Paddy Production of Maliwanda and Namhula Irrigation Schemes in Bunda District: Status and Challenges

Mululi Zacharia Leo[*] & Tilumanywa V. Tindichebwa[**]

Abstract

This study assesses the production trend of two irrigation schemes in Bunda district, namely Maliwanda and Namhula. It employs quantitative and qualitative research designs. Data was collected through questionnaires, interviews, observation, and documentary review. The findings indicate a positive trend in paddy production of the two schemes. The findings further reveal that after the application of irrigated agriculture, paddy yield increased from less than 2 tons per hectare to over 5 tons per hectare. The high yield was attributed not only to irrigation, but also to improved knowledge on rice production and the use of improved seeds that are highly productive and adaptive to local conditions. We recommend that to achieve sustainability of the two schemes, the current water association should be strengthened, annual fees be increased, and human activities around the schemes be restricted to avoid silting of the dams.

Key words: *production trend, farm yields, irrigation schemes and irrigated agriculture*

Introduction

Irrigation has contributed greatly to the improvements of global agricultural productivity and output in recent decades (Domenench & Ringler, 2013). Irrigated agriculture provides about 40% of the world's food production from 18% of the world's cultivated land (World Bank, 2003). The total cultivated area worldwide is estimated to be 143.3m ha (You et al., 2010). Whereas in Africa the total irrigated land is estimated to be 12.2m ha, in Asia about 35-40% of cropland is under irrigation (Hussain & Hanjira, 2004). The development of irrigation in Sub-Sahara Africa (SSA) has been limited and below expectations (Innocencio et al., 2007).

The World Development Report of 2008 pointed out that irrigation has fundamentally influenced not only agricultural productivity but also incomes and employment. Furthermore, irrigation has greatly contributed to agricultural development and transformation of community livelihoods (Hussain & Hanjra, 2004; Smith, 2004). The recurrence of droughts in many parts of SSA has created uncertainty for agricultural production and emphasized the need for irrigated agriculture. Irrigated agriculture in Africa is currently given more attention as a

*P.O. Box 219 Bunda, Tanzania: zakarialeo2015@gmail.com
**University of Dar es Salaam, Dar es Salaam, Tanzania: ttindichebwa@yahoo.com

strategy for food security and poverty reduction. It is widely known to play a key role in improving productivity, reducing poverty, and improving rural livelihoods (van Koppen & Safilios-Rothschild, 2005).

Agriculture in Tanzania, like in many other SSA countries, is mainly rain-fed and largely undertaken by smallholder farmers. Rainfall patterns in the country are unreliable in both distribution and amount, limiting production of food and cash crops, especially in arid and semi-arid parts of the country (Igbadun et al., 2005). For example, there are reports that in the last 40 years Tanzania has experienced severe and recurring droughts with devastating effects not only to agriculture, but also to water and energy sectors manifested by climate change and variability (URT, 2016). According to World Bank (2015), weather-related risks already cost the agriculture sector in Tanzania at least $200m per year. Researchers and experts are rooting for more investment in the irrigation farming as a solution for the farmers to manage drought caused by climate change (UNESCO, 2016).

The National Irrigation Master Plan (NIMP) of 2002 identifies the irrigation potential in Tanzania to be 29.4m ha. Out of this total area, 2.3m ha are classified as of higher potential, 4.8m ha as of medium potential, and 22.3m ha as of low potential (URT, 2002). Even though the government is targeting to cover at least 1m ha by 2020, the current irrigated area in Tanzania is only about 450,392ha (URT, 2012a). Countrywide, irrigation growth is one of the key plans for attaining the objective of the National Strategy for Growth and Reduction of Poverty (NSGRP) to reduce poverty and hunger (URT, 2013).

Investment in irrigation is evident in Mara region where about 90% of the population depends on agriculture as a major source of livelihood. The potential area for irrigation in Mara is 25,590ha, which is 9.6% of the 300,000ha of cultivated land, while the remaining is covered by water (URT, 2012b). Bunda district in Mara region has an estimated total land area of 8071ha that is potential for irrigation purpose. Out of these, however, only 160ha (2%) utilize irrigation (URT, 2014).

