent of participation in rice agricultural commercialization by small holders farmers in the study area. Cragg double Hurdle models, initiated by Mathenge and Olwande (2012), were considered when estimating the factors that influence farmers as economic agent’s participation in agricultural commercialization. The double-hurdle model is the type of corner solution outcomes, as they define an initial discrete probability of participation model; first, it involves conditional participation (Y>0), and a second decision is made on the intensity of participation.

“Tobit models were used originally for estimating these models that accounted for clustering zeros due to non-participation; however, its major limitation is that it assumes the same set of parameters and variables determined both the probability of market participation and the level of participation” (Wooldridge, 2002). A two-step model, however, relaxes these assumptions by allowing different mechanisms to determine the discrete probability and level of participation. These models allow for separation between the initial decision to participate (Y>0 vs. Y=0) and the decision on how much to sell given that (y>0). In this case, it is assumed that some right hand side variable may affect differently the decision to participate at all and the decision on the level of participation. The first step in the two-tier model involves probit estimation, while the second stage can take different functional form distributions. The simplest two-step model for a corner solution outcome assumes that conditional on Y>0, Y│X follows a lognormal distribution (second stage).

 …………………………………………………………………… (1)

Where μ denotes the expected value of y, i.e., E(y)=μ

>0=1-µ(x…………………………………………………………………(2)

Double-hurdle model of Craig (1971) is a commonly “used two-tier model, as in this model second stage is defined by a truncated normal distribution instead of the log-normal distribution described here. The main advantage of the truncated normal distribution over lognormal is that it nests the usual Tobit model, thus allowing testing restriction implied by the Tobit hypothesis against a two-step model” (Wooldridge, 2002).

Double hurdle can be noted by:

The relationship between the Participation Decision" and the "Intensity Decision relate to this model;

Intensity Decision Q\*=

Participation Decision =……………………………………… (3)

>0)ln)…..(4)

This model is very useful and related to this study as it helps to estimate the factors that influence farmers as economic agents to participate in agricultural commercialization. This model gives room for the initial decision to participate and the decision on how much to sell. Based on this model, the decision to participate in the market and the extent of market participation for the smallholder farmer will depend on the utility of the choices. If utility realised from participation in the market is greater than that derived from non-participation. Then, the smallholder will opt to participate in the marketing of their agricultural products, and definitely, the extent of participation in the market for the products will be higher.

**2.2. Transaction Cost Theory**

This paper was guided by the Transaction Cost Theory (TCT), first presented by (Coase, 1937) while attempting to characterise the interaction between a corporation and the market. “According to the notion, if transaction costs are not reduced to the barest minimum, smallholder farmers won’t be motivated to participate in the market, which implies profit levels actively” (Kirsten et al., 2005) “defined transaction costs to include those costs related to finding a trading partner with whom to exchange goods and services, screening and haggling with the partner and upholding the terms of the trading partner’s contract. The TCT refers to costs that occur before (ex-ante) and after (ex-post) market, and the farmer physically exchanges the agricultural commodity. Ex-ante transaction costs include the costs of obtaining information and bargaining for an exchange of goods or services to occur, while ex-post transaction costs, on the other hand, are incurred in coordinating production, harvesting, transportation, and processing as well as monitoring and enforcing compliance with the agreement” (Mugwagwa et al., 2005). This Transaction Cost Theory (TCT) is relevant for this study due to the visible and non-visible of the variables cost measurement to the whole process of rice production has been considered for smallholder rice commercialization.

“In this regard, a TCT can help smallholder farmers select an appropriate cooperative society for known transaction characteristics. The idea of opportunity cost is typically utilised to capture transaction costs because they are, by nature, hidden expenditures” (Kirsten et al., 2005). “The theory has been widely used in agricultural economics studies and related fields in developing countries” (Mugwagwa et al., 2020; Otekunrin, 2019). “Transaction frequency is an important part of transaction cost theory and an important factor affecting transaction costs” ([Williamson, 1989](https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2024.1448874/full#ref48)). “In production, farmers need to employ many factors connected with multiple transaction subjects or make frequent transactions when purchasing production materials. The higher transaction frequency than that associated with connecting to a single service subject results in higher transaction costs” ([Thomas and Vink, 2020](https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2024.1448874/full#ref43)). “Therefore, when farmers have more frequent transactions, their transaction costs are relatively high” ([Sgroi and Sciancalepore, 2022](https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2024.1448874/full#ref36)), which may inhibit their participation in commercialization. This theory is relevant to this study for the measurement of invisible to visible transaction costs to the smallholder farmers of rice, particularly in the context of smallholder rice commercialization. For example, it can be challenging to quantify the time and effort required to bank loan negotiate with farmers or to resolve disputes with input suppliers.

**2.3 Empirical Review**

Adugnaw et al., 2023, conducted this study to analyse determinants of teff commercialization among smallholder farmers in Hulet Eju Enese Woreda, Ethiopia. The primary data were collected from 384 randomly selected smallholder farmers to measure the level of teff commercialization and analyse determinants of teff commercialization among smallholder farmers. To address the objectives of this study, an output commercialization index and a beta regression model were used. The findings show that about 77.2% of smallholder farmers are classified as commercial, while semicommercial farmers account for 22.8% of all observations. Furthermore, the model results revealed that the number of oxen, teff land size, farming experience in teff production, market distance, and agroecology had statistically significant effects on teff commercialization. Therefore, sources of improved traction power, land productivity, market infrastructure, experience-sharing strategies, and new varieties that can adapt to varied agroecology should be given special priority to increase smallholder farmers’ commercialization.

