

CONTRIBUTION OF IRRIGATION SCHEMES ON THE LIVELIHOOD OF FARMERS IN RWANDA: A CASE STUDY OF KANYONYOMBA IRRIGATION SCHEME

¹JOANITA MWIZA, ²Dr. PATRICK MULYUNGI, ³Dr. JAYA SHUKLA

^{1, 2, 3}Jomo Kenyatta University of Agriculture and Technology

Abstract: Irrigation farming is one of the most important rural development investments that can have both direct and indirect impacts on poverty and food security. Irrigation schemes is said to be the dominant contributor to the total irrigated areas. Despite the contribution of irrigation systems in enhancing rural agricultural production and poverty alleviation being widely recognized, this contribution has not been evident for small scale holder farmers at Kanyonyomba irrigation scheme. The purpose of this study was to establish the contribution of irrigation schemes on livelihood of farmers in Rwanda. a case study of Kanyonyomba irrigation scheme. The study employed a descriptive research design. The target population under study was 350 households that has benefited on the rehabilitation of Kanyonyomba irrigation scheme and 15 Agricultural extension officials from the ministry of agriculture. The study used both primary and secondary data, where questionnaires, interview were used for data collection. Data collected was analyzed through SPSS version 21. Data analysis involved statistical computations for averages, percentages, and correlation and regression analysis. Ordinary least squares (OLS) regression method of analysis was adopted to determine the inferential statistics. The results indicate that households with large cultivated land size where less likely to participate in the irrigation scheme. Negative coefficient of cultivated land size showed this (-1.63) and significant at 1% significance level. The utilization of Kanyonyomba irrigation scheme has been a success to farmers in Gatsibo district. This is a clear testimony that irrigation schemes can be successfully operated and managed by the farmers themselves. In view of that Kanyonyomba irrigation scheme has enhanced the employment availability as many people have engaged themselves in agricultural activities something that has reduced the possibility of falling into hunger, address climatic challenges as well as avoiding rural urban migration among the youths.

Keywords: Crop diversification, Irrigation schemes, Livelihood of farmers, Kanyonyomba irrigation scheme.

1. INTRODUCTION

1.1 Background:

Many countries in Sub-Saharan Africa, have realized the important role of irrigation in food production, and irrigation investments have increased in the region. You et al. (2010) reported that the average rate of expansion of irrigated area over the past 30 years was 2.3% in Africa. Total irrigated land in Africa is estimated to be about 12.2 million hectares and six countries, namely Egypt, Madagascar, Morocco, Nigeria, South Africa and Sudan account for nearly 75% of this total irrigated land (FAOSTAT, 2012). Despite some notable irrigation expansion, the developmental impact of irrigation in Africa has been limited and below expectations (García-Bolanos *et al.*, 2011).

Irrigation is said to be the dominant contributor to the total irrigated area in many African countries (Mwakalila & Noe, 2009). There seems to be a consensus that improving agriculture and enhancing agricultural productivity through irrigation will remain a key strategy for rural poverty alleviation in most of the low-income countries, where most the rural poor depend directly or indirectly on agriculture (Hillel, 2007). A few 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* (2013) state that irrigation can reduce poverty through increasing production, income, and reduction of food prices. This helps very poor households meet the basic needs associated with improvements in household overall economic welfare, protection against risks of crop loss due to erratic, unreliable, or insufficient rainwater supplies, promotion of greater use of yield enhancing farm inputs and creation of additional employment, which together, enable people to move out of the poverty cycle. Frequent drought and adverse economic conditions are the major problems faced by the irrigation sector in semi-arid areas of sub-Saharan Africa. Irrigation scheme 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 (Sokoni & Shechambo, 2015). Successful smallholder irrigation schemes can result in increased productivity, improved incomes and nutrition, employment creation, food security and drought relief savings for the government. However, socio-economic evaluations of smallholder irrigation schemes are needed at regular intervals to be able to derive lessons from past experiences and help policy makers in formulating sound policies for future development. Yet, government-managed (large-and small-scale) schemes have generally performed far below expectations and most of the time, initial capital costs have not been recouped and the financial returns have not been able to cover operation and maintenance (O&M) costs (Ortman *et al* 2010)

1.1.1 An Overview of irrigation in Rwanda:

Irrigation in Rwanda began during the Belgium colonial rule in 1945 at Karongi (Kibuye) after the famine known as Ruzagayura (1943-44). An 8km water channel was dug from Ntaruka towards Rubengera with its tributaries irrigating local people's farms. In 2003, the government of Rwanda embarked on swamp reclamation under the Rural Sector Support Project (RSSP, World Bank/IDA 2015) with major focus on large scale rice production. The importance of the role of irrigated agriculture in achieving food security and offering away out of poverty and additional benefits include; overall modernization of agriculture production through introduction of quality inputs such as chemicals, fertilizers, quality seeds, extension systems and knowledge support.

