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Comparative Profitability among Adopters and Non-Adopters of Selected Innovations

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Abstract

Level of profit generated from adoption of paddy innovations can influence famers' decision to adopt such innovations; however it is imperative to know whether there are profit differences between adopters and non-adopters of innovations. This study was conducted in Mvomero District, Tanzania. The main objective is to compare profitability among adopters and non-adopters of selected innovations. Cross-sectional research design is employed and simple random sampling technique is employed to select 299. The interview uses a semi-structured questionnaire. Net farm income (NFI) and Return on investment (ROI) are used to analyze the profitability for selected innovations. Content analysis is used to analyze qualitative information. The study reveals that adoption of SRI, PTs and WTs is more profitable compared to non-adoption of the same innovations ($p < 0.01$). Adoption of SRI, PTs and WTs to farmers in the study area is a profitable venture ($p < 0.01$) and serves as a stimulus for other farmers to apply the innovations in paddy production. Extension officers and rural development agents should educate farmers especially those who do not adopt innovations on the advantages of adoption of paddy innovations so as to improve their wellbeing.

Keywords: *Adoption; Innovation; Net Farm Income; Profitability; Return on Investment*

1.0 Introduction

Agriculture is an important economic sector of the Tanzanian economy and contributes about 29.1% of Gross Domestic Product (GDP) (URT, 2017). The important cereal crops produced in Tanzania are maize, paddy, sorghum, finger millet, bulrush millet, and wheat. Paddy is among the important cereal crops grown in different parts of Tanzania as food crop and source of income. In the 2016/17 season, paddy was the second most produced cereal crop after maize with the harvest of 1 382 794 tons (17.8 %) compared to 1.4 million metric tons in National Panel Survey (NPS) 2014/15. Morogoro Region recorded the highest paddy production in Mainland Tanzania with 332 280 tons (24.0 %) and crop yield of 4.0

tons/ha, followed by Mbeya Region with 246 649 tons (17.8 %) (URT, 2017; NBS, 2017). Morogoro is among the three potential paddy producer regions in the Central Corridor, others are Tabora and Shinyanga. The regions have larger areas under paddy which together constitute 48.4 % of the total area under rice cultivation in Tanzania (Rice Sector Assessment Report, 2009).

In Morogoro, paddy is produced on large scale as well as by smallholder farmers. Mkindo and Dakawa paddy irrigation schemes, located in Mvomero District in Morogoro region, are among Tanzania's major areas of paddy production. The study area is strategically positioned attracted different stakeholders to diffuse paddy innovations. The stakeholders include Mkindo Farmers Training Center, Chinese Agro-technology Demonstration Center - ATDC, NAFAKA project under feed the future program, Ministry of agriculture, researchers from Sokoine University of Agriculture (SUA) and Cholima research station. Paddy innovations have been introduced in the study area by the Government of Tanzania and related stakeholders so as farmers to adopt and enhance their productivity as well as profitability (Makundi, 2017 and Katambara et al., 2013). Katambara et al. (2013) reported that SRI in Mkindo area produced 9.90 tons/ha paddy yield compared to 3.83 tons/ha in conventional practice, which is 158% more.

Among the motivating factors of adoption of paddy production innovations is the level of profit generated. There are various measures of profitability; including the Return on Investment (ROI), Net Farm Income (NFI), Gross Margin (GM), Net Present Value (NPV), Internal Rate of Return (IRR) and the Benefit-Cost Ratio (BCR or B/C). The measures differ from one another on how profit generated is expressed and simplicity on financial profitability analysis of a given project. Benefit-Cost Ratio (BCR or B/C) and Internal Rate of Return (IRR) are useful in expressing project viability for a number of years (year t). According to Terauchi et al. (2014) the NPV is the profitability of an investment in monetary terms, and this takes into account the risk of future profits. If the NPV is greater than zero, the investment for a project is profitable. IRR is the discount rate at which the NPV of the costs of the investment equals the NPV of the benefits of the investment. If the B/C ratio is greater than 1, the benefit of the investment exceeds the cost of the investment. GM is an important measure of resource efficiency in Small and Medium Enterprises (SME). GM is the gross return minus the total variable expenses, can be expressed in normal value (Tzs), ratios or percentage of return. The GM does not take into account total fixed costs involved during production and may not necessarily reflect genuine production performance of the farms (Tugeineyo and Hella, 2011). ROI and NFI take into account of the variable costs and fixed costs in measuring profit.

