# Contributions of Small Scale Paddy Irrigation Schemes to Household Food Security in Mvomero District, Tanzania

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## Abstract

The Agricultural and Livestock Policy of Tanzania gives high priority to the promotion of food sufficiency and security through irrigated agriculture. The objective of this study was to assess the contributions of small scale irrigated rice production to household's food security in Mvomero District; specifically on household's food security status, the extent to which small scale irrigated rice production contributes to household's food security and ways to improve sustainability of household's food security situation in the study area. The study employed cross-sectional research design in two villages namely Sungaji and Mkingo in Mvomero District. Demographic characteristics and assets of households as well as agricultural production were collected using structured questionnaires from 55 irrigation scheme users. A systematic random sampling technique were used to obtain usersof irrigation schemes from the Village Registry Book (VRB) in the village and sampling process useda skip interval at every 8$^{th}$ household using random number table repeatedly. However, in order to get population sample within each village, probability proportional to size (PPS) was applied.Descriptive statistics methods were applied to analyze the data and to determine the association of the variables among irrigation scheme users in the study area. The findings indicates that 32 percent of the respondent acknowledged that irrigation schemes have increased agricultural production per unit area while almost 56.4 percent of the rice produced were served for food. However, monthly income weresignificantly correlated with the number of meals taken per day at $p>0.041$. Level of education and household size indicated a significant association with the number of meals per taken per day at $p< 0.000$ and $p<0.002$ respectively. On the basis of the findings, it is recommended that careful action is needed to improve irrigation infrastructure, extension services to farmers to increase productivity, market for their produce as well as access to loans/credit. Collaboration with all agriculture stakeholders is needed so as to improve the productivity to enhance household food security and community livelihood at large.

***Key words:*** *Food security, irrigation scheme, livelihood, paddy*

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## Introduction

Food insecurity in the world has been addressed as one of the biggest problem for over several decades now and attributed reasons for food insecurity in the world is the result of population increase while agriculture production of food remains the same, hence the increase of population will have an effect on food supply and food security.In developing countries, food security is one of the serious problems, where by malnutrition is an outcome of food insecurity is not declining because agricultural production system is heavily dependent on highly variable rainfall and the farming system is also mainly based on traditional farming system (IWMI, 2005).

Indeed, food security has been a major concern especially in Africa where close to thirty million people are food insecure because of frequent droughts, armed conflicts, corruption and the mismanagement of food supplies, environmental degradation and trade policies affecting most African countries (Benson, 2004), while the biggest proportion of the poor living in a state of acute poverty is found in Africa South of Sahara (Todaro, 1997), whereby 30 poorest countries in the world 22 are in Africa (World Bank, 1996). During the last decade, per capita agricultural production has not kept pace with population growth and Sub Saharan Africa had over 20% of their population undernourished, rising to 35% in the 18 worse affected countries (FAO, 2016).

However, agricultural growth offers possibilities for reducing risks of food shortages at all levels, increasing overall supply of food, creating economic opportunities for vulnerable people and improving dietary diversity and the quality of food consumed by farm households (Lyne*et al*. 2009). Development of the agricultural sector in Africa is therefore seen as central to combating hunger, reducing poverty, and generating economic growth, however, progress in the sector can only be achieved if the main constraints are successfully addressed such as: variability in climate; limited access to technology; low levels of rural infrastructure; and poor institutional structures.

Tanzania like many other countries in Africa, has been facing food insecurity every year in different parts of the country with different reasonswhich includes changes of climate, environmental degradation, gender inequality, poverty and diseases (IFRC, 2008). But also probable reasons influencing food insecurity may include household's size, sex of the household, social capital, physical capital of the household, financial capital as well as employment status of the households. When food becomes scarce, children and women are most affected; and mothers employ a sequence of strategies to manage increasingly severe

situations with an overall function of protecting children from hunger (Fram et al., 2011). Given the large proportion of Tanzanian households that rely on farming for their livelihoods and thehigh rate of rural poverty, this brings further challenge in food production by the overwhelming majority (74%) of poor Tanzanians who are primarily depend on agriculture (URT, 2011). Small-scale irrigation is said to be the dominant contributor to the total irrigated area in many African countries (Mwakalila and Noe, 2004) while the development of small-scale irrigation schemes practice by farmers is seen as a viable and practical alternative to rain-fed agriculture and it is said to be adopted easily in order to suit local socio-economic and environmental conditions (Sokoni and Shechambo, 2005).