Irrigation was identified as a key strategic activity in PSTA II. Rwanda signed the CAADP compact which establishes in its Pillar I on Land and Water management that the Government should allocate at least 2% of public funds for irrigation development. Irrigation is important to increase agricultural productivity through allowing multiple cropping and reducing vulnerability to weather shocks. Considering the potential impacts of climate change, irrigation infrastructure also made rural households more resilient and adaptable to longer term shifts in seasonal rainfall. This irrigation development took place in line with the National Irrigation Policy, the law on Water Users Associations and the Irrigation Master Plan (MINAGRI 2008-2012).

The Kanyonyomba irrigation scheme was visualized to improve irrigation facilities to provide a stable supply of water required by agriculture in the area and especially rice. The scheme was expected to enable double cropping (two harvests per year) of rice and horticultural crops, as well as to improve the productivity of rice and other crops by expanding the total cultivated area to 600 ha. Through these efforts, the project aims to contribute to the improvement of food security in Rwanda and to the livelihoods of farmers in the region, hence ensuring the country is secure in crop production to ensure food security and boost incomes of the beneficiaries.

1.2 Statement of the Problem:

Irrigation is a crucial input in the agricultural production process and movement towards market-oriented production is often requiring a greater application of irrigation techniques (World Bank, 2008). As a regional strategy of water resources development, irrigated agriculture has become the main intervention to mitigate recurrent drought and thereby improve food security and income of the rural population in Amhara Region (Mati, 2008). The World Bank, various development agencies and numerous countries have invested in large irrigation projects, but there is disagreement on whether investing in new irrigation projects is appropriate because of the less than satisfactory performance of existing projects (Tilahun & Paulo, 2014).

The Kanyonyomba Dam alone in Gatsibo district was developed in 2006 where before rehabilitation a small part downstream was cultivated for rice on 45 ha with inadequate agricultural techniques used on the pretext that farmers were unskilled in the domain.

Rwanda is promoting commercial drought resilient agriculture, that's why the country is expanding its area under irrigation. The big question lies as to whether the irrigation scheme contributes in uplifting livelihood. It's for this reason that researcher investigates the contribution of irrigation schemes on the livelihood of farmers in Rwanda. A case study of Kanyonyomba irrigation scheme.

1.3 Objectives of the study:

1.3.1 General objective:

The general objective of the study was to determine the contribution of irrigation schemes on the livelihood of farmers in Rwanda. A case study of Kanyonyomba irrigation scheme.

1.3.2 Specific objectives:

The following specific objectives guided the study:

1. To analyze the contribution of irrigation on crop diversification of the livelihood of farmers in Rwanda.

2. CONCEPTUAL FRAMEWORK

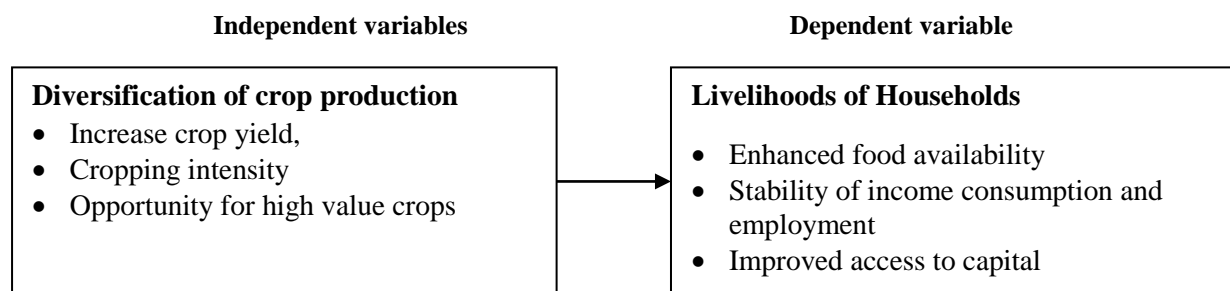


Figure 2.1: Conceptual framework

3. TARGET POPULATION

A population refers to an entire group of individuals, events or objects that have a common observable characteristic (Orodho, 2012). A population describes the parameters whose characteristics the research attempted to describe. The target population of this study considered households from Kanyonyomba sector in Gatsibo District. The households were targeted because the study focused on the rural residents of Gatsibo District who could best be found in households as opposed to meeting people on street. A total of 350 households were chosen because the study required household survey.

3.1 Sampling Procedure:

Sampling is defined as the process of selecting several individuals for a study in such a way that they represent the larger group from which they are selected (Mugenda & Mugenda, 2013).

Purposive sampling technique was employed to select Gatsibo District as the study site since there is an irrigation scheme in the area. In Gatsibo, Kiramuruzi Sector was purposively selected as the study location because Kanyonyomba is among the first schemes to be rehabilitated in the Eastern province of the country which is considered as the driest of all provinces in the country. Kiramuruzi sector is among other sectors in Gatsibo District where irrigation has been employed for the last 6 years.

4. RESEARCH FINDINGS AND DISCUSSION

4.1 Diversification of crop production on rural livelihood in Rwanda:

4.1.1 Respondents involvement in agricultural activity

Respondents were asked whether they were involved in any agricultural activity.

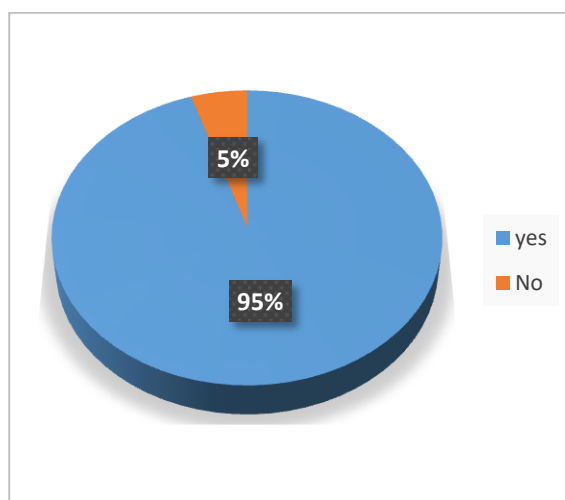


Figure 4.2: Respondents involvement in farming

Majority (95%) of the respondents indicated that they were involved in agricultural activity whereas only 5% of the respondents were not involved in agricultural activity.

4.1.2 Activities respondents involved in

Respondents were asked to indicate the activities involved in

Table 4.1: Activities in which respondents involved in

		Frequency	Percent
Valid	Rice	19	10.2
	Maize	105	56.1
	Beans	40	21.4
	Fish farming	23	12.3
	Tomato	105	56.1
	Other	40	21.4

Comparative yields analysis by crop type could not be done because of lack of uniformity in the use of inputs. However, gross yield for major crops by access to irrigation schemes was presented in Table 4.1. As expected, irrigation use has significantly contributed towards achieving household's goal of increased production and this result is similar to other reports (Getaneh, 2011). Data analysis of major cereals and horticultural crops showed that mean crop yield per household for maize, tomato, and rice is highest for irrigation users. This evidence has ensured that irrigation use is a guarantee for increased food supply and ensured food security. Crops like tomato, vegetable, are only grown by those households with access to irrigation. This is also an indication of the fact that irrigation use increases crop diversification and intensity.

4.1.3 Agricultural production improved since the inception of Kanyonyomba irrigation scheme?

Table 4.2: Benefits of diversification in Kanyonyomba irrigation scheme

		Frequency	Percent
Valid	Very well	80	60.6
	Well	32	24.2
	Neutral	12	9.2
	Not well	8	6.1
	Total	132	100.0

Most farmers however preferred to grow other crops for various reasons. About 60.6% of farmers preferred other crops to what they were currently cultivating. Out of those farmers who preferred to cultivate other crops, 86% of them assigned a higher market value to their preferred crops than what they were cultivating. The rainy season is from September to November. In this period both irrigating and non-irrigating households produced rain-fed crops. The dry season is

practiced from December to April. In this cropping season, only irrigating households can cultivate using water from irrigation. Access to irrigation has been regarded as a powerful factor that provides a greater opportunity for multiple cropping, cropping intensity, and crop diversification (Saleth *et al.*, 2003).