Bunda district has been repeatedly affected by drought due to insufficient and erratic rainfalls. This has significantly affected the livelihoods of most farmers who depend on agriculture as the major source of food and income. Since 2008 the district has been receiving food relief from the government and other organizations, such as the Anglican Church (BDC, 2012). Between 2008 and 2012, for example, the district received 5617 metric tonnes of maize as relief food from the National Food Reserve Agency (BDC, 2013). Thus, due to the prevalence of unreliable rainfall distribution and persistent droughts in the district, it follows that irrigated agriculture is key in attaining food self-sufficiency, and also increasing household incomes. Hence, the need for irrigation development cannot be overemphasized as this will help in ensuring the availability of food and contribute to sustainable economic growth and development of the district, and the country as a whole.

It is within this background that the district authority, in collaboration with the government, built the Maliwanda and Namhula schemes with the aim of not only increasing food production and the income of smallholder farmers, but also of reducing poverty and improving the livelihoods of smallholder farmers in the district. The two schemes focus mainly on paddy production over other crops in the district. The projects are in line with the National Strategy for Growth and Reduction of Poverty (NSGRP/MKUKUTA I and II), and the Sustainable Development Goals (SDGs), especially Goal number 2, which emphasises on ending poverty and hunger, protecting the planet, and ensuring prosperity to all people by making them achieve food security and promoting sustainable agriculture. It also sets boundary to the progress already achieved under the Millennium Development Goals on addressing the problem of hunger and extreme poverty to be achieved in 2030 (UN, 2015). The National Irrigation Policy (2010) also recognizes irrigated agriculture as a key component of enhanced agricultural productivity and growth (URT, 2010). Therefore, determining the production trend of paddy for the five years before and after the implementation of the two schemes, as well as the challenges facing irrigators in the study area, is fundamental.

This paper is based on a research conducted between June 2016 and November 2016 to explore the performance of the two schemes. Specifically, the study intended to examine the production trend of paddy in the five years' period before and after operation, and the challenges associated with irrigated agriculture in the two schemes.

The Study Area

This study was conducted in Bunda District, located between 33^{0} 30′ and 34^{0}30′ longitudes; and between 1^{0}30 and 2^{0}45′ latitudes (Fig. 1). The district is situated at an elevation of 1,225m above sea level. It has a total surface area of 23,978.20km^2, of which 189.02km^2 (0.79%) is covered by water equivalent, and the remaining 23,789.180km^2 (99.21%) is covered by dry land (URT, 2014).

Two wards in the district—Namhula and Hunyari—were selected for the study on the basis that the Namhula irrigation scheme is in Namhula ward, whilst the Maliwanda irrigation scheme is in the Hunyari ward. The selection of Maliwanda and Namhula schemes was due to the following reasons. Firstly, the two are the only active schemes throughout the year in the district compared to others such as Nyatwali, where most farmers have stopped irrigation farming due to low discharge of water. Secondly, both Maliwanda and Namhula schemes harvest rain water from catchment areas, and store the water in storage dams (reservoirs), hence assuring water discharge for irrigation purposes. Thirdly, the number of irrigators in the two schemes is promising unlike in other schemes, especially in the Nyatwali scheme.