A number of studies such as those conducted by You *et al* (2010) in different countries show that irrigation has served as the key driver behind growth in agricultural productivity and in increasing household income and alleviating rural poverty. Lipton *et al.* (2004) state that irrigation can reduce poverty through increasing production, income and reduction of food prices. To reduce risks associated with rainfall variability and increase yields of food crops, more public investments in yield-enhancing technologies such as small-scale irrigation and irrigation management systems have been recommended as one important rural development and poverty reduction strategy (Sokoni and Shechambo, 2005) and smallholder irrigation development has shown throughout the developing world that it can be used as a key drought mitigation measure and as a vehicle for the long-term agricultural and macro-economic development of a country.

Therefore, Irrigation is important in terms of food supply and economic growth in Tanzania like elsewhere (URT. 2005; Bos*et al.*, 2005). In Tanzania, the commitment to investment in irrigated agriculture and the impetus to construct new irrigation projects has not matched with performance improvement efforts through application of management tools (Sokoni and Shechambo, 2005). Thus, the purpose of the study was to assess the status of food security and associated factors among the households in rice irrigated schemes in Mvomero District-Morogoro-Tanzania in an attempt to alleviate food insecurity.

The general objective of the study was to assess the contributions of small scale irrigation schemes in rice production to household's food security in Morogoro Region. This general objective was assisted three objectives which were

1. To examine household's food security status among the households in the study area.

2. To examine the extent to which small scale irrigated rice production contributes to household's food security.
3. To evaluatethe sustainability of irrigation schemes in improving household's food security situation among households in the study area

## Literature Review

### *Potential Contributions of Small Scale Irrigation Schemes Development*

Irrigation is a key strategy for food security and poverty alleviation among small farmers in Tanzania. However, the potential of irrigation to improve food security is limited by multiple barriers. Irrigation development in Tanzania, as in other countries in Sub-Saharan Africa, has taken place in stages and has been associated with large challenges. In the early 1960s, Tanzania entered a phase of developing large irrigation schemes for commercial and food security purposes (Mwamakamba at el. 2017). Also, studies in agriculture and food security show that it can hardly be disputed that the majority of the world's poor still live in rural areas and depend crucially on agriculture for their livelihoods. Food and Agriculture Organization speaks of food security on household basis when all members of a household can be supplied with sufficient and adequate food, whether through their own production or through buying of food (FAO, 2011). Smallholder irrigation development has shown throughout the developing world that it can be used as a key drought mitigation measure and as a vehicle for the long-term agricultural and macroeconomic development of a country (Sokoni and Shechambo, 2005). Successful smallholder irrigation schemes can result in increased productivity, improved incomes and nutrition, employment creation, food security and drought relief savings for the government.

Irrigation has long played a key role in feeding expanding populations and is undoubtedly destined to play a still greater role in the future (FAO, 2011). It not only raises the yields of specific crops, but also prolongs the effective crop-growing period in areas with dry seasons, thus permitting multiple cropping (two or three, and sometimes four, crops per year) where only a single crop could be grown otherwise. With the security provided by irrigation, additional inputs needed to intensify production further (pest control, fertilizers, improved varieties and better tillage) become economically feasible

### *The Role of Irrigation in Alleviating Poverty and Improving Food Security*

There is a positive, albeit complex, link between water services for irrigation and other farm use, poverty alleviation and food security (IFAD, 2001; FAO, 2001a; FAO/World Bank, 2001). Many of the rural poor work directly in agriculture, as smallholders, farm laborers or herders. The overall impact can be

remarkable. In India, in unirrigated districts 69 percent of people are poor, while in irrigated districts, only 26 percent are poor. Their income can be boosted by pro-poor measures, such as ensuring fair access to land, water and other assets and inputs, and to services, including education and health. Relevant reforms of agricultural policy and practices can strengthen these measures.

The availability of water confers opportunities to individuals and communities to boost food production, both in quantity and diversity, to satisfy their own needs and also to generate income from surpluses. Irrigation has a land-augmenting effect and can therefore mean the difference between extreme poverty and the satisfaction of the household's basic needs. It is generally recognized that in order to have an impact on food security, irrigation projects need to be integrated with an entire range of complementary measures, ranging from credit, marketing and agricultural extension advice to improvement of communications, health and education infrastructure (Alexandre and Stanislaw, 2016). Community-managed small-scale irrigation systems, by improving yields and cropping intensities, have proved effective in alleviating rural poverty and eradicating food insecurity.