“A review of case studies conducted in 10 countries in Africa, Asia, and Latin America found that commercialization increased household incomes in most cases as a result of increased labour and land productivity on farms as well as increased employment opportunities for hired labour. In most

cases, increased incomes resulting from commercialization led to increased food consumption” (Barrett, 2021). “Hence there is a strong case for promoting food crops commercialization while seeking to ensure that the benefits and costs of the process are equitably distributed” (Kilimaet al., 2020; Mnenwaet al., 2022;Tadesseet al., 2023).

“In Tanzania, commercialization has opened up means for increasing greater agricultural output and farmers’ income” (Msuyaet al., (2022). “Unfortunately, not all rural dwellers have benefited equally from greater economic opportunities brought about through the commercialization process. An interview conducted with the smallholders’ farmers group in Iringa District, Southern Tanzania, showed that commercialising food crops benefits farmers, and they may instantly move on to high-value crops. Often, the increased market orientation of staple crop production offers a more pertinent option to smallholders in the short term until infrastructural facilities are developed to accompany the production, processing, transportation and marketing of high-value crops. Commercialising food crops is an indispensable pathway towards economic growth and development for most developing countries relying on the agricultural sector” (Barrett et al., 2022), “while food crops commercialization may not be a viable activity to ensure sustainable food security and welfare” (Swinnenet al.,2020;Adjimotiet al., 2023).

“The government of Tanzania views the increased commercialization of food crops as an important element and effective to increase income and improve the living standards in rural areas. However, scant evidences suggest that commercialization of food crops creates a dilemma for smallholders whether to sustain their households with food or focus on production for the market. Using a case study of a highly commercialised smallholder farming district of Iramba in the centre of Tanzania, this paper examines circumstances under which commercialization of rice production and food crops could lead to household food insecurity among smallholders. Specifically, it examines the effects of low productivity of commercialised food crops, affordability of food at the market prices for households with income from selling own food products, shifting away from traditional crops, and specialisation and its effects on food security among smallholders”. (URT, 2022).

**3. METHODS AND MATERIALS**

**3.1 Description of the study area**

This study was conducted in Wembere basin in Iramba district, Tanzania, located in the centre of Tanzania. The basin has a swamp with several agroecological zones and agrobiodiversity that support diverse crops and livestock. Districts have smallholder farmers engaged in various crops such as sunflower, onion, round potato, maize, rice and other vegetables, as well as livestock and poultry. Wembere basin or swamp is located in Singida Region, which has a total surface area of 49,438 km2, out of which water bodies of Lake Eyasi, Kitangiri, Singidani, Kindai, Munang and Balengida cover 95.5 km2 or 0.19 per cent. The remaining 49,342.5 km2 is land area. It is the 5th largest and occupies about 5.6 per cent of mainland Tanzania's total area of 881,289 km2. Manyoni District Council (57.9%) is the largest district in the Singida Region, followed by Ikungi District Council (14.9%), Iramba District, Singida District Council, Mkalama District Council, and Singida Municipality at the tail end.

The Wembere basin is the downstream of the rivers located in northwestern Singida Region, Tanzania. The river discharge basin is part of the water basin of Lake Eyasi. The Wembere River originates in hilly country in central Tanzania at 6.0º south and flows northwards through a branch of the Eastern Rift Valley. Its tributary, the Nyahua River, forms a seasonal floodplain 60 miles long and 1-5 km wide, covering 11,000 ha. After the Nyahua joins the Wembere from the northwest, the Wembere widens into a larger floodplain 105 km long and up to 20 km wide, covering 140,000 ha. (4º12'-5º01' S/33º47'-34º11' E). The floodplain consists of flooded grasslands, inundated during the wet season and laced with drainage channels. Stands of the trees Vachellia seyal and Vachellia drepanolobium edge the seasonally flooded portion of the plain. This basin was selected due to the fact that the production of rice has been promoted in recently years, and smallholder farmers have been intensively involved in producing rice as a major cash crop. The study was carried out in three villages, namely, Lugongo, Nyaha and Kidaru.

**3.2. Sample Size**

Cochran formula is used to calculate the essential sample size for the required level of precision, confidence level and the estimated proportion of the attribute present in the population. The Cochran formula is most suitable for a large population. Cochran (1963) developed an equation to find the sample size for the large population proportion. The sample size formula (n) was calculated as follows:

……………………………………………………………………..…(5)

Whereas z= level of confidence (1.96 for 95% confidence level), p = expected proportion (8.3%)

ε = margin of error at 5% (0.05), n= 1.962×0.083×0.917 / (0.05)2 = 116.9 ≈**117**

Therefore, a total of 117 household participants in rice production were required; but in order to increase the statistical power of the study, 117 participants were recruited.