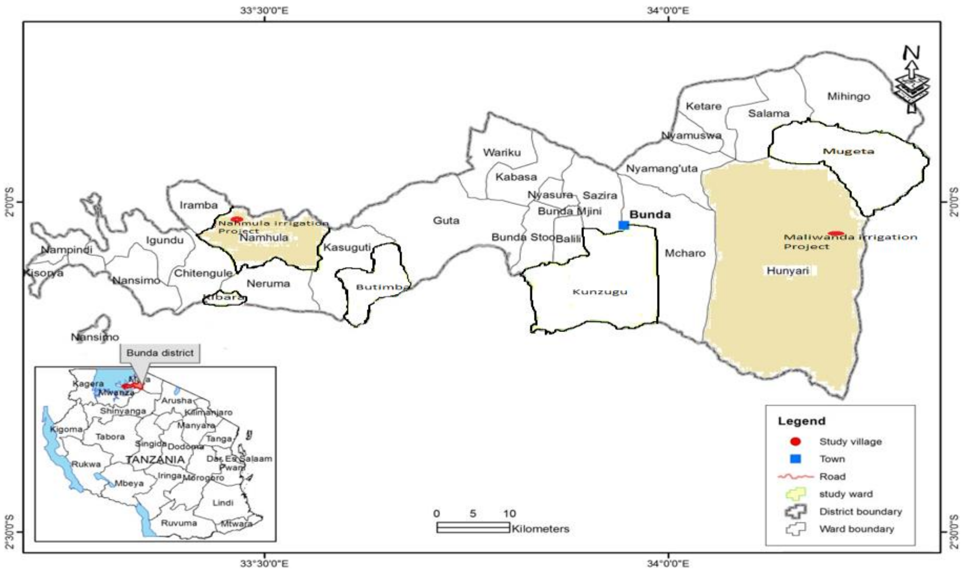

Figure 1: ***Location of the Study Area***
Source: Bunda District Council (2016)

Fourthly, since the establishment of the two schemes (i.e., Maliwanda in 2010 and Namhula in 1999), their performance and influence on productivity have not been documented. This research is expected to shed light on the performance of irrigation and how the two schemes have contributed to food availability at household level and the district in general.

The data collected from the two schemes included the background of the schemes, including water availability, scheme management and performance. Information collected from households and key informants included household characteristics such as age, level of education, meals obtained per day, harvest from paddy production, and benefits and challenges of paddy production.

The study collected both secondary and primary data. Secondary data sources included inventory of records from both published and unpublished documents; and relevant literature such as reports, censuses, newspapers, and the Internet. Primary data was obtained directly from the sampled villages, and involved heads of households engaged in paddy irrigation and key informants. Qualitative data methods were used in primary data collection to provide perception of farmers on the performance and challenges of irrigated agriculture. Qualitative methods included interviews, focus group discussions and observations. The aim of using qualitative methods was to underscore the behaviour and attitudes of irrigators in using and managing the irrigation systems**.** Were also employed household interviews, using structured questionnaire and key informant interviews using semi-structured questionnaires to collect primary data.

At the quantitative level, yields of paddy before and after the implementation of the two schemes were measured and compared. Yield was measured primarily in terms of crop yield per unit area. The contribution of inputs to the overall output was measured as well. The analyses of productivity typically used capital (K) and labour (L). The analysis also considered other factors such as the use of fertilizer and improved seeds as an input for agricultural development.

A total of 157 irrigators—both men and women—were interviewed in the two selected villages. This sample was obtained from a population of 258 irrigators for the two schemes: 202 coming from Maliwanda village, and the rest 56 coming from Namhula. The sample for the Maliwanda project was 123 from a population of 202 irrigators, and that for Namhula project was 34 from a population of 56 irrigators. The list of irrigators in the two schemes was obtained from the ward agricultural extension officers of Hunyari and Namhula. To obtain an adequate and representative sample of the irrigators, we applied the statistical formula proposed by Israel (1992).

Result and Discussion

Paddy Production Under Rainfed Agriculture

As noted earlier, before the establishment of the Maliwanda and Namhula irrigation schemes in 2010 and 1999, respectively, small-scale farmers in the study villages were growing paddy as one of their important crops. Paddy cultivation during that time was rain-fed. The findings of this study reveal that all respondents cultivated paddy before the commencement of the irrigation schemes, whereby in this period the average production was 1.8 tons per hectare.

Fig. 2 indicates the production trend between 2004/2005 to 2008/2009 seasons under rain-fed agriculture in the area before the Maliwanda irrigation scheme. We can see clearly from this figure that the area cultivated and the yield were fluctuating.