**Challenges Encountered by Irrigation Schemes in Developing Countries**

The problems associated with irrigation system are the main cause for low productivity and the sector has become increasingly the target of criticism and considered as the main cause for productivity problems in agriculture because of water scarcity, in-efficiency, and inequity and sustainability issues.

Climate variability and change pose a considerable challenge for Tanzania's development, particularly given the country's high level of dependency on rain fed agriculture. Rainfall is already highly variable in terms of timing and volume and can be difficult to predict. Some regions are also vulnerable to extreme events such as floods and drought (McSweeney et al., 2010). According to the World Bank (2013), weather-related risks already cost the agriculture sector at least $200 million per year. The 2005/06 drought alone affected millions of people and cost 1% of gross domestic product (GDP) (GCAP, 2011).

**Methodology and Approach**

The study was conducted at Mvomero district in Morogoro, Tanzania. District is located at North East of Morogoro Region. The District has a total area of 7,325 km square (Mvomero District Council, 2012). Agriculture is the main economic activity and most of the people engage in farming of both subsistence and cash

crops where the major food crops are paddy, maize, beans, cassava and bananas.The major cash crops are sisal, sugar cane, cotton, onions, simsim, sunflower and more than 80% of the district's population is employed in agriculture activities. The study area was chosen because there are various irrigation schemes and there has not been promising irrigation production which has yielded good results hence, requiring a study.

A cross- sectional research design was employed in this study. The cross-sectional research design allows data to be collected at a single point in one time and used in descriptive study and for determination of relationships of variables (Bailey, 1998; Babbie, 1990; Bernard, 1994). The cross-sectional research design is considered to be favourable not only because of resource and time limitations for data collection but also it takes place at a single point in time, does not involve manipulating variables, allows researchers to look at numerous things at once (age, income, gender etc.) and often used to look at the prevalence of something in a given population (Trochim, 2006).

***Population and Sample Size***

The population for this study was made up of 55 small scale farmers engaged in irrigation as well as 5 extension officers assisting these farmers. The study covered household who involve in small scale irrigated rice production farms in Sungaji and Mkindo wards Mvomero district, Morogoro. In the study research used simple random selection and stratified sampling to obtain the data required by the researcher so as to be used to answer the research. A statistical model will be used to determine the sample size which will reduce sampling error within the population**.**

$$n = \frac{Z^{2}_{\alpha/2}\, pq}{e^{2}}$$

Whereby;

$n$ = is the sample size

$Z$ = the point in the normal curve corresponding to the desired confidence level.

$e$ = the desired level of precision (sampling error)

$p$ = the estimated proportion of an attribute that is present in the population.

$q$ = $(1-p)$.

## Results and Discussion

### *Socio-demographic Characteristics of the Respondents*

The results from Table 1 indicated that the majority of the respondents were aged 26-31 years having almost 44 percent, followed by respondents aged between 32-37 years who had 22.7 percent. However, 5.5 percent of the respondents were aged between 18-25 years. This indicates that the majority of the respondents in the study area were youth who are engagedmore in production activities. Moreover, marriage is a lifetime commitment (Brai, 1997). Futhermore, it shows that, a greater part of the respondents were married consisting of 64 percent of respodents. Besides, 21.9 percent of the respondents were widowed and 14.5 percent were single. Futhermore, anoter characteristic was thelevel of education being formal or informal attained by the respondents in the study area. Education tends to broaden the horizon beyond habit and traditions of individuals and encourage them into development skills (Nanai, 1993). In this study it was found that, 60 percent had attained primary education, 21.8 percentattended secondary education while only 5.5 percent had non- formal education.which in one way or another influenced paddy production in the community.

The issue of income was very sensitive during the interview because it was considered as one of the important determinants of household food security. The findings inTable 1 show that 30.9 percent had income between 100,000/= to 220,000/= while 25.5 percent had income above 300,000/= and only 10.9 percent had income less than 50,000/=. Besides this the household size of respondents indicated that the majority had household size between 4 to 6 individuals (56.4 percent), 1 to 3 individuals were 26.5 percent while only 18.2 percent of households had more than 7 individuals.