**Table 2. Sample Distribution N=117**

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of respondent** | **The number of respondents expected** | **Questionnaire Distribution (%)** | **Sampling techniques** |
| Lugongo Village | 39 | 39 | Random Sampling |
| Nyaha Village | 39 | 39 | Random Sampling |
| Kidaru Village | 39 | 39 | Random Sampling |
| **Total** | **117** | **100.0** |  |

**3.3. Methods of Data Collection**

This paper used a study survey where cross-section data was collected from the field, and the population of the study was rice farmers. Both qualitative and quantitative data were collected by using tools of data collection, which are questionnaires and personal interviews. The field survey was conducted in 2024 to collect data from primary and secondary sources in 2023 and 2024. Primary data were collected from randomly selected rice-producing households using a snowball semi-structured questionnaire, with trained enumerators conducting face-to-face interviews under the researcher’s supervision. The questionnaire used to collect primary data from respondents includes both closed-ended and open-ended components to gather detailed information about the issue under study. The collected data were analysed using descriptive and econometric methods of data analysis. For the descriptive analysis, mean and standard deviation were used. Inferential statistical tests such as t-test and coefficient test were used for the existence of any statistically verifiable differences among households participating in the rice production participation. Under econometric analysis, the double hurdle model was used to estimate household rice production and the level of commercialization of rice producers. A logistic regression model was used during data analysis. Logistic regression is a process of modelling the probability of a discrete outcome given an input variable (Edgar & Manz, 2019). In all the analyses, we adjusted for facility-level clustering and multivariate logistic regression was subjected to diagnostics aimed at identifying observations of outliers, leverage, and influence. The theoretical model presented in Equation 1 below.

$Y(1/0)= α+ β\_{ij}X\_{ij}+…………….. +e$……………………………………………. (6)

**2.3. Method of data analysis of Commercialization Index**

Measurement of the ricecommercialization index deals with the shift of production from consumption to a more market-oriented production system (Ogutuet al., 2020). Similarly, it refers to a significant proportion of specific commodities in output market commercialization of smallholder farming can also improve the well-being of rural farm households by stimulating investments into farm productivity, which could enhance agriculture profitability and consequently improve household incomes (Tabe-Ojong, Hauser and Mausch, 2023a). While a growing body of literature has identified agricultural commercialization as instrumental in accelerating rural economic progress through improving rural household well-being, empirical findings on the welfare implications of smallholder commercialization have been mixed and context-dependent (Haji, 2022; Tabe-Ojong, Hauser and Mausch, 2023a).Thus far, a growing body of literature exists on smallholder commercialization and its impacts on farmers’ welfare in developing countries (Ochieng et al., 2020; Ogutu, Gödecke and Qaim, 2020; Grote et al., 2023; Wolfe et al., 2023; Tabe-Ojong, Hauser and Mausch, 2022a).

\* 100………… (7)

Statistical Package for Social Science (SPSS version. 23) was utilised to perform descriptive and inferential statistics. Percentage, frequency, minimum, maximum, mean, and standard deviation were employed as descriptive statistics. Furthermore, multiple linear regression tests were used to determine the relationship between categorical variables and rice commercialization. In contrast, the independent sample t-test was used to determine the mean difference between continuous variables and rice commercialization.

**2.4. Theoretical Model**

This study is based on Barrett's (2021) behaviour of the Agricultural market participation model and overcoming global food security challenges through science and solidarity, which is mainly focused on Utility maximisation. The key assumption for the model is that the decision of a farm household is based on the principle of utility maximisation, where one can be a net seller or net buyer.

The household utility function, as described by Kirimi et al. (2013), can be shown as follows:

$U= \left\{X\_{i},X\_{m},L, D\_{h}\right\}$……………………………………………………………….……... (8)

Whereby U is the utility function (assumed to be twice differentiable, increasing and strictly quasi-concave). Xi and Xm are vectors of home-produced and market-produced goods, respectively, that are consumed by household i, L is the leisure, and Dh presents a set of demographic characteristics that influence the preference of household members and the level of utility derived from consumption of goods and leisure. Utility of the household is maximised from the consumption of goods subject to farm production, income and time constraints as described here under:

$Q \left\{Q\_{i},L,A, K\right\}=0$………………………….. …………………………………………... (9)

$P\_{i}\left\{Q-X\_{i}\right\}-P\_{m }X\_{m}-W\left(L-L\_{f}\right)+N=0$……………………………………………. (10)

$T=L\_{f }+l $…………………………………………………………………………….... (11)

Where Q(.) is a production function, Qi is the quantities of goods produced by the household on the farm, L is the total farm labour inputs, A and K are household fixed quantities of land and stock of capital, Pi is the price of good i, Pm is the price of marketed purchased goods; $(Qi-Xi)$ marketed of surplus good i, ω is the wage rate; Lf is the household labour supply used by the farm, N is the non-farm income, T is the total time available for the household that is located between farm work and leisure.

The income and time constraints can be combined into one equation:

$P\_{i}\left\{Q\_{i}-X\_{i}\right\}-P\_{m }X\_{m}-w\left(L-T-L\right)+N=0$ …………………………………….. (12)

Rearranging the equations will give:

$P\_{i }X\_{i}+ P\_{m }X\_{m}+Wl= P\_{i }Q\_{i}+wT+wL+N$ …………………………………….… (13)

The left hand side of the equation represents household expenditure on home products.$P\_{i }X\_{i}$and marketed purchased goods $P\_{m }X\_{m}$ and leisure time $Wl$ while the right hand side is the income equation, representing the value of total agricultural production$P\_{i }Q\_{i}$, the household entitlement on time $wT$, and labour value used on a farm which includes hired labour $wL$and non-farm income $N$.