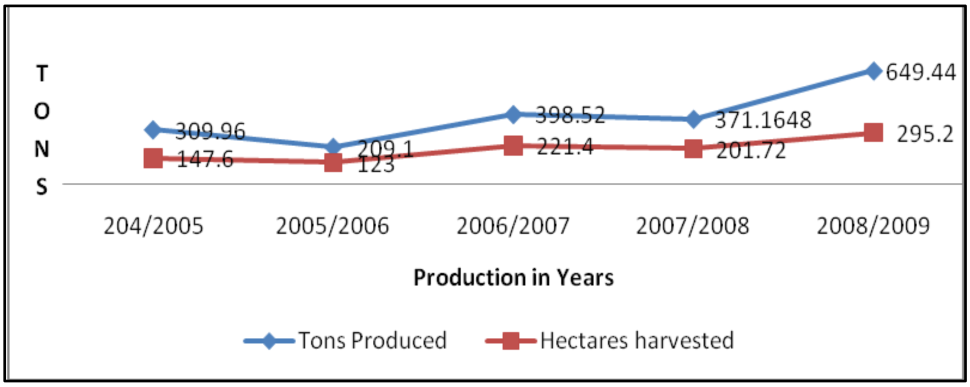

Figure 2: ***Paddy Production Trend Before Maliwanda Irrigation Scheme***
Source: Field data (2016)

The land under paddy cultivation and the production in Maliwanda decreased in the 2005/2006 season. The paddy yield for 2005/2006 was approximately 209.1 tons from 123 hectares, which is equivalent to 1.7 tons per hectare. In the 2006/2007 season the yield increased slightly to 398.52 tons from 221.4 hectares, which gave an average production of 1.8 tons per hectare. In the 2008/2009 season both production trend and area under irrigation increased. In this season paddy production was 649.4 tons from 292.2 hectares, an average production of 2.2 tons per hectare. The BDC (2010) report showed that cereal requirement for Maliwanda village alone in 2009 was 1,772.8 tons, while actual production was 1,098.81tons (62%). The contribution of paddy was so significant to the actual cereal production. Even though paddy production was doing well over other cereals in the area, farmers were not satisfied with the level of production. During household surveys, a majority (86%) of the respondents revealed that the low production of paddy in the area was due to unreliable and low rainfall, while 14% attributed this to the destruction of crops by elephants from the Serengeti National Park.

As noted earlier, the Namhula scheme started operating in 1999. In the same fashion, the findings from Namhula scheme in Fig. 3 indicate that the rain-fed production trend of paddy from the 1993/1994 to 1997/1998 seasons was fluctuating. The findings indicate that land under paddy cultivation and production decreased in the 1993/94 and 1994/95 production seasons. Additionally, an increased trend was observed in the 1997/98 season, with the highest peak in production where the average yield was 2 tons per hectare.

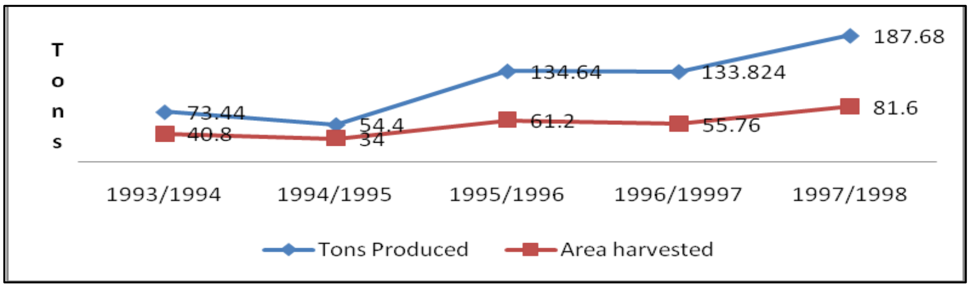

Figure 3: ***Paddy Production Trend Before Namhula Irrigation Scheme***
Source: Field data (2016)

This implies that the variation in cultivated land size was due to the uncertainty of rains. Regarding production, the findings presented in Fig. 3 suggest that there was a general fluctuation in the trend of average production of paddy in Namhula from the 1994/1995 to 1998/99 production seasons, with minimum production of 1.6 tons per hectare being obtained in the 1994/95 season. The maximum output was achieved in the 1996/1997 production season, which was 2 tons per hectare.