NPV, IRR and BCR seem to be complex compared to GM, ROI and NFI as indicators of profit especially for smallholder paddy farmers like that of Mvomero District. Time factor is ignored when using ROI but it is not a problem to present study since profitability analysis of selected innovations considers only 2015/16 production season. However, this study is in favour of Return on Investment (ROI) and Net Farm Income (NFI) because they are widely used by different scholars, simple and yet the effective techniques in evaluating financial performance of a given business (Antwi and Aborisade, 2017; Ngabitsinze, 2014). ROI and NFI are used to evaluate the performance of small and medium projects/investment and businesses. The two profitability measures were applied in the study area because smallholder paddy production is seasonal and respective farmers would be interested to increase income and reduce poverty. Smallholder paddy farmers would like to know profit (that is NFI) in terms of exact income (Tzs) generated after they have incurred production costs which involve variable costs and fixed costs. Also, ROI is useful for farmers who get loan and invest in production process so as to measure the returns. Since nowadays smallholder rural farmers tend to acquire loans from credit facilities, it could be imperative to know the ratio of the profit made on paddy farming to the cost of the paddy production in terms of how much money in Tzs produced for every single TZS invested in production.

Paddy farming in Tanzania is characterized by poor innovation and a limited application of improved technologies (Makundi, 2017). The unique innovations that were introduced to smallholder farmers in Mvomero District include the System of Rice Intensification (SRI), Power Tillers (PTs), Wooden Threshers (WTs) and Combine Rice Mills (CRMs). Enhancing adoption of paddy innovations in the study area is subject to its economic feasibility. However, profitability of adoption of introduced innovations for the 2015/16 production season in Mvomero District was not evaluated by other scholars. Despite technical superiority of SRI, PTs, WTs and CRMs, there is limited information on the profitability of these innovations. To develop effective policies to enhance adoption of introduced innovations specifically the SRI, PTs, WTs and CRMs, policy makers need information on the profitability of the innovations that can be targeted to improve farmers' well-being and reduce poverty. The overall objective of this paper was to assess profitability for adoption of selected innovations among paddy farmers in Mvomero District. Specifically the paper aimed at comparing profitability between adopters and non-adopters of SRI, PTs, WTs as well as CRMs in the study area.

1.1 Theoretical Framework

This study is guided by the theory of the firm. The theory of the firm considers a firm in profit making perspective. Behavior of a firm in pursuit of profit maximization is analyzed in terms of (1) what are its inputs, (2) what production techniques are employed, (3) what is the quantity produced and (4) what prices it charges. The theory suggests that firms generate goods to a point where marginal cost equals marginal revenue and use factors of production to the point where their marginal revenue product is equal to the costs incurred in employing the factors. Theory of the firm assumes firms maximize profit. This means that a firm achieves a maximum profit with low operating expenses. The theory also considers perfectly competitive markets whereby the firms (and consumers) are price-takers and quantity is firms' only choice variable. Smallholder paddy farmers in Mvomero District are not different from other smallholder farmers in the developing countries who produce under perfect competition characteristics (Makindara et al., 2009). These are: (1) a large number of small farms, (2) identical products sold by farmers, (3) perfect resource mobility or freedom of entry into and exit out of the production. In this study a firm is considered as an individual paddy farmer, while factors of production involve land, labour, money and resources used in paddy production. Production techniques are the methods and tools used to create and process paddy yield. The production techniques are SRI, PTs, WTs and CRMs.

1.2 Conceptual Framework

Paddy production is an economic activity that is practiced by farming community in course of their survival. In this activity both prices and quantities produces are sometimes uncertain (Makindara et al., 2009), such that many smallholder rural farmers find it difficult to estimate profit. Profitability analysis is a way to help a project to make decision whether the investment is profit-making potential or not. Profit is estimated by considering income accrued from sales of paddy output, variable cost incurred and fixed cost involved in paddy production. Profit is generated where there is excess of revenue and a loss is obtained where there is excess of costs. The revenue is derived from the sale of the paddy output and costs could be from the farm inputs such as fertilizers, pesticides, seeds and labour and other cost can be transportation of materials and farmer registration into a farmer group. Cost can be categorized into variable cost (VC) and fixed cost (FC).

2.0 *Methodology*

Data for the study were collected from Mkindo and Dakawa paddy irrigation schemes in Mvomero District, Tanzania. The two irrigation schemes were selected because they are the areas where selected Innovations under study were introduced among the smallholder paddy irrigation schemes.