The household production decision is made first, and the general full income is allocated between agricultural production and leisure. The first order condition can be solved for input demand (L\*) and output supply (Q\*) in terms of prices, wage rate, land and capital.

$L^{\*}= L^{\*}(P\_{i}P\_{m },w, A,K)$ *…………………………………………………………………….…* (14)

$Q^{\*}= Q^{\*}(P\_{i}P\_{m },w, A,K)$ ……………………………………………………………… (15)

Given the optimum input (L\*) and output level (Q\*), the full income obtained when profit is maximised is given by substituting L\* and Q\* into the equation.

$Y^{\*}=P\_{i}Q\_{i }+wT-wL+N$ ………………………………………………………….….. (16)

$Y^{\*}=wT+µ^{\*}\left(P\_{i}P\_{m },w,A,K\right)+N$ ………………………………………………..…… (17)

Where Y\* is the full income that is achieved under the assumption of maximised profit, μ \* on the consumption side, first order equation can be solved for consumption demand as;

$X\_{i}^{\*}= X\_{i}(P\_{i}P\_{m },w, Y^{\*})$…………………………………………..……….…………….… (18)

$X\_{m}^{\*}= X\_{m}(P\_{i}P\_{m },w, Y^{\*})$………………………………………………………………….. (19)

The above equation shows the demand for home-produced goods. $X\_{i}^{\*}= X\_{i}(P\_{i}P\_{m },w, Y^{\*})$, and market produced goods$X\_{m}^{\*}= X\_{m}(P\_{i}P\_{m },w, Y^{\*})$, one of which is food. The equations combined through the profit effects, given that production decisions contribute to income through farm profit as the factors influencing production affect income and hence market participation decision. Based on this and incorporating households’ demographic characteristics (D), determinants of agricultural commercialization can be represented as:

$X\_{i,m}^{\*}=X\_{i,m}\{P\_{i}P\_{m },w, Y^{\*}\left(P\_{m },w,A,K,N\right),D\}$ ……………………………………………... (20)

**3.5. Model Specification**

The basic quantitative parameter of interest targeted is the household commercialization index $(HCI). T$his was computed to estimate the level of commercialization among smallholder farmers. A Correlation Analysis was performed to measure the degree of association among the factors for rice farmers’ commercialization and the level of commercialization.

The household commercialization index $(HCI)$ measures the ratio between the gross value of crop sales by a household in a given year to the gross value of all crops produced by the same household (*i*) in the same year (*j*) and is normally expressed as a percentage.

$HCI=\frac{Gross sale value of rice sales}{Gross value of rice production}x100\%$*…………………………………….* (21)

In this study, the household commercialization index (*HCI*) is explained in terms of the volume of produce sold to the market by the household to the value produced. Due to the nature of the dependent variable, the OLS model was employed to analyse the effects of different factors on the independent variable. The justification is that the sample respondents were producing rice both for sale and consumption. As a result, the researchers preferred to use the OLS model as the dependent variable was found to be continuous i.e. JAD 2 (1) 2011 factors determining the degree of commercialization when all the households were participating regardless of the amount they are supplying to the market. OLS is widely used due to its ease of estimation and straightforward interpretation. It helps in identifying the relationship between dependent (e.g., rice yield or revenue) and independent variables (e.g., inputs, market access). The justification for using the Ordinary Least Squares (OLS) model for this study was based on analysing rice production and commercialization which depends on the research objective and data characteristics.

**3.6. Econometric model**

To examine the determinants of rice commercialization among smallholder farmers for rice production in Wembere basin in Iramba district, Tanzania, of rice multiple linear regression model was used. The model was found to be appropriate because all the sample respondents produced and supplied a positive amount of rice to the market. The multiple linear regression model employed was specified as shown below eqn (22). This paper applied a variety of econometric models to examine determinants of commercialization and rice production as a function of individual characteristics. The multiple linear regression model was specified as follows;

* + 1. *Y* is the rice production of a smallholder farmer measured as the total output of a Likert scale item (1 = not sure, 2 = not at all, 3 = to a small extent, 4 = to a moderate extent, 5 = to a great extent).
		2. *X1* is the sex of the respondent (1 = male, 2 = female).
		3. *X2* is the age of respondents in years.
		4. *X3* is the land owned by a respondent in acres.
		5. *X4* is the access to extension to services (1 = if have access, 0 if otherwise).
		6. *X5* is the household size of the respondent.
		7. *X6* is the level of education of the respondent
		8. *X7 is* Quantity of rice produced
		9. *X8 is* Oxen owned
		10. *X9 is* Market distance
		11. *X10 is*Price of rice purchased
		12. *X11 is* Bank Loan use (1=Yes, 2=No)
		13. *X12 is* use of inorganic fertilisers
		14. *X13 is* farm income
		15. *X13 is* Use of improved Seeds
		16.  is a constant.
		17.  is a stochastic error term