Further, the findings indicate that the average annual production between the 1993/94 to 1997/1998 seasons was 2.06 tons per hectare. This trend was lower than the recommended extension target of 2.4 tons per hectare under rain-fed agriculture per year in Bunda district (BDC, 2012). The BDC (2000) report noted that in the year 1997/1998 food requirement in Namhula only was 872 tons of cereals. The actual production was only 551 tons (65%), which forced farmers to buy food from traders. Following the inadequate production of cereals, the Bunda district has been one of the districts in the country receiving food relief. For example, between 2008 and 2012 the district received 5617 tons of maize as relief food from the National Food Reserve Agency (BDC, 2013).

Generally, the noted low production trend before the irrigation schemes was mainly due to the fact that the district received low and unreliable rains since the 1990s; with an average rainfall of 600mm out of the optimum rainfall requirements of 900-1200mm. Apart from low amount of rainfall, 75% of the respondents associated low production to the cultivation of small plots ranging between 0.4 to 0.8ha. Only 25% of the respondents indicated to have cultivated farm sizes between 1 to 2ha. Likewise, the use of local paddy varieties contributed to low productivity. About 95% of the respondents acknowledged using local seed varieties such as *faya, kahogo,* and *supa,* which are low yielders despite having good aroma and being preferred by consumers. A small number (5%) of the respondents used improved seeds before the establishment of the schemes. Overall, the BDC (2014) report indicates that paddy production at the district level from rain-fed was 25,065 tons from 12,532ha, which is equivalent to 2 tons per hectare.

The FAO (2015) observes that the general yield potentials of local cultivars have a limited yield between 2.5 to 3.7 tons per hectare. In the study area the highest yield reached was 2.2 tons per hectare, which is below the general yield potentials of local breeds postulated by FAO. Another reason attributed to low yields was farmers' inadequate knowledge of rice husbandry, including little knowledge on rice production. Farmers used to broadcast seeds and their fields were not well-levelled, which led to uneven water distribution. These findings are in line with those of Maxwell and Frankenberg (1992) who noted that low productivity is associated with low amount of rainfall, poor soil fertility, unavailability of water for irrigation, and small areas under cultivation.

Paddy Production Trend After Implementation of the Schemes

As noted earlier, irrigation is a requisite in dealing with food security, and is a stimulant of rural development in different parts of the world (World Bank, 2008). The findings of this study indicate that after the irrigation schemes from 2010 to 2015, all irrigators in both schemes were engaged in paddy production. Fig. 4 indicates the production trend of paddy in Maliwanda for five years, from 2010 to 2015.

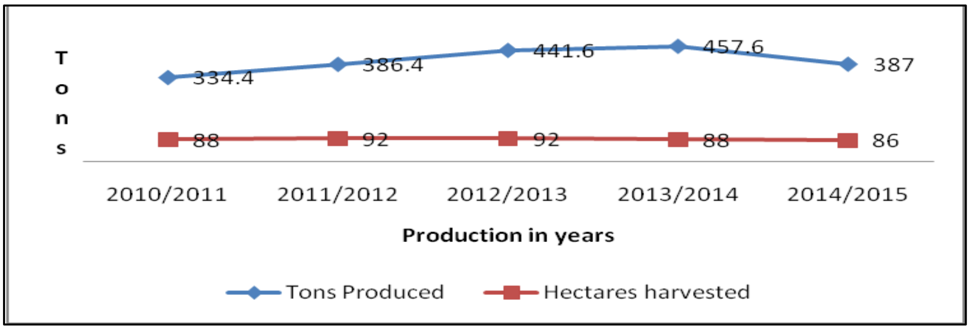

Figure 4: ***Paddy Production Trend after Maliwanda scheme***
Source: Field work (2016)

