The Capacity of On-farm Research in Reducing Poverty: Experiences from Twenty Seven Projects in Tanzania

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Abstract

Poverty can be categorized into income poverty and non-income poverty. At the small-scale farmers level income poverty results from low productivity of agricultural enterprises, hence low sales of products. On the other hand, non income poverty encompasses a wide range of live phenomena, including level of education, poor survival strategies, poor nutritional status, lack of clean and safe drinking water, poor social wellbeing, vulnerability, etc. In 2000/01 about 62% of households in Tanzania succumbed to income poverty. While the Poverty Reduction Strategy Paper (PRSP) was silent on research as one of the strategic approaches to reduce poverty in Tanzania, a study was conducted between 2001 and 2004 by Sokoine University of Agriculture (SUA) in collaboration with the Agricultural Sector Lead Ministries (ASLMs) to evaluate the effectiveness of on-farm research and development (R&D) approaches in bringing about poverty reduction amongst the smallholder farmers in the country. The study was based on 27 projects under Tanzania Agricultural Research Project Phase II (TARPII) managed by SUA (TARPII-SUA) conducted in the Eastern and Southern Highlands Zones of country. By responding to a questionnaire, smallholder farmers evaluated technologies introduced through research. Results have shown that smallholder farmers' poverty could be significantly reduced by introducing appropriate technologies. Thus, on average, participating farmers observed reductions in income poverty by the period of this study. It is concluded that introduction of technologies through on-farm research increases technology adoption and reduces income poverty.

Key words: On-farm research, income poverty, poverty reduction, and technology transfer.

Introduction

Poverty can be categorized into two broad terms, *income poverty* and *non-income poverty*. At the small-scale farmers level income poverty results from low productivity of agricultural and natural resources enterprises, hence low sales of products. On the other hand, non income poverty encompasses a wide range of live phenomena, including level of education, poor survival strategies, poor nutritional status, lack of clean and safe drinking water, poor social wellbeing, vulnerability, etc. Evidence consistently shows that agricultural growth is highly effective in reducing poverty. For example, Thirtle et al. (2003) have

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shown that research-led technological change in agriculture generates substantial productivity growth and has resulted into high rates of returns in Africa and Asia. Agricultural research has been instrumental in introducing improved technologies that increased production, stimulated economic growth, and improved people's welfare through lowering food prices and increasing income (Lipton and Longhurst, 1989). It has been reported that for every 1% increase in per capita agricultural output there is a 1.6% increase in the incomes of the poorest 20% of the population (Gallup *et al.*, 1997). A study by Thirtle *et al.* (2001) concluded that, on average, every 1% increase in agricultural yields reduced the number of people living on less than a dollar per day by 0.83%. Agricultural technologies have helped food production grow faster than human population, thus avoiding widespread food shortages that would otherwise be detrimental, particularly to the poorest section of the community (Plucknett, 1991).

Consequently agricultural research is generally perceived as one of the most economically productive investments that a country can make (Alston *et al.*, 1995). Agricultural research in Sub-Saharan Africa (SSA) has followed a unique evolutionary path and African policy makers are now embracing research in their endeavours to alleviate poverty. Rukuni *et al.* (1998) gave an excellent overview of the evolution of SSA agricultural research systems and their impacts on economic growth.

In Tanzania, increasing productivity in agricultural sector is considered as one of the most important prerequisites for improving the quality of life of people and often it is a long-term goal for almost all development policies and strategies. According to URT (2005) technological change is the main driver for enhancing factor productivity in agriculture, especially in rural areas. Poverty is rampant in rural Tanzania. According to a study conducted in 2000/01 about 62% of households in Tanzania succumbed to income poverty while in terms of non-income poverty; figures varied from 53% (using unprotected water) to 54% (lack of education) (PRSP, 2001). Currently, slightly over 80% of Tanzanians depend on agriculture for their livelihoods.

Thus, in recent years, Tanzania has been implementing several donor-supported research projects to transfer technologies in agricultural and natural resources to households and communities, e.g. the SUA-led program under Tanzania Agricultural Research Project Phase II (TARPII-SUA), which was implemented between 2000 and 2005.