$Rice Production = β\_{0}+β\_{1}SEX+β\_{2}AGE+β\_{3}EDULEV+β\_{4}FAMSIZE+β\_{5}FARMICOME+β\_{6}FARMSZ+β\_{7}LANDOWNS+β\_{8}RICEPRD+β\_{9}MAKTDTC+β\_{10}PRIPURC+β\_{11}EXTN+β\_{12}BALOA+β\_{13}FERTLZR+β\_{14}IMPSEED+ε$………………………………………………………………………………………. (22)

**Table 3. Explanatory Variables Commercialization for Rice Production**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Descriptions** | **Types** | **Expected sign** |
| SEX | Sex  | Dummy | + |
| AGE | Age of household  | Continuous | + |
| EDULEV | Education level  | Continuous | + |
| FAMSIZE | Family size | Continuous | - |
| FARMICOME | Farm income  | Continuous | + |
| FARMSZ | Farm Size (in hectares) | Continuous | + |
| LANDOWN | Number of hectre of land owned | Continuous | + |
| RICEPRD | Quantity of rice produced | Continuous | + |
| MAKTDTC | Market distance (in Km) | Continuous | - |
| PRIPURC | Price of rice purchased from the rice farmers | Continuous | + |
| EXTN | Extension Services/contacts  | Dummy | + |
| BALOA  | Bank Loan use  | Dummy | + |
| FERTLZR | Use of inorganic fertilizers  | Dummy | + |
| IMPSEED | Use of improved Seeds  | Dummy | + |

**4. RESULTS AND DISCUSSION**

**4.1. Descriptive analysis**

Table 4, the results of the descriptive analysis of continuous variables discussed in this paper, examines the determinants of rice commercialization among smallholder farmers for rice production on average. With regard to a standard deviation of 1.116 for oxen provides pull plough power, which is a major input in the rice production process, showing that 6.19 an average of cows is used for cultivating rice farms. On average, smallholder farmers owned 6.19 oxen, which was more than the pairs of oxen owned by smallholder farmers. At the 5% level of significance, the average land size and oxen ownership among smallholder farmers were statistically significant (P<0.05). Furthermore, the age of smallholder farmers of rice production and the education level have taken about an average of 1.15 and 2.43, respectively. At the 5% level of significance, the t-test result showed that the average age and education level are statistically significant(P<0.05). This implies that smallholder farmers’ age is the responsibility of the family as most of them have to take care so as to meet day to day family living expenses, should increase incomes through agriculture commercialization. The distance between the homesteads of smallholder farmers and the nearest market centre has taken about an average of 1.15km from the homes of farmers. The t-test results indicate that the average distance to the nearest market is statistically significant (P < 0.05), meaning that farmers closer to the market tend to engage in more rice commercialization. Furthermore, the result indicated that there was variation in households in terms of the average distance to the nearest market between market participants.

**Table 4. Descriptive Statistics Analysis of Continuous Variables**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |  **P-value** |
| Age | 26.00 | 74.00 | 1.15 | .376 | 0.0095 |
| Education level (in years) | 0.00 | 9.00 | 2.43 | .836 | 0.0006 |
| Household size | 2.00 | 12.00 | 1.00 | .049 | 0.0087 |
| Annual income  | 2.00 | 60.00 | 5.91 | 1.124 | 0.0228 |
| Total farm size (hectares) | 0.25 | 6.00 | 3.25 | 1.363 | 0.0014 |
| Rice quantity produced (in tons) | 0.40 | 8.30 | 6.10 | 1.094 | 0.0001 |
| Rice sold (in tons) | 0.00 | 7.50 | 5.90 | 1.277 | 0.0001 |
| Oxen owned | 0.00 | 4.00 | 6.19 | 1.116 | 0.0109 |
| Market distance (km) | 3.00 | 18.00 | 1.15 | .376 | 0.0006 |

**Survey data (2024) indicates a significant *p*≤0.05**

**4.2. Determination of Household Commercialization Index (HCI) for Rice Production**

Analysis of Determination of Household Commercialization Index (HCI) for Rice Production is a key metric used to assess the extent to which a farming household participates in the market. In the context of rice production, HCI measures the proportion of rice output that is marketed versus what is retained for household consumption. A higher HCI indicates a greater degree of commercialization, which is essential for agricultural development and rural economic growth.

$HCI=\frac{GVS ij }{GVPij }x100\%$……………………………………………………………….……. (23)

Where:

HCI= Commercialization Index

*GVS ij* = Gross Value of Rice sales of *i*th household for *j*thcrop

 *GVPij* = Gross Value of Rice Production of *i*th household for *j*th crop.

 HCI = 0% implies full subsistence farming (no market participation).

 HCI = 100% indicates full commercialization (all output is sold).

 0% < HCI < 100% represents partial commercialization

 Value of rice sold = Total quantity of rice sold × Market price

 Total value of rice produced = Total quantity of rice produced ×Market price

 HCI ranges between 0% (subsistence farming) and 100% (full commercialization).