**Table 1: Socio-demographic Characteristics of the Respondents**

| Variables | Frequency (N) | Percentage (%) |
|---|---|---|
| **Age (n=55)** | | |
| 18-25 years | 3 | 5.5 |
| 26-31 years | 24 | 43.6 |
| 32-37 years | 23 | 41.8 |
| 38 years & above | 5 | 9.1 |
| | | |
| **Gender (n=55)** | | |
| Male | 40 | 72.7 |
| Female | 15 | 27.3 |
| | | |
| **Marital Status (n=55)** | | |
| Married | 35 | 63.6 |
| Widow/Widower | 12 | 21.9 |
| Single | 8 | 14.5 |
| | | |
| **Education level (n=55)** | | |
| None | 3 | 5.5 |
| Primary education | 33 | 60 |
| Secondary education | 12 | 21.8 |
| College education | 7 | 12.7 |
| | | |
| **Income (n=55)** | | |
| Less than Tsh 50,000 | 6 | 10.9 |
| Tsh 500,000-100,000 | 8 | 14.5 |
| Tsh 100,001-200,000 | 17 | 30.9 |
| Tsh 200,001-300,000 | 10 | 18.2 |
| Tsh 300,001 and above | 14 | 25.5 |
| | | |
| **HH Size (n=55)** | | |
| 1-3 | 14 | 26.5 |
| 4-6 | 31 | 56.4 |
| 7 and above | 10 | 18.2 |

**Availability of Household Food Security at the Study Area**

The findings from Table 2 showed that, maize was the main food stuff by 38.2 percent while rice is almost 11 percent as one among food stuff consumed by the households. The main source of household food was own production by 56.4 percent while only 20 percent was through assistance/aid. However, 47.3

percent t consumed three meals per day while 43.6 percent of the household at the study area less than three meals per day and only 9.1 percent they access more than three meals per day. However, the implication of these findings depicts the variations of food productivity using the available irrigation schemes which probably were affected with the kind of technology they used including inputs and extension services. The food availability in any household had a pattern within a time frame which was either increased, decreased or was at a constant level (Oni et al., 2010).

**Table 2: Status of Food at Household Level**

| Variables | Frequency (N) | Percent (%) |
|---|---|---|
| **Major food stuff** | | |
| Maize | 21 | 38.2 |
| Legumes | 14 | 25.5 |
| Rice/Paddy | 6 | 10.9 |
| Cassava | 14 | 25.4 |
| | | |
| **Source of household food** | | |
| Own production | 31 | 56.4 |
| Purchase/buying | 13 | 23.6 |
| Aid/assistance | 11 | 20 |
| | | |
| **Number of meals per day** | | |
| 1 | 8 | 14.5 |
| 2 | 16 | 29.1 |
| 3 | 26 | 47.3 |
| More than 3 | 5 | 9.1 |

**Utilization of Irrigation Schemes inIncreasingRice Productivity**

The study tried to find out whether the respondents were utilizing the irrigation scheme and the findings from Table 3 indicated that 78.2 percent applied it while only 21.8 percent did not apply irrigation during farming time. However, the majority of the respondents used traditional methods of irrigation by 50.9 percent and only 49.1 percent used modern methods of irrigation.

**Table 3: Irrigation Scheme and rice productivity**

| Variables | Frequency | Percent (%) |
|---|---|---|
| **Use of Irrigation** | | |
| Yes | 43 | 78.2 |
| No | 12 | 21.8 |
| | | |
| **Type of Irrigation** | | |
| Tradition | 28 | 50.9 |
| Modern | 27 | 49.1 |
| | | |
| **Application of fertilizer** | | |
| Yes | 29 | 52.7 |
| No | 26 | 47.3 |
| | | |
| **Use of rice produced** | | |
| Food | 31 | 56.4 |
| Sales | 24 | 43.6 |
| | | |
| **Markets for rice produced** | | |
| Retail individuals | 34 | 61.8 |
| Whole sellers | 17 | 30.9 |
| Local industries | 4 | 7.3 |

**Reasons of Farmers not Utilizing Irrigation Schemes for Rice Production**

The findings from Fig. 1 indicate that 50.9 percent of the respondents do not utilize irrigation scheme due to water scarcity while only 29 percent showed that it was due to illegal users in the scheme. Water scarcity much depends on rainfall which has a lot of variations due top climate change, hesitatation of the farmers to use these schemes and also probably they do not have technology in water harvesting. Sometimes it is due to lack of initial capital to invest on irrigation schemes and the fear to opt to illegal methods.