While advocating for research-led agricultural development it is important to realize conditions under which technological advancement may help or harm poor people, and suggest some approaches for promoting more favourable outcomes in the future. To objectively address the scepticism

regarding the impact of agricultural research on poverty there is a need to assess the impact of previous and on-going research projects with respect to two aspects. One aspect is the extent to which on-farm approaches are embraced to accommodate interests of beneficiaries in formulating and implementing research projects, especially the economically weak and disadvantaged groups. Existing evidence on the impact of on-farm research in Tanzania is generally weak and what ever little information is available focuses on technology development and adoption, not poverty alleviation. Secondly, it is also important to account for the controversy surrounding the issue of targeting agricultural research to explicitly address poverty concerns. Accumulated evidence shows many cases in which attempts to design technologies with pro-poor characteristics were costly and ineffective, so new efforts must proceed with caution. On the other hand, most of the agricultural projects implemented in Tanzania entailed attractive opportunities which were tested on a small scale and under farmers' conditions.

This paper summarizes experiences from TARP II – SUA to show the potential of agricultural projects on poverty reduction in Tanzania.

Materials and Methods

Studies were conducted in March and April in 2005 i.e. about 8 to 12 months after termination of direct support to TARP II – SUA projects.

A questionnaire survey involving a minimum of 20 randomly selected participating farmers per project was used to estimate the level of adoption of introduced technologies. Households that had tried a technology also indicated whether or not they were continuing to use the introduced technology or technologies at the time of the interview. Moreover, the respondents were asked to estimate their income from the relevant activity before and after adopting the introduced technologies as well as any assets acquired from income attributable to those technologies.

The projects that were conducted on-farm were: (1) Promotion of cassava commercialisation through value adding (2) Sweet potatoes and cassava processing methods (3) Fruits and vegetables processing (4) Milk processing (5) Local chicken health (6) Mastitis control (7) Ticks and tick-borne diseases (8) Dry season feeding alternatives, (9) Cattle productivity enhancement (10) Small ruminant productivity (11) Rainwater harvesting (12) Integrated striga management (13) Integrated rice improvement (14) Sequential cropping (15) Tillage practices for improved rice farming systems (16) Draft animal power (17) Control of Rice Yellow Mottle Virus (18) Effects of N and P on cereal productivity (19) Soybean variety evaluation, (20) Common beans production (21) Mushroom production (22) Smallholder irrigation (23) Improved fallow (24) Pigeon pea variety adaptation (25) Agroforestry technologies (26)

Sweet potato germplasm evaluation (27) Coconut based farming systems.

Descriptive statistics including means, range, frequencies, and percentiles were used in summarizing data.

Results

This section points out impacts obtained from technologies introduced by the TARP II – SUA project in terms of changes in income and investments made following income obtained from the projects. The presentation of these results has been grouped into four broad themes: processing, marketing and utilization of agricultural produce; animal production; cereal crops production; pulses and other crops.

Effects of projects within processing, marketing and utilization

Processing, marketing and utilization are important activities in agriculture that influence the livelihoods of rural communities in Tanzania. Processing adds value and storability to agricultural produce. In this section, four projects belonged to this thematic area. They included cassava commercialization; fruit and vegetable processing; milk processing; sweet potato and cassava processing. The majority of the participants in this thematic area observed an increase in income due to adoption of the introduced technologies except for a project on fruits and vegetables processing, where more respondents reported reduced than increased income (Table 1). Income increases ranged from 59 to 94%. The cassava processing project introduced processing equipment that increased processing efficiency. Consequently, cassava production increased that lead to increased household income ranging from TZS 200,000 to 340,000 per annum.

As an indicator of increased income levels, households in this thematic group invested in various items (Fig. 1). On average, 72% of respondents invested their income in various items, while 28% did not. The value of investment was as high as TZS 300,000 in purchase of livestock by participants in the fruit and vegetable processing project. Housing, purchase of new farm plots, and payment of school fees were other areas of investments that were made by most households following increases in income.