5. CONCLUSIONS

Based on the empirical findings, some major conclusions are drawn after being achieved with regards to the irrigation schemes in rural livelihood in Rwanda.

The utilization of Kanyonyomba irrigation scheme has been a success to farmers in Gatsibo district. This is a clear testimony that irrigation schemes can be successfully operated and managed by the farmers themselves. In view of that Kanyonyomba irrigation scheme has enhanced the employment availability as many people have engaged themselves in agricultural activities something that has reduced the possibility of falling into hunger as well as avoiding rural urban migration among the youths. However, inflexible land tenure system available has necessitated the land shortage leading to farmers' unnecessary conflicts. Although, there has been a need for carrying out research and development in order to improve the irrigation scheme, the un-availability of skilled extension officers and farmers still pose a challenge for the government and other stakeholders to solve.

5.1. Recommendations:

Based on the findings and the conclusions drawn above, this study makes the following recommendations.

1. Kanyonyomba irrigation scheme improvement attained by small scale holder farmers need to be properly maintained; hence attainment of higher production
2. When land conflicts emerge, the resolution need to be passed wisely in order to avoid continuous conflicts among farmers for the smooth running of the irrigation scheme
3. Efficient and effective training to farmers and extension officers should be enhanced for the performance of agriculture in the district.
4. Policy makers have to see a need for promoting irrigation, enhancing marketing system and promoting new technology acquisition in terms of production methods and inputs in order to enable small scale farmers to carry on their activities aiming at value addition.

5.2. Areas for further research:

The findings assessed the contribution of irrigation schemes on enhancing the livelihood of rural households. It is advised that further studies could be done on the following issues; To what extent have farmers been able to utilize fully the irrigation schemes found in their areas? What are the challenges small scale farmers face when carrying out their jobs?

REFERENCES

- [1] Alem Kiros (2008). Opportunities and Challenges of Vegetable Marketing in Kilte-Awlaelo Woreda, *MSC Thesis, Mekelle University*
- [2] Allen, C. R., & Holling, C. S. (2010). Novelty, adaptive capacity, and resilience. *Ecology And Society*,
- [3] Anderson, D.A. (2010). Environmental Economics and Natural Resource Management, Third Edition. *New York, Routledge, pp. 235-257*
- [4] Asayehegn, K., Yirga, C., & Rajan, S. (2011). Effect of Small-Scale Irrigation on the Income of Rural Farm Households: The Case of Laelay Maichew District, Central Tigray, Ethiopia. *Journal of Stored Products and Postharvest Research, Vol. 2(10), PP. 208-215.*
- [5] Assan, K. J., Caminade, C., & Obeng, F. (2009). Environmental Variability and Vulnerable Livelihoods: Minimising Risk and Maximising Opportunities for Poverty Alleviation. *Department of Agricultural Economics University of Liverpool, 21, 403-418.*
- [6] Benin, S., & Mugarura, S. (2016). Determinants of change in household-level consumption and poverty in Uganda, 1992/93-1999/00. *International Food Policy Research Institute (IFPRI), Discussion Paper No. 27.*
- [7] Berkes, F. (2009). Understanding uncertainty and reducing vulnerability: Lessons from resilience thinking. *Natural Hazards, 41, 283-295*