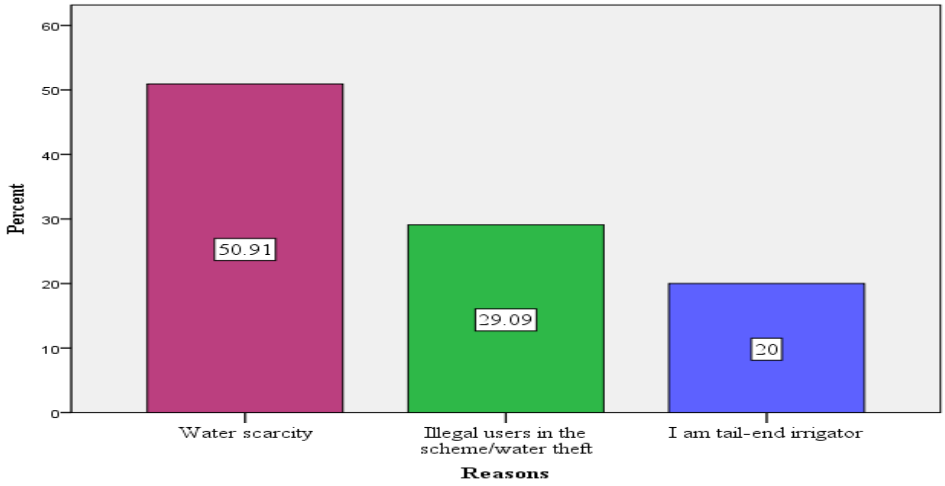


**Fig 1: Challenges of farmers in utilizing irrigation schemes**

**Suggestions to Improve the Irrigation Schemes to enhance food Security**

The findings from Table 4 indicated that capital/credit provision is very important in improving irrigation schemes by 28.8 percent, irrigation infrastructure by 25 percent while extension services by 19.2 percent.

**Table 4: Plans to Improve Irrigation Scheme**

| Suggestions | Frequency | Percent (%) |
|---|---|---|
| Improve irrigation | 13 | 25 |
| infrastructure | 10 | 19.2 |
| Extension services | 15 | 28.8 |
| Capital | 14 | 26.9 |
| Others | | |

**Contributions of Irrigation Scheme to the Livelihood and Food Security of the Households**

The majority of the respondents from Figure 2 indicated that there was increased agricultural production per unit area by almost 33 percent, taking children to modern schools by 29 percent, 25 percent contributed to increase household income while only 12.7 percent is showed increased building modern houses.

**Variables Association in Utilization of Irrigation Schemes in Increasing Rice Productivity**

***Number of Meals Taken at the Household and Education Level of Household Head***

Cross tabulation was carried out to test the association between education level of household heads and number of meals taken. The findings from Table 6 depicted that the majority of them had attained primary education and varied by number of meals consumed. Moreover, the computed Chi-square showe that, the variable education was statistically significant on the number of meals consumed at household level (*P*=0.000). This has a lot of implication on eating and dietary behavior because was affected by knowledge, skills, attitudes, food preparation factors and environment.