Table 1: Impact of processing, marketing and utilization thematic group on household income

Technology	Response on income (%)		Average change in income	
	Increase	Decrease	TAS	%
Cassava Commercialization	69.0	24.1	162,976	59
Sweet potatoes and cassava processing	76.5	5.9	109,658	80
Fruits and Vegetable processing	30.8	42.3	366,337	84
Milk Processing	90.3	3.2	195,507	94

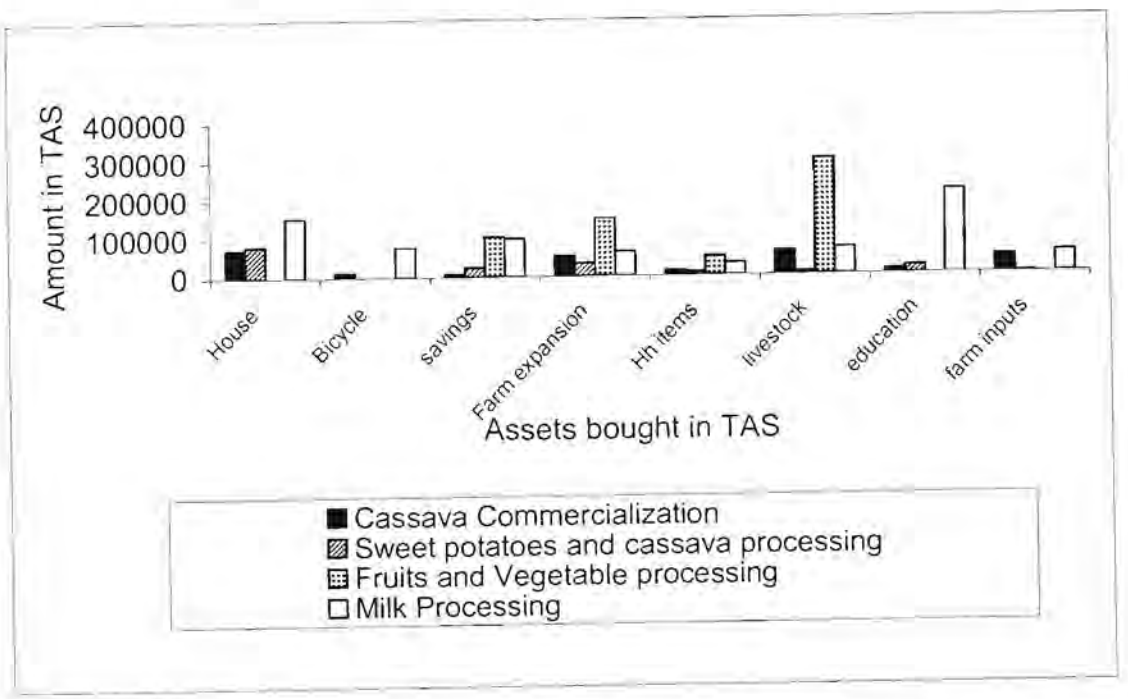

Figure 1. Type and levels of investments made following increases in income due to improved agricultural processing, marketing and utilization.

Effects of projects within animal production and health

Livestock and livestock products are highly valued in terms of unit price when compared with crop products. For example, the local poultry health project introduced technologies focusing on use of improved housing, vaccination and improved feeding whereas another project dwelt on bovine mastitis control with a focus on hygienic milking, improved milking practices, proper housing and early detection of mastitis. In the Southern Highlands of Tanzania

interventions were done to mitigate dry season shortage of pasture. Fodder trees, improved pasture and hay bailing were introduced. Two other projects focused on improvement of zebu cattle productivity through tick-born disease control, and improvement of small ruminant productivity, particularly among dairy goats (Table 2).

Most of the projects participants (48 – 97%) reported increases in income under this category. Changes in income ranged from 39 to 179 percent. Higher average incomes were reported in the mastitis control and tick and tick-borne disease control projects. In terms of relative change in income, the chicken health project was outstanding. This was realized following reduction in mortalities as result of vaccination against Newcastle disease and other managerial interventions. Consequently, the average local chicken population in this project increased from 29 to 55 per household, contributing to an income change of up to 179% (Table 2).

The project addressing control of mastitis among dairy cattle and reduction in microbial contamination in milk increased household income as attested by 90% of the participating farmers. The reported level of income increase was as high as TZS 499,927 per household per year.

Table 2: Impact of animal thematic group on household income

Technology	Response on income (%)		Average change in income	
	Increase	Decrease	TAS	%
Chicken health	96.6	1	37,310	179
Mastitis	90.0	3.3	499,927	94
Tick and tick-borne Diseases	76.5	-	263,947	39
Dry season feeding	92.3	1	182,250	66
Cattle productivity	48.4	3.2	76,366	51
Small ruminant	64.7	35.3	27,000	134

Increased household incomes and return to investments is an indicator of improvement in the financial capital of the household. The result under livestock thematic group shows that in general major investments were made in house construction/repair, purchase of livestock, increased acreage and in children education (Fig. 2). Technologies under the project on mastitis control were outstanding in this direction. Project recipients invested up to TZS 432,000 in housing, TZS 306,000 in acquiring livestock and TZS 276,000 in the purchase of new farming plots.