The result in Fig. 4 shows that the lowest production for Maliwanda scheme in 2010/2011 was 334.4 tons from 88ha, which gave an average production of 1.8 tons per hectare. The highest production in the 2013/14 season was about 457.6 tons from 88ha, which gave an average yield of 5.2 tons per hectare. In the same vein, the findings for Namhula irrigation scheme in Fig. 5 indicate that in 2010/11 season, the production was 147 tons from 37ha, equivalent to 4.2 tons per hectare. In the 2014/2015 season, production increased to 212.8 tons from 38ha. The average yield was 5.6 tons per hectare. Comparatively, Namhula scheme's production was ahead of Maliwanda by 0.4 tons, even though Maliwanda has a bigger land under irrigation (88ha). The average trends for Namhula after the operation of the irrigation scheme was 4.82 tons per hectare, compared to 4.5 tons per hectare of the Maliwanda irrigation scheme. The difference is due experiences in paddy production: Namhula started had 16 years of experience in paddy cultivation, while Maliwanda had only 5 years.

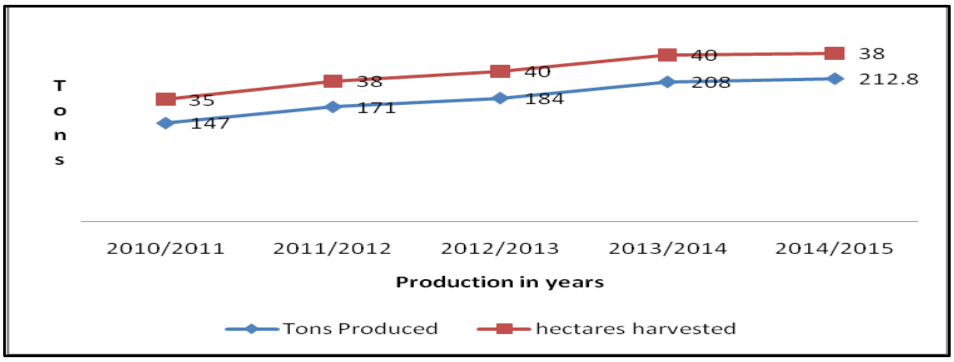

Figure 5: ***Paddy Production Trend After Namhula Scheme***
Source: Field work (2016)

At the household level, the results indicate that both Maliwanda and Namhula schemes gave the best yields as 80% of the farmers obtained an average yield of 4.5 tons per hectare. The best performing respondents (10%) obtained an average of 5 tons per hectare, which is slightly above 2 times the yield obtained prior to the irrigation project. The findings indicate that only 10% of the respondents were in the category of low yields of 3.90 tons per hectare. About 90% of the respondents reported that paddy was enough to feed their families, with a surplus for sale.

We should note here that apart from irrigated agriculture, there other reasons behind the high yields. These include improved knowledge on paddy production, and the use of improved seeds that are highly productive compared to the local varieties. Other reasons included the use of improved farming tools or implements. There was also an improvement in the use of hired animal power (oxen), which are hired at an affordable cost TZS15, 000 per hectare. The use of animal power was also friendlier to the irrigation infrastructure compared to tractors which were expensive and sometimes wrecked the irrigation infrastructure.

Challenges of Paddy Production

Despite the increased production and productivity due to irrigated agriculture, findings showed that there are various challenges confronting paddy producers to achieve their potential production capacity. The first is water availability. More than three-quarters (75%) of the respondents are forced to grow paddy only once per year due to the shortage of water. This implies that cultivating paddy once per year negatively affects farmers' economy and the availability of food. Water in the catchments (dams) is not enough for a second cropping as much is lost through leakages. During the study survey, we observed that water was leaking from unlined canals and broken canal systems.