- [8] Birendra K, C, Schultz, B and Prasad, K (2011) Water Management to meet present and future food demand. *Irrigation Drainage. Vol 60, p 348-359*
- [9] Birol, E., K. Karousakis, P. Koundouri. (2016). Using Economic Valuation Techniques to inform Water Resources Management: A Survey and Critical Appraisal of Available Techniques and an Application. *Science of the Total Environment, Vol. 365, pp. 105-122*
- [10] Bryman, A. (2014). *Social Research Methods (Second Edition)*. Oxford University Press, *Oxford*
- [11] Chazovachii, B. (2012). The Impact of Small Scale Irrigation Schemes on Rural Livelihoods: The Case of Panganai Irrigation Scheme Bikita District Zimbabwe. *Journal of Sustainable Development in Africa, Vol. 14 (4), PP. 217-231*.
- [12] Creswell, J. W. (2014). *Research design: Qualitative and quantitative approaches*. Thousand Oaks, CA: SAGE Publications.
- [13] Dillon, A. (2011). The effect of irrigation on poverty reduction, asset accumulation, and informal insurance: Evidence from Northern Mali. *World Development. 39 (12), 2165-2175*.
- [14] Dittoh, S., & Awuni, A. J. (2012). Groundwater use for food security and livelihoods in the Upper East Region. "Groundwater in sub-Saharan Africa: Implications for food security and livelihood". Final project report submitted to the *International Water Management Institute as part of the Rockefeller Foundation funded project*.
- [15] Dittoh, S., Bhattarai, M., & Akuriba, M. A. (2013). Micro Irrigation-based Vegetable Farming for Income, Employment and Food Security in West Africa. In M. A. Hanjre, *Global Food Security* (pp. pp. 178-199). New York, NY:: NOVA Science Publishes Inc.
- [16] Eshetu, S., Belete, B., Goshu, D., Kassa, B., Tamiru, D., Worku, E., et al. (2010). Income Diversification through Improved Irrigation in Ethiopia: Impacts, Constraints and Prospects for Poverty Reduction. *Evidence from East Harerghe Zone, Oromia Region, Ethiopia. Overseas Development Institute, Research Inspired Policy and Practice Learning In Ethiopia and the Nile Region (Ripple), Working Paper 14, Ethiopia*.
- [17] FAO. (2011). *The State of Food Insecurity in the World: How Does International*.
- [18] FAO. (2008). Socio-economic impact of smallholder irrigation development in Zimbabwe: case studies of ten irrigation schemes. *FAO Sub-Regional Office for East and Southern Africa (SAFR), Harare, SAFR/AGLW/DOC/002*.
- [19] Fanadzo, M. (2012). Revitalisation of smallholder irrigation schemes for poverty alleviation and household food security in South Africa: A review. *Afr. J. Agric. Res., Vol. 7 (13), 1956-1969*.
- [20] Faurès, J. M., & Santini, G. (2008). *Water and the rural poor: Interventions for improving livelihoods in sub-Saharan Africa*. Rome, Italy: Food and Agriculture Organization of the United Nations.
- [21] Fincham, E. J. (2008). *Response Rates*
- [22] FOOD AND AGRICULTURAL ORGANISATION STATISTICS (FAOSTAT) (2002). *FAO Statistical Databases*. <http://apps.fao.org/default.htm>, Accessed 23 June 2017
- [23] García-Bolanos, M., Borgia, C., Poblador, N., Dia, M., Seyid, O.M.V. and Mateosa, L. 2011. Performance assessment of small irrigation schemes along the Mauritanian banks of the Senegal River. *Agricultural Water Management 98:1141-1152*.
- [24] Gatrell, A. C. (2015). Complexity theory and geographies of health: A critical assessment. *Social Science and Medicine*,
- [25] GCI. (2011). The Volta Basin Transboundary Basin Sub- Projects: *The Volta. PP 42- 45*.
- [26] Gebregziabher, G., Namara, R., & Holden, S. (2009). Poverty reduction with irrigation investment: *An empirical case study from Tigray, Ethiopia. Agricultural Water Management, 96, 1837-1848*.
- [27] Getaneh, K. (2011). The impact of selected small-scale irrigation schemes on household income and the likelihood of poverty in the Lake Tana basin of Ethiopia. MSc. *Thesis Presented to the Faculty of the Graduate School of Cornell University, USA*.