Cross-sectional research design was adopted whereby 299 farmers who are members in two schemes were estimated using Yamane (1973) and farmers were sampled using simple random technique. The formula assumed 95% confidence level and precision of 0.05; $n = N/[1+Ne^2]$ where: *n* is the sample size, *N* is the population size and *e* is the level of precision, whereby farmers constituted the population for the study. Proportionate samples of 96 and 203 farmers were obtained from Mkindo and Dakawa respectively for good representation in each scheme. Key informant (KI) was purposively selected and interviewed using checklist of questions. Semi-structured questionnaire was used to gather quantitative information related to quantity of paddy harvested by farmers, selling price, costs related to inputs used and costs incurred in different paddy production activities. Interviews were conducted in Swahili language and translated in English during data processing and analysis. Qualitative information was analyzed using content analysis whereby pieces of information collected KII were summarized, coded, grouped into themes and compared to reflect profitability among farmers. The data were entered, processed and analysed in Statistical Package for Social Sciences (SPSS) and Microsoft Excel Programme to calculate profitability in terms of Net Farm Income (NFI) and Return on Investment (ROI). Then, profitability analysis was conducted using NFI and ROI.

2.1 Net Farm Income (NFI) Analysis:

The net farm income analysis was used to determine the profitability of paddy production upon adoption of SRI, PTs, WTs and CRMs innovations in the study area. A unit of calculation for paddy crop was a hectare. The net farm income analysis is given by the following mathematical expression:

$$NFI = TR - TC \quad \ldots\ldots(1)$$

Where:

NFI=Net Farm Income (Tzs); TR=Total Revenue (Tzs)

$$TR = \sum Py.Y \quad \ldots\ldots(2)$$

Where:

Py = Price per unit output (Tzs) i.e per kg of paddy

Y = Total quantity of output (Kg)

$$TC = TVC + TFC$$

Where:

TVC =Total variable cost (Tzs)

$$TVC = \sum Px_i.x_i \quad \ldots\ldots(3)$$

Where:

Px_i =Price per unit of input (Tzs)

x_i =Quantity of ith input used per unit input

TFC = Total fixed costs involved in paddy production (Tzs).

2.2 Return on Investment (ROI) Analysis:

Return on Investment was estimated using the following mathematical expression:

$$ROI = \frac{Benefit}{InvestmentCost} \quad \text{.....(4)}$$

Where:

ROI =Return on Investment in paddy production (Tzs)

$Benefit(TZS)$ = Total Revenue (TR) – Investment Cost (TC)

TR =Total Revenue (Tzs) (equation 2)

$TC = TVC + TFC$

TVC =Total variable cost (Tzs) (equation 3)

TFC = Summation of fixed costs involved in paddy production (Tzs).

Variable costs in this study included extension services, bunds maintenance, land renting, land preparation, nursery bed preparation, seeds preparation, raising seeds in nursery, uprooting seedlings and transplanting, irrigation, water fee, fertilization, weeding, birds scaring, farm security, harvesting, threshing, winnowing, inputs purchase, seeds purchase, chemical spraying, storage, milling and transportation during 2015/16 production season while fixed cost involved membership admission fee.

The Mann-Whitney U test was conducted to determine if there are statistically significant differences in ROI and NFI between adopters and non-adopters for each innovation. The test was ideal because it is appropriate to test for differences between two independent groups (Pallant, 2007). The test was carried out because the dependent variable, profit (Tzs), was not normally distributed. Also the test is the alternative of the t-test for independent samples and also it analyses differences in the positions of dependent variables in two independent groups (Nachar, 2008).

Calculation of the Mann-Whitney U used the following illustration:

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - \sum_{i=n_1+1}^{n_2} R_i \quad \text{.....(5)}$$

Where:

U=Mann-Whitney U test

n_1 = sample size one (adopters of innovations/male adopters of innovations)

n_2 = Sample size two (non-adopters of innovations/female adopters of innovations)

R_i = Rank of the sample size

3.0 Results and Discussion

The results in Table 1 present profitability among adopters and non-adopters of SRI, PTs, WTs and CRMs.

3.1 Profitability among Adopters and Non-adopters for SRI, PTs, WTs and CRMs

Results of the analysis of profitability for paddy farmers in Mvomero District show that, there were significant differences ($p<0.01$) in mean ranks for Return on Investment (ROI) and Net Farm Income (NFI) between the adopters and non-adopters of SRI, PTs and WTs (Table 1). Thus the hypothesis that profitability in terms of ROI and NFI is likely to differ between adopters and non-adopters of SRI, PTs and WTs is confirmed. The ROI medians and NFI medians for adopters of SRI, PTs and WTs were higher compared to that of non-adopters of the same innovations meaning that adopters of SRI, PTs and WTs performed better in profit compared to non-adopters of the same innovations (Table 1).