***Number of Meals Taken at the Household and Monthly Income of the household***

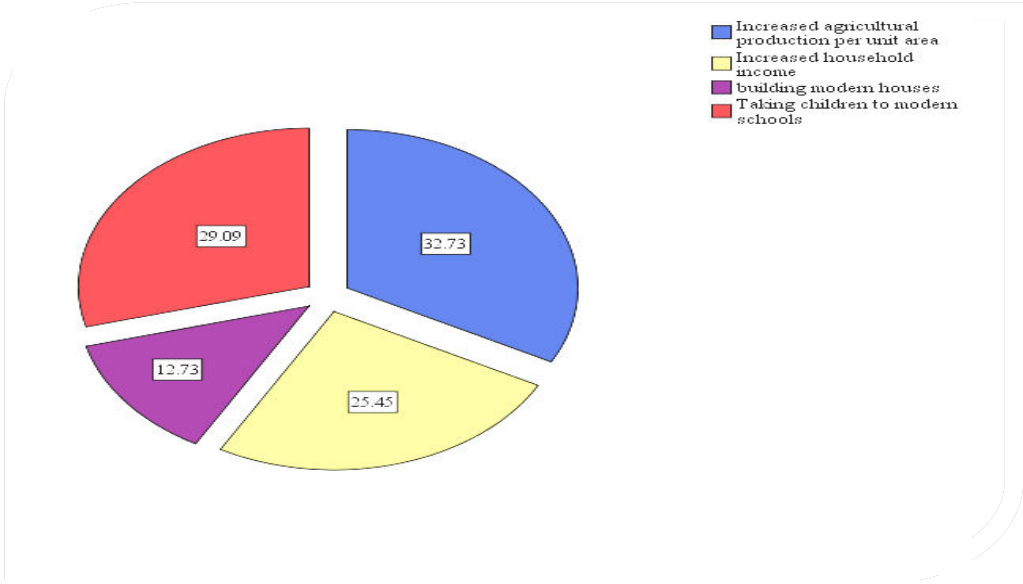


**Fig 2: Contribution of irrigation scheme to the livelihood of the**

From the analysis in Table 6 it was found that 60 percent of household earning income between 200,000/= and 300,000/= ate three meals per day while those who earned between 50,000/= and 100,000/= ate once per day. The tested Chi-square has significant association with income and number of meals taken at households at 5 percent level (*P* = 0.041).

***Number of Meals Taken and Size of the Household***

The findings from Table 6, depicted that there is a significant association between household size and number of meals take per day at 5 percent level (*P*=0.022).Whereby, household with four members and above only ate once per day had 19.5 percent while households comprising of between one to three members ate more than three meals per day at 14.3 percent

**Table 6: Cross Tabulation between Number of Meals at Household and Other Variables**

| Variable | OneTwo | Three | More than three | |
|---|---|---|---|---|
| **Education** | | | | |
| None | | | | |
| Primary | 33.1%33.1% | 33.1% | | 0.5% |
| Secondary | 18.2%30.3%48.5 | | | 3% |
| Collage | 8.3% | | 16.7% | 75% - |
| | - | 20% | - | 80% |
| **Income** | | | | |
| Less than Tsh 50,000 | $\chi^2 = 42.563$ df =12 $p = 0.000$ | | | |
| Tsh 500,000-100,000 | 33.3% | 33.3% | 33.3% | |
| Tsh 100,001-200,000 | - 50% | 12.5% | 37.5% | - |
| Tsh 200,001-300,000 | 11.8% - | 29.4% 20% | 41.2% 60% | 17.6% |
| Tsh 300,001 and above | - | 42.9% | 20% 57.1% | |
| | $\chi^2 = 20.338$ df =12 $p = 0.041$ | | | |
| **Household Size** | | | | |
| 1-3 | - 19.5% | 28.6% 29.3% | 57.1% 43.7% | 14.3% 7.3% |
| 4 and above | $\chi^2 = 3.678$ df =3 $p = 0.022$ | | | |

## Conclusion

Non-water-related factors such as access to inputs, farm equipment, transportation, value-adding opportunities and functional markets impede the ability to increase production and farm profitability, ring highly inn irrigators' minds. Lack of finance (cost) might be a root cause of many of these factors, as it prevents farmers from securing. First timely and adequate supply of high-quality seeds when irrigation systems are operating and also lack of appropriate fertilizer and chemicals which led to high yields; Secondly, timely and adequate access to implements,to ensure that farm operations are carried out at the optimal time and are not limited by availability. Third, transport, to access inputs from the best sources and sell output to the most profitable buyer; and fourth the storage of outputs until prices are optimal as well as for household food security in the future.

However, the current level of market risk makes farmers reluctant to take out loans and banks reluctant to lend to farmers. It is thus necessary to address the issues holistically, as part of a complex system, and agriculture innovation platforms seem to be a promising means of achieving this approach (van Rooyen et al., 2017). We also find strong evidence that water supply issues are negatively influencing productivity. Water issues will come into focus when the non-water-related issues have been resolved, when irrigation has proven to be profitable and when demand for water increases. In addition, attention should be put on other livelihood activities that seems to be doing well as part of food and income diversification; including market gardening, small businesses and poultry and provide the necessary policy framework at all levels to give more attention to poor people and women to be a major beneficiary of investments.

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