- [28] Hays, J. (2008). Agriculture in China. Retrieved from <http://factsanddetails.com/china.php?itemid>
- [29] Hillel D (2009). Small-Scale Irrigation for Arid Zones. Principles and Options. FAO Development Series 2. *Food and Agriculture Organization of the United Nations (FAO), Rome.*
- [30] Hope, R., Gowing, J., & Jewitt, G. (2008). The contested future of irrigation in African rural livelihoods: Analysis from a water scarce catchment in South Africa 10. *Water Policy, 10, 173-192.*
- [31] Hussain, I., Hanjra, M., Thrikawala, S., Wijeratne, D., Shinkai, N., & Sawada, Y. (2007). Impact of irrigation infrastructure development on dynamics of incomes and poverty: Econometric evidence using panel data from Sri Lanka. JBIC Institute Research Paper 32. Tokyo, Japan: *Japan Bank for International Cooperation (JBIC).*
- [32] IFAD. (2009). *Innovation Water: Water, innovations, learning and rural livelihoods*
- [33] Jaghdani, T.J. Brümmer, B. and Barkmann, J. (2009). Comparison of Methods to Economically Valuate Irrigation Water in the Qazvin Irrigation Network (Iran). *Conference on International Research on Food Security, Natural Resource Management and Rural Development, Tropentag, University of Hamburg, October 6-8, 2009, pp. 1-4*
- [34] Jin, S., Yu, W., Jansen, H., & Muraoka, R. (2012). The impact of irrigation on agricultural productivity: Evidence from India. Selected poster prepared for presentation at the *International Association of Agricultural Economic (IAAE) Triennial Conference, Foz do Iguacu.*
- [35] Karthikeyan, C. (2010). Economic and Social Value of Irrigation Water: Implications for Sustainability. *Fourteenth International Water Technology Conference, IWTC 14 2010, Cairo, Egypt, pp. 823-835*
- [36] Khai, H.V. and Yabe, M. (2011). Technical Efficiency Analysis of Rice Production in Vietnam. *J.ISSAAS, Vol. 17, No. 1, pp. 135-146*
- [37] Kinfu, A., Chilot, Y., & Rajan, S. (2012). Effect of small-scale irrigation on the income of rural farm households: *the case of Laelay Maichew district, central Tigray, Ethiopia. J. Agric. Sci, Vol. 7, 1.*
- [38] Kuwornu, J., & Owusu, E. (2012). Irrigation access and per capita consumption in farm households: Evidence from Ghana. *Journal of Development and Agricultural Economics, 4(3), 78-92.*
- [39] Kothari C (2014). *Research Methodology: Methods and Techniques, (2nd ed). New Delhi: New Age International Limited Publishers*
- [40] Lange, G.M., Hassan, R. (2016). The Economics of Water Management in South Africa: *An Environmental Accounting Approach. Edward Elgar Publishing Limited, Cheltenham, United Kingdom, chapter 7, pp. 114-276*
- [41] Lipton, M., Litchfield, J. and Faures, J.-M. (2013). The effect of irrigation on poverty: A framework for analysis. *Water Policy 5:413-427.*
- [42] Mallios, Z. (2010). Irrigation Water Valuation Using Spatial Hedonic Models in GIS Environment. *International Journal of Information Systems and Social Change, Vol. 1, No. 4, pp. 1-13*
- [43] Maganga, A.M. (2012). Technical Efficiency and its Determinants in Irish Potato Production: Evidence from Dedza District, Central Malawi. *African Journal of Agricultural Research, Vol. 7, No. 12, pp. 1794-1799*
- [44] Mati, B., (2008). Capacity development for smallholder irrigation in Kenya. *Irrigation and drainage, 57, pp 333-334. John Wiley inc., London.*
- [45] Mesa-Jurado, M.A, Martin-Ortega, J, Ruto, E and Berbel, J. (2011). The Economic Value of Guaranteed Water Supply for Irrigation Under Scarcity Conditions. Paper prepared for presentation at the EAAE 2011 Congress Change and Uncertainty, *Challenges for Agriculture, Food and Natural Resources, ETH Zurich, Zurich, Switzerland August 30 to September 2, 2011, pp. 1-16*
- [46] MINAGRI (2008). *Strategic Plan for the Transformation of Agriculture 2008-2012 II (PSTA II)*
- [47] Mugenda, O.M. & Mugenda, A. G. (2008). *Research Methods: Qualitative and Quantitative Approaches. Nairobi: ACT Press.*
- [48] Mugenda, O.M. & Mugenda, A. G. (2013). *Research Methods: Qualitative and Quantitative Approaches. Nairobi: ACT Press.*

- [49] MOFED. (2010). Trends and prospects for meeting MDGs by 2015, *millennium development goal report*.
- [50] Mwakalila, J and Noe, P (2