According to Table 5, the results show the level of Household Commercialization Index (HCI) for Rice Production to the rice producer farmers in 2023 and 2024 are 0.95133 and 0.94793, respectively. The average commercialization indices of commercial farmers in two years were almost similar to the average of the whole observation of the commercialization variables. Wembere basin or swamp in Iramba district -Singida show that the level of rice commercialization had significant of households in the high commercialization category (HCI=95.13%) in 2023, followed by 2024 (HCI=94.79%). According to FAO (2023), “Household crop commercialization was further categorised into low (<33%), medium (33-66%) and high (66-100%). The results presented in Table 5 show that the level of Household Commercialization Index (HCI) was at a high level. This implies that there is a high level of rice commercialization in the Wembere Basin area. Also implies that a high degree of commercialization brought about high revenue to farmers, which makes it easy for farmers to purchase the required inputs for increased food production. In addition, generated revenue will provide a means to increase access to a variety of foodstuffs in the market”. These results are similar studies to Oladimeji and Abdulsalam(2022), Barrett (2021); Muteaet al. (2025) and Abate (2024) to “increase rice production to meet local demand and reduce imports, which constitute a significant portion of the national consumption. The government, along with various NGOs, has implemented programs to support rice farmers by providing improved seed varieties, promoting the use of fertilisers, and improving irrigation infrastructure with a gradual increase in agricultural commercialization. However, the engagement of smallholder farmers in the agricultural input and output markets, including labour markets, has increased considerably”.

**Table 5. Summary of Commercialization Index**

|  |  |
| --- | --- |
| **Commercialization Variable cost** | **Average Costs of the Variable Per Unit** |
|  Average Farm Preparation Cost | 55,000 |
|  Average Improved Seed Cost | 70,000 |
|  Average Fertiliser Cost | 70,000 |
|  Average Market Distance (Km) Cost | 40,230 |
| Average Harvesting Cost | 50,000 |
| Average Extension Services/Contacts Costs | 25,500 |
| Average Bank Loan Follow Up Costs | 20,000 |
| **Fixed Cost** |  |
| Average Farm Hiring Cost | 45,000 |
|  Average Oxen Owned Cost | 250,000 |
| **Total Cost (TC)** | **625,730** |
|  |
| **Average Value of Crop Produced (Gross Value of Production)** |
| **2023** | 13,688,945,000 |
| **2024** | 12,899,800,000 |
|  |
| **Average Value of Crop Sold (Gross Value of Sales)** |
| **2023** | 13,022,753,000 |
| **2024** | 12,228,111,000 |
|  |
| **Household Commercialization Index (HCI)for Rice Production (%)** |
| **2023** | **HCI** = 0.95133= 95.13% |
| **2024** | **HCI** = 0.94793= 94.79% |

**4.3. Econometric Results of Rice Production**

The linear regression model results indicated in [Table](#_bookmark21) 6 below show that the interaction of different demographic, economic, and institutional factors determined the determinants of rice commercialization among smallholder farmers for rice production. Before conducting regression, the correlation of dependent variables and independent variables was checked, and those variables satisfying the correlation conditions were included for regression analysis. The presence of multicollinearity among explanatory was conducted, on which the several variables together may be highly interdependent. The collinearity statistics check of diagnostics are produced by tolerance and VIF values. Table 6 indicates the collinearity statistics. The collinearity diagnostics are also checked to confirm the multicollinearity and displayed in Table 5. The results of this analysis clearly indicate that there is no multicollinearity between light conditions and time determinants of rice commercialization among smallholder farmers for rice production at Wembere basin in Iramba district.

Table 6 shows the econometric model; fourteen variables were found in multiple regression analysis of rice commercialization among smallholder farmers for rice production. However, eight variables have a significant influence on rice commercialization among smallholder farmers of rice production. These are sex, age of household, education level, family size, market distance, price of rice purchased, bank loan use and use of improved seeds.

Sex and age of household relationship to rice commercialization among smallholder farmers on rice production of rice participation. The regression results indicate that male-headed households are more likely to engage in rice commercialization, with the coefficient for sex and age being statistically significant (P < 0.05). This finding results is supported by Oladimeji., et al. (2022), determinants of rice commercialization among smallholder farmers in sub-Saharan Africa 68.4% of the respondents that commercialised were male, while the rest were female. However, for non-commercialised respondents, 67.5% were male, while the rest were female. This implies there were more male rice farmers than female rice farmers in the sample. This finding could be associated with the possibility that rice farming is a labour and resource intensive enterprise (it requires much more productive resources that men are usually more endowed with than women, especially in African settings). The usual practice in farming enterprises is that women tend to support their husbands in the processing aspect of rice production activities.

“Education level is a continuous variable measured a contribution of rice commercialization among smallholder farmers on production, which positively influenced the probability of rice production participation and degree of commercialization of rice at a 5% level of significance, and the results show that the coefficient for education level had significant (<0.05). This indicates that households who were more educated had better rice production participation and a high degree of commercialization. The positive relationship could be due to the fact that educated people can more easily contribute to the generation of new technologies and more readily utilise those technologies” (World Bank, 2023). Furthermore, educated people manage their fields properly, and then this activity results have pushes to get good production and productivity of the land. This result is in line with the findings of Ochienget al. (2023), which is analysed by Cragg’s Double Hurdle Model and confirmed that the level of education has a positive and statistically significant effect on market participation of farmers in rice marketing.