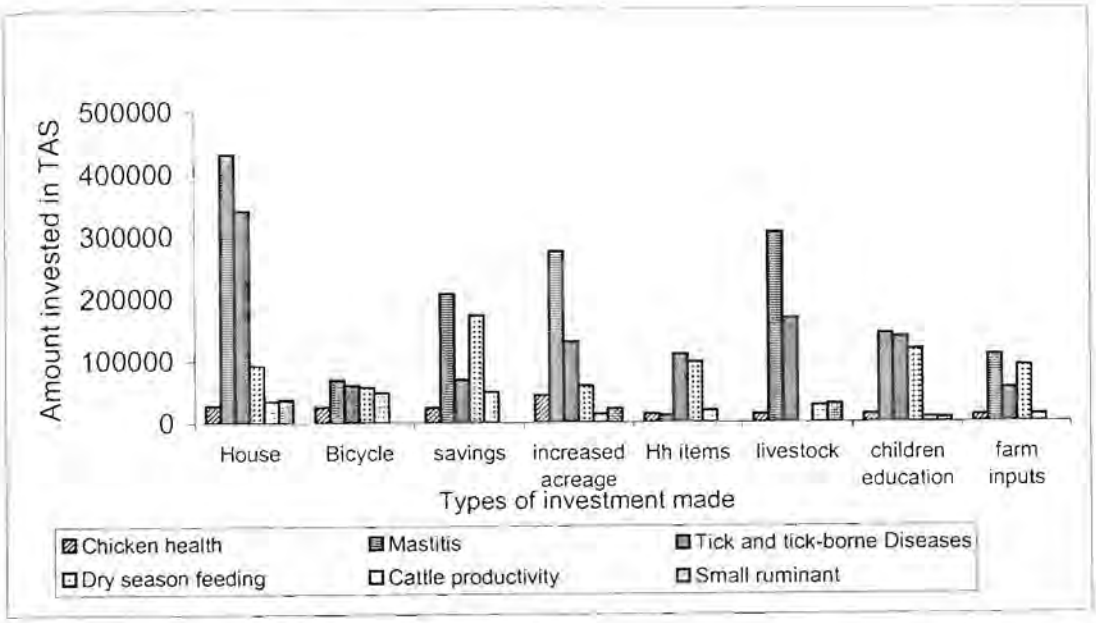

Figure 2: Types and level of investment made due to improved animal production and health

Effects of projects within cereal crops production

Eight projects had a focus on cereal crops production. The types of interventions promoted were diverse in terms of technologies promoted, including rainwater harvesting, weed and disease control, tillage, soil fertility management and draught animal power. Overall, a large proportion of the project participants (25 – 93%) reported increased income following adoption of the introduced technologies. However, in a project on Rice Yellow Mottle Virus (RYMV), more respondents reported decreases in income (Table 3). A project on sequential cropping system registered an average income of TZS 41,115 per household as reported by 60% of the participants. The draught animal power project reported significant reductions in workload, increased production of cereals and consequently, increased incomes of up to TZS 129,352 per household. The increased income gave substantial improvements on the livelihoods of the rural households under the projects.

Following increased incomes the mean values of investments varied but the highest was TZS 152,600 in terms of saving (Fig. 3.) observed from the project on rainwater harvesting. Within a project on effects of N and P on crop productivity the highest investment was TZS 130,000 for children's education. Even in most of the other projects, respondents reported considerable investment in education.