The second challenge reported by most of the respondents (95%) was ineffectiveness in water distribution. Siltation, seepage, and sedimentation from unlined canals are a problem to canals, furrows, and dams; which reduces the water flow and storage capacity of dams. This in turn hinders effective and even distribution of water to paddy irrigators. Although there are by-laws formulated by water users, the Water Users Association (WUA) committees are still inefficient in the implementation of regulations and collection of operation and maintenances fees. As a result, water user fees are not adequate to operate and maintain irrigation infrastructures. The WUA committees were not collecting the required fees from water users as per agreed procedures mainly due to negligence.

The third relates to slow uptake of agricultural technology by irrigators. The study findings revealed that about 22% of the respondents were not using technologies like application of fertilizers, improved seeds, herbicides, and insecticides due to the lack of knowledge and low income. The low uptake of technology was compounded by the lack of extension services. About 35% of the respondents indicated that insufficient extension services were a problem as extension workers, who resided far away from the villages, did not visit irrigators regularly. Only ward extension officers visited them once per month, while district agricultural officers visited them only on special occasions. Since extension services were not reliable, sometimes farmers got information from secondary school teachers who were members of the irrigation schemes. This research findings tally with those of Beyene (2008) in Ethiopia: that inadequate extension services contribute to low crop production, and in some villages farmers got information from village leaders.

The role of trained extension services cannot be overemphasized. Sokoni (2014) reveals that agricultural support services, including extension services, are essential in enhancing farmers' productivity. Sokoni (ibid.) also noted that in the absence of public and/or trained extension services, farmers rely on uptake of technology through private extension systems that are not always trained and linked to centres of scientific research, which means extension messages from private providers often lack scientific bases. In addition to irrigated agriculture, the availability of extension services plays a great role in increasing farmers' productivity.

Conclusion and Recommendations

The production trend of paddy before the Maliwanda and Namhula schemes was low and did not meet food demands for households. The establishment of the two schemes in Bunda district was a proper strategy for increasing yields per unit, which in turn increased farmer's incomes, employment, and food security at household levels. After the implementation of the two schemes paddy yield was enough to feed families of irrigators, with remaining surplus for sale. The study findings in this paper provide a strong support for investing in irrigation infrastructure in Tanzania, and a proper strategy for increasing yields per unit area: these increase not only food security at household levels, but also has a multiplier effect on people's incomes through selling surplus produce. The two irrigation schemes increased and added to total food requirement in the area. The schemes also played an important role in enhancing food security, income, and livelihoods of farmers. Furthermore, irrigator's households were in a better position in terms of food security and dietary energy intake.

The current trend in paddy production of the two schemes is promising. This is because the production of between 4.5 to 5 tons per hectare in the Maliwanda and Namhula schemes is better compared to the recommended production in Tanzania of between 2 to 4 tons per hectare. However, despite this tremendous performance of the Maliwanda and Namhula schemes, there is room for more improvement in paddy husbandry practices and water management for more increased production.

Nevertheless, the study has also revealed some weaknesses with the WUA committees for failing to collect and manage irrigation service charges, operation, and maintenance of irrigation schemes. This reflects limited capacity of district authorities and the enforcement of respective bylaws. Thus, we recommend that the local government should empower the leaders of WUA with leadership skills, and help them realize the importance of effective collection of annual fees in the operation and maintenance of the schemes.

The study has revealed that the two schemes focus on paddy production only. This denies farmers opportunities to diversify their produce and income. We thus recommend that the district agricultural office should sensitize and educate irrigators to diversify into other appropriate food and horticultural crops rather than depending on one crop only.

References

Beyene, A.D. 2008. Determinants of off-farm participation decision of farm households in Ethiopia [http://ageconsearch.umn.edu/bitstream/5969/2/ 47010140. Pdf] visited on 16, Nov., 2016 J. Best & J. Kahn. 2006. *Research in Education, 5th* edition, Hall, New Delhi.

Bunda District Council (BDC). 2000. Bunda District council Agriculture Annual Report.

—. 2012. Bunda District council Agriculture Annual Report.

—. 2013. Bunda District council Annual Report.