According to the results in Table 1, adopters of SRI, PTs and WTs accrued more profit compared to non-adopters of the same innovations. This means that the use of SRI, PTs and WTs in paddy production result into high yield while the cost of production was minimized. Also, PTs reduce cost related to labour demand in puddling operation and the mode of construction as well as operation with WTs maximize paddy yields through reduced grain loss. WTs are wooden stand made with crossing timbers and during threshing the paddy kernels are detached from the panicles by impact through beating in which a canvas is camped to surround the threshing area and another canvas is spread down. This finding implies that increased profitability to adopters of SRI, PTs and WTs in paddy farming is a motivation for non-adopter farmers to apply such innovations towards improving their wellbeing.

Table 1: Results for ROI and NFI between adopters and non-adopters of SRI, PT, WT and CRM innovations

Innovation	Adoption category	ROI median	ROI $\overline{X}$ rank	p-value	NFI median	NFI $\overline{X}$ rank	p-value
SRI	Adopters (n=148)	2.59	216.63	0.000	829 950.80	223.66	0.000
	Non-adopters (n=151)	0.12	84.70		40 307.60	77.81	
PT	Adopters (n=140)	2.39	215.84	0.000	750 633.55	224.59	0.000
	Non-adopters (n=159)	0.10	92.03		29 048.90	84.33	
WT	Adopters (n=16)	3.50	236.94	0.000	344 0910	260.50	0.000
	Non-adopters (n=283)	1.04	145.08		344 0910	143.75	
CRM	Adopters (n=53)	1.04	148.09	0.860	331 735.80	146.32	0.733
	Non-adopters (n=246)	1.04	150.41		341 120.20	150.79	

Source: Researcher (2016)

Key: $\overline{X}$ =mean

The result on profitability of SRI is supported by the information from Key Informant Interview (KII) who was a researcher in Dakawa research station known as CHOLIMA. A Key Informant gave the following statement:

> *"...adoption of SRI practices is more profitable since input costs are reduced, high yield is achieved and minimum water is needed and therefore it solves water problems compared to traditional practices"* (Dakawa interview, 24th May, 2016).

This qualitative information implies that farmers who adopted SRI practices got higher profit compared to non-adopters because SRI practices lead to increased yield and minimize cost of production. This means that adoption of some of SRI practices like minimum water application of 2cm depth reduces demand for labour in water management; use of single transplants per hole encourages high tillering and grain yields due to plants being well aerated; wide plant spacing of 25x25 cm discourages pests therefore reduces cost attached with pest control. Therefore if operation costs are reduced and higher paddy output are achieved, that means the return and net income are anticipated to increase.

However, there were no statistically differences in profit between adopters and non-adopters of CRMs. This means that adopters of CRMs in fact tend to face high amount of cracked and broken kernels during de-husking or de-hulling due to poor drying of paddy which end up obtaining low amount of quality rice. This is due to the fact that majority of rural farmers lack knowledge and skills on performing paddy drying.

Similar to this study's findings, Nayak et al. (2016) reported that SRI farmers received higher net income per acre than traditional farmers in Kendrapara district of Odisha in India. Also, Dagar et al. (2015) found that the adoption of SRI by farmers was profitable through increased yield of rice as compared to the conventional method of rice cultivation in Haryana, India. Similar suggestion was given by Katambara et al. (2013) who conducted a study in Mkindo scheme, that SRI produced as high yield as 158% more than conventional practices. Katambara et al. (2016) as well provided similar argument that, rice yields under SRI practices yield more than 16ton/ha against less than 8ton/ha for conventional rice growing practices. In their study conducted in Sri Lanka on adoption of SRI, Namara et al. (2003) found that among other advantages, adoption of SRI is profitable since farm operational costs are reduced. Miah and Haque (2015) reported that power tillers' operation services for land preparation, sowing and transplanting seeds/seedlings of different crops at farm level was highly profitable. Again, similar argument to this study was provided by Kwatra et al. (2010) that, the use of paddy thresher was profitable and cost of work was reduced by 60.28 percent. Moreover, Prasanna et al. (2004) found that, farmers who adopted paddy threshers increased profit against reduced labour cost.

Conclusions and Recommendations

This study shows that paddy production in Mvomero District is profitable for farmers with SRI, PTs and WTs compared to farmers without SRI, PTs and WTs as estimated using both Net Farm Income (NFI) and Return on Investment (ROI). Extension officers and rural development actors should educate paddy farmers on the significance of adoption of innovations especially SRI, PTs and WTs because it is proved to be worthwhile investment for paddy farming communities. Policy makers should be design agricultural policies that ensure adequate supply of agricultural inputs at subsidized rates so as to help paddy farmers to minimize cost of production.

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