Table 3: Impact of cereal crops production on household income

Technology	Response on income (%)		Average change in income	
	Increase	Decrease	TAS	%
Rainwater Harvesting	86.7	13.3	195,134	436
Integrated Striga management	57.9	10.5	66,381	109
Integrated Rice Improvement	64	4	54,625	121
Sequential Cropping	68.4	5.3	41,115	124
Tillage Practices	91.7	0	51,363	167
Draft Animal Power	92.6	7.4	92,572	252
Rice Yellow Mottle Virus	25	75	21,107	13
Effect of N and P	70	30	141,571	253

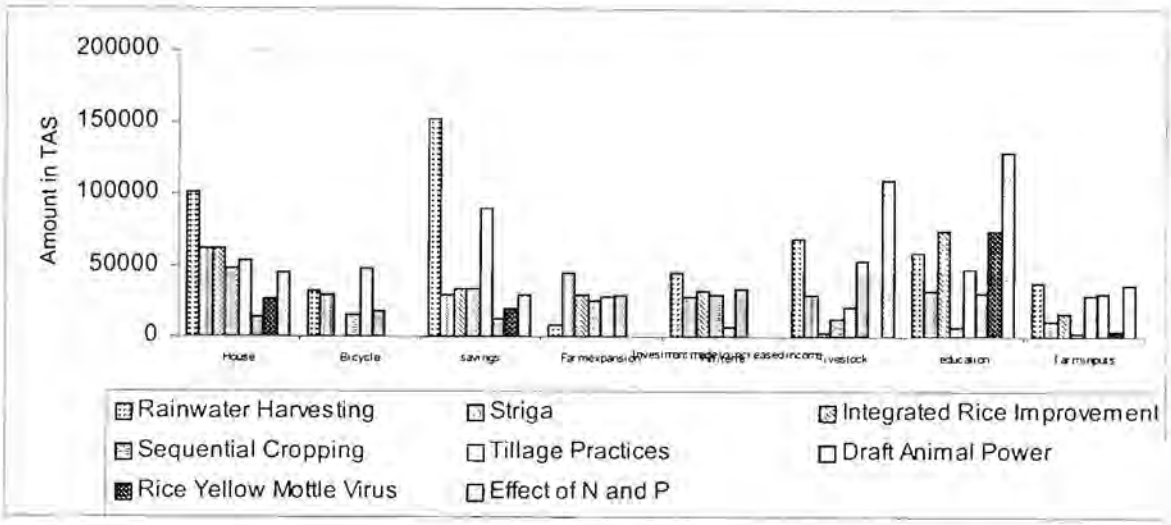

Figure 3: Type and levels of investment made due to increased income in cereal crops

Effects of projects within pulses and other crops

In all projects, the majority of the participating farmers (43 –95%) noted increased incomes because of using technologies evaluated on-farm (Table 4). Percentage changes in income varied from 80% (sweet potato varieties) to 638% (pigeon pea varieties adaptation). The soybean variety evaluation and mushroom production technologies were newly introduced, hence incomes from these crops were zero before the project and the percentage increase was infinite.

Table 4: Impact of pulses and other crops on household income

Technology	Response on income (%)		Average change in income	
	Increase	Decrease	Income (TZS)	Change (%)
Soybean variety	68	20	27,000	Infinity
Pigeon peas varieties	87.5	0	46,734	638
Common beans varieties	84.4	0	30,940	372
Agroforestry technologies	84.8	3	197,072	87
Mushroom cultivation	94.4	0	180,000	Infinity
Sweet Potatoes Germplasm	42.9	4.8	109,658	80
Smallholder Irrigation	73.3	13.3	449,000	185
Improved soil fertility in coconut based farming	95.7	-	120,152	248
Improved Fallow	93.3	5	76,587	117