“Farm size relation with sales volume was positive and influenced the marketable supply of rice positively at a 5% level of significance. This shows that if the farm size of a household increases by a unit or simply by a hectare, the supply of rice to the production increases by 0.031 tons, holding other things constant. This can be explained by the fact that farm households that have larger land sizes produce rice in larger amounts and have the probability of revenue/profitability more. In addition, through diversification, they produce other crops like maize, sorghum, and others that can support household consumption needs. Since rice has a better market price than other crops, more rice is supplied to the market. The land is an important factor in production, and the larger the size of productive land the producer owns, hence the higher the production levels are likely to be due, enabling a household to produce a market surplus and be gifted to sell a substantial amount of produce” Gebremedhinet al., (2023). “This result is in line with the findings of Arega et al. (2008), which stated that a larger household is likely to consume more output, leaving smaller and decreasing proportions for sale”; Gebreslassie et al. (2023), family size had negative and significant association with the market participation of the smallholder wheat farmers; Guta et al. (2020) family size negatively affected vegetable market participation; Nigus and Tsegaye (2022), found that “family size negatively and significantly affected Avocado market participation”. These findings are in contrast to the findings of Osmani and Hossain (2015), who found that family size has a positive effect on smallholder market participation, and Banchamlak and Akalu (2022) found that “family size is positively associated with farmers’ likelihood of participating in vegetable market supply in the Yayo and Hurumu districts of Ethiopia”.

Oxen owned was hypothesised to have a positive influence on the dependent variable. The regression model has shown a positive sign on the coefficient, and the variable that influenced the rice production had a positive significant (<0.05) at a 5% level. This shows that if the number of oxen owned by a farmer increases by a unit, the production of rice to the will increases by 0.005 tons holding other things constant. Since land preparation in the Wembere basin Irambadistrict is merely done by using oxen, having more of it enables producers to prepare land on time and effectively to produce rice in larger plots and increase production. The finding is similar to a previous study by FAO (2023) on the livestock assets and rural livelihoods with the role of oxen in smallholder agricultural production.

Table 6 is all about access to market distance; the regression result showed that those households who have access to the market for selling rice have more probability of being rice market participants. However, the coefficient is negative and statistically significant at -0.001 at a 5% significance level (Table 6). The average partial effect result indicates that with a unit increase in access to facilities for households who have access to market information, the probability of being a market participant decreases by about 0.1%. Access to price information and communication services are key in prompting the market participation decision and encouraging the degree of commercialization. This confirms Ochienget al. (2023), who found that “those households that have high access to communication facilities have increased information flow, which enables farmers to link to buyers at a lower cost”.

Improved seed, most of the farmers were using well-known local rice varieties and little improved varieties. However, farmers need high yielding, improved varieties critically. According to Table 5,the farmers’ response to the existing newly supplied rice varieties. Improved seed affected sales volume in a positive relation and influenced the production of rice at a 5% level of significance. This shows that if the quantity produced increases by a unit, the supply of rice to the market increases by 0.022 tons holding other things constant. Rice in the Wembere was produced in a better market oriented way than other crops. It can be explained by a farmer who produces more would probably supply more to the market. In line with this finding, Kusse et al (2022), also showed “higher yield increases the farmer’s likelihood to participate in the market because the surplus above their household consumption needs makes more supply to the market. The quantity of rice produced is positively related to the intensity of market participation as the quantity produced is critical for semi-commercial farmers who first have to produce for home consumption and only sell surplus. The need for other promising new varieties is continued as it holds a high-value question for researchers to provide varieties to increase productivity sustainably in the district”. FAO (2023) revealed “the contribution of access to improved rice varieties via that adoption helps to participate in rice markets and that, in turn, had a higher significant impact on welfare indicators, such as consumption expenditure, rice income, average yield, and access to credit”.

“Bank loan use influenced the rice commercialization among smallholder farmers on the production of rice positively and significantly by 0.021 at a 5% level of significance. This shows that if households participated in credit, the production and supply of rice to the market increased by 2.1% tons, holding other things constant. This might be due to the reason that rice producer households with labour and financial shortages need to use hired labour for land preparation, weeding, and harvesting, as a result, they utilise credit for paying labour and fertiliser costs for rice production in larger amounts. In line with this, other researchers also showed that access to credit enables producers to increase the amount of inputs and other inputs (fertiliser, seed, oxen), which in turn boosts output produced and surplus for the market and food security. Total farm income is influenced by the rice commercialization among smallholder farmers on production of rice of rice positively at a 5% level of significance due to coefficient of 0.027. This shows that if households’ annual income (in thousands) increases by a unit, the supply of rice to the market increases by 0.027 tons, holding other things constant. It might be due to a farmer with a better annual income having a better opportunity to produce rice in larger size by employing all necessary production inputs and supplying more rice to the market than those with lower income”. (FAO,2023).