—. 2014. Bunda District council Agriculture Annual Report.

Domenech, L. & C. Ringler. 2013. *The Impact of Irrigation on Nutrition, Health, and Gender* IFPRI Discussion Paper 01259 April 2013 A Review Paper with Insights for Africa south of the Sahara Washington, DC: International Food Policy Research Institute, 36(6): 770–782.

Food and Agriculture Organization (FAO). 2015. *The Rice Value Chain in Tanzania.* A report from the Southern Highlands Food Systems Programme, Rome.

Hussain, I., Hanjra, M.A. 2004. Irrigation and poverty alleviation: review of the empirical evidence. *Irrigation and Drainage,* 53(1): 1–5.

Igbadun, H.E, H.F. Mahoo, A. Tarimo & B.A. Salim. 2005. Productivity of Water and Economic Benefits Associated with Deficit Irrigation Scheduling in Maize. *Research Gate, 1-65*

Inocencio, A. M. Kikuchi, M. Tonosaki, A. Maruyama, D. Merrey, H. Sally & I. de Jong. 2007. Costs and Performance of Irrigation Projects: A Comparison of Sub-Saharan Africa and Other Developing Regions. Colombo, Sri Lanka: International Water Management Institute. 81 pp. (IWMI Research Report 109).

Israel, G. D. 1992. *Sampling the Evidence of Extension Program Impact.* Program Evaluation and Organization Development, IFAS, University of Florida. PEOD- 5.

Maxwell, D. G. & T.R. Frankenberger. 1992. *Household Food Security: Concepts, Indicators, Measurements: A Technical Review.* UNICEF and IFAD, New York and Rome.

Smith, L. 2004. Assessment of the Contribution of Irrigation to Poverty Reduction and Sustainable Livelihoods. *International Journal of Water Resources Development,* 20.

Sokoni C. 2014. The Role of Medium Towns in the Provision of Agricultural Services. In B. Charlery de la Masselière & B. Calas (eds.). *À la Croisée du Transect de la Montagne è la Ville Éloge d'une Géographie Tropicale Traversiére*.

United Nations (UN). 2015. Sustainable Development Summit. September 25–27, 2015 in New York, USA.

United Nations Educational Scientific and Cultural Organizational (UNESCO). 2016. The United Nations World Water Development Report 2016. Published in 2016 by 7, place de fontency 75352 Paris 07 SP France, UNESCO, 2016.

United Republic of Tanzania (URT). 2012. Mara Region Investment Profile. Prime Minister's Office Regional Administration and Local Government Mara Regional Commissioner's Office, Dar Es Salaam.

—. 2016. Tanzania Climate Change Action Report for 2015.

—. 2010. The National Irrigation Policy. Ministry of Water and Irrigation Dar es Salaam.

—. 2014. *Bunda District Socio-Economic Profile.* Dar es Salaam: National Bureau of Statistics, Ministry of Finance.

Van Koppen, B., & Safilios-Rothschild C. 2005. *Poverty Considerations in Investments in Agricultural Water Development.* Report for African Development Bank. Pretoria, South Africa: IWMI.

World Bank 2015. Tanzania - Agricultural Sector Risk Assessment (English). Agriculture Global Practice Technical Assistance Paper. Washington, DC: World Bank Group. Available at: http://documnets.worldbank.org/curated/en/248961468001158010/ Tanzania-agricultural-sector-risk-assessment

—. 2003. Water Resources and Environment Technical Note E. 2. *Irrigation and Drainage*: *Rehabilitation*. World Bank Washington D.C.

World Development Report (WDR). 2008. *Agriculture for Development*. World Bank, Washington.

You, L., C. Ringler, G. Nelson, U. Wood-Sichra, R. Robertson, S. Wood, …. Z. Guo. 2010. *What Is the Irrigation Potential for Africa? A Combined Biophysical and Socio-economic Approach.* IFPRI, Discussion Paper 00993. Washington, DC: International Food Policy Research Institute, 36(6): 770–782.