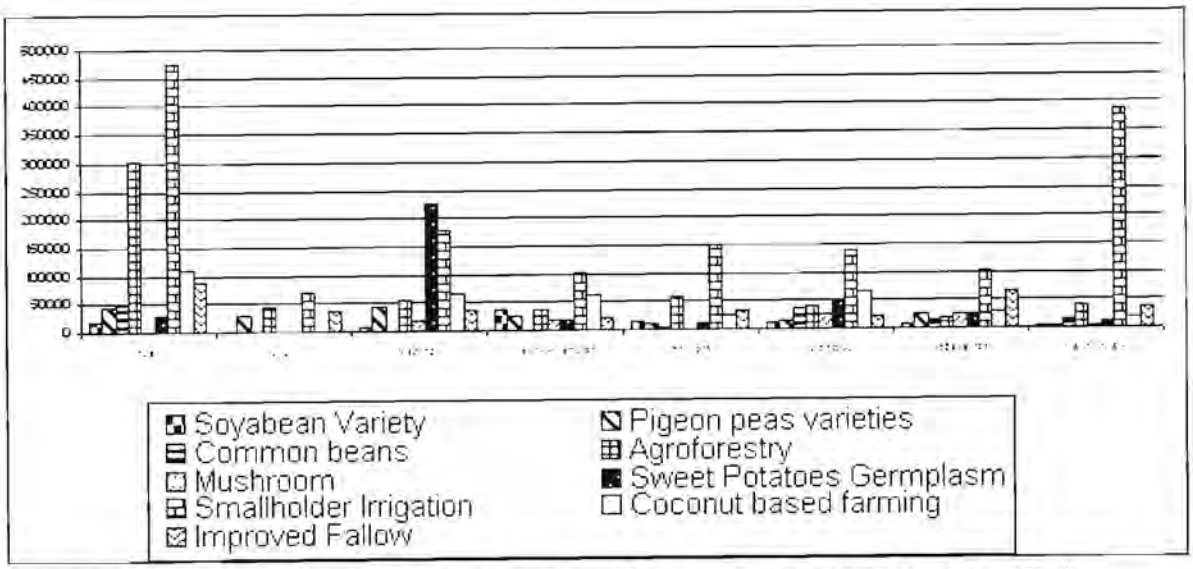

Figure 4. Types and level of investment made due to introduced technologies by the pulses and other crops projects

Income obtained from these projects was invested in various items as shown in Fig. (4). There were considerably higher investments made under this thematic group compared with the other groups.

Investments in housing were highest in the smallholder irrigation project (TZS 473,333). The same project also invested relatively high in procurement of farm inputs (TAS 387,700), savings and farm expansion. Majority of the projects invested only small amounts in the other areas (Figure 4).

Discussion

Impact studies focus on technology adoption and its observable effects on the livelihoods of recipient communities. The success of these research projects could be basically explained by the methodological approach adopted, which put emphasis on on-farm research. On-farm research helps to make the extremely poor households become more secure economically through increased agricultural outputs and incomes. It reduces economic shocks, catastrophes or personal problems that would otherwise affect their livelihoods. According to Kilima *et al.* (2006) on-farm research is the most efficient way of getting smallholder farmers out of abject poverty.

The observed ability of households to re-invest their income signified that the research projects had positive impacts on income poverty at household level and are likely to be sustained in many years to come. Some of the technologies were modified from time to time to reduce complexity as perceived at the farm level. Some technologies required more knowledge on the part of farmers and initially more labour but more labour was compensated for by farmers achieving higher yields and financial returns to labour invested. Determination of different ways in which agricultural products can be utilized is an important aspect in improving production since it increases the market demand for the products and consequently incomes of the producers and processors alike but the time factor is important in intensifying adoption (Lipton and Longhurst, 1989).

Investment is a good indicator of poverty reduction emanating from on-farm research. Increased levels of investment contribute substantially to poverty reduction and increase food security in rural areas (Thirtle et al., 2003). In the present study, the values of investments were relatively high. The magnitude of investment varied with enterprise type, for example the value of selling animals is higher than that of food crops and hence, the total income which allowed for more households in the livestock group to invest more than those in other thematic groups.

In the few cases where reduced income was observed, this was attributed more to the pest outbreak and floods than poor performance of the technologies.

Increases in production due to adoption of on-farm research might show the way towards achieving sustainable economic growth and poverty reduction in Tanzania. The country has a land mass of 945,200 km^2 within which there are 39.5 million ha of arable land much of which is unexploited. Improved agricultural production could be achieved through minimizing dependence on rain-fed agriculture, improved soil fertility, use of improved varieties, improved management practices, draught animal power, improved feeding particularly in the dry season and improved control of livestock diseases. Small scale processing technologies have considerable potential to add value to crops and livestock products.

Conclusions

From this study it is evident that on-farm research in agricultural production enhances adoption of technologies and contributes to poverty reduction among smallholder farmers. Most projects reported increases in income above a previously targeted increment of 25% overall. It was proved possible to increase the income of the smallholder farmers by using technologies that have been proven or only needed adaptation before adoption.

In the order of importance, accrued incomes were invested in housing, education, livestock and household assets, which are indicators of higher standard of living. Farm inputs received low priority by farmers.

The experiences from this study confirm that on-farm research coupled with appropriate interventions leads to innovations that improve agricultural productivity and thereby reduce income poverty among smallholder farmers in Tanzania.

It is recommended that for enhanced rural development, up-scaling of successful on-farm technologies should be emphasized for enhanced development and improved livelihoods of rural communities.

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