[**Table 6.**](#_bookmark20) **OLS Regression Results for Rice Production**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Coefficient** | **Std. Error** | **t-ratio** | **Collinearity statistics** |
| **Tolerance** | **VIF** |
| Sex  | -0.015 | 0.102 | -0.15 | .845 | 1.030 |
| Age of household  | -0.004 | 0.004 | -0.91 | 0.896 | 1.116 |
| Education level  | 0.001 | 0.013 | 0.72 | 0.882 | 1.134 |
| Family size | 0.031 | 0.021 | 1.45 | 0.915 | 1.093 |
| Farm income  | 0.027 | 0.042 | 2.27\*\* | 0.959 | 1.043 |
| Farm Size  | 0.063 | 0.004 | 15.33\*\*\* | 0.911 | 1.097 |
| Number of hectre of land owned | 0.063 | 0.065 | 0.95 | 0.916 | 1.091 |
| Quantity of rice produced | 0.067 | 0.094 | 0.70 | .997 | 1.003 |
| Oxen owned | 0.005 | 0.054 | 0.64 | .911 | 1.064 |
| Market distance  | -0.001 | 0.0088 | -0.21 | .993 | 1.102 |
| Price of rice purchased  | -0.053 | 0.081 | -0.66 | .994 | 1.006 |
| Extension Services/contacts  | 0.168 | 0.079 | 2.13\*\* | .997 | 1.004 |
| Bank Loan use  | 0.021 | 0.004 | 4.73\*\*\* | .971 | 1.030 |
| Use of inorganic fertilisers  | 0.150 | 0.057 | 2.66\*\*\* | .965 | 1.023 |
| Use of improved Seeds  | 0.022 | 0.079 | 0.52 | .945 | 1.023 |
| Constant | -0.764 | 0.21 | -3.62 | .992 | 1.022 |

Number of observations = 117 R-squared = 0.954. Root MSE = 3.385 Adj R-squared = 0.9484.

F (13, 106) = 167.67 Prob.> F = 0.0000.

**5. CONCLUSION AND RECOMMENDATIONS**

This paper set out to examine the determinants of rice commercialization among smallholder farmers for rice production in Wembere basin in Iramba district. The study shows that farmers in the Wembere basin were oriented towards a semi-commercial farming system in the rice crop output market, pinpointing an opportunity still exists to improve farm households’ scale of commercialization. Moreover, like much literature that found a positive association between commercialization and rice production, the study results also suggest positive effects of commercialization on household production with HCI comparisons considered criterion decision (moderate vs. low, high vs moderate, and high vs. low commercialization categories).

In the study area, most of the smallholder farmers were producing rice in a better market oriented way than other crops grown in the area, and it created better employment opportunities for most farm households. The results show that the level of Household Commercialization Index (HCI) was high level at Wembere basin or swamp in Iramba district -Singida, where the level of rice commercialization was significantly high at (HCI=95.13%) in 2023, followed by 2024 (HCI=94.79%). Also implies that a high degree of commercialization brought about high revenue to farmers, which makes it easy for farmers to purchase the required inputs for increased food production. In addition, generated revenue will provide a means to increase access to a variety of food stuffs in the market. Furthermore, determinants of rice commercialization among smallholder farmers for rice production were sex, age of household, education level, family size, market distance, price of rice purchased, bank loan use and use of improved seeds.

Hence, the study concludes that any policies and strategies targeted at improving the commercial status of smallholder farmers can contribute to an improvement in their welfare status. Therefore, the study calls for the promotion of commercialization in the rice farming systems in Wembere Basin, specifically and Tanzania, in general. This can help the farmers increase their income and food security (both on consumer goods/services and other assets) and enjoy a better life. Moreover, in a commercial farming system, as farmers rely more on purchased inputs, agricultural commercialization has a spillover effect on the input market, thus creating more capital and employment in other sectors and stimulating economic growth in rural areas. In the Wembere basin, commercialization can be enhanced by improving public service delivery for the rural community, investing in modern agriculture, establishing a well-functioning market system, and employing market-oriented production strategies for improving food security in rural areas.

This paper recommends strengthening farmer cooperatives and value chains so as to support the formation of farmer cooperatives to increase bargaining power, reduce transaction costs, and improve economies of scale. The government is required to strengthen government extension services to enhance knowledge dissemination and technology transfer. The stakeholders include International Agencies, Regional Co-operations, the Central Government, district councils, NGOs, other development partners, and household regarding security and malnutrition. International institutions should continue to help poor countries like Tanzania to build internal capacities and strengthen local and international institutions, maintain food security, and get rid of hunger and malnutrition. Currently, cash crops are the biggest determinant of food security in Singida and Iramba districts; the Government, District Councils and other development partners are urged to create capacity and build sustainable institutions, including for people to generate income through small and medium enterprises (SMEs) for bulk production of cash crops including sunflower, onions, simsim and finger millet, commercial fishing at Kitangiri and Magungumuka lakes as along Wembere basin. Major problems related to rice production in the area were a lack of improved rice production technologies, the requirement of heavy crop management, especially weeding, fertiliser supply and high prices, problems related to security problems sometimes causing conflict, weak extension service provision, weak research extension-farmer linkage, weak monitoring of traders and market by concerned government organization. The rice crop is a significant contributor, and the same will be in the future as the crop has considerable potential to improve the livelihood of farm households and communities. Thus, attention should be given to Wembere basin in Iramba district for rice production and marketing related constraints.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

I hereby affirm that this paper was composed by myself and that the work herein is my own. During the preparation of this paper, I have used Chat GPT 3.5 to assist me in the writing process to improve language, flow, and readability.

**CONSENT**

As per international standards and University standards, respondents’ written consent has been collected and preserved by the author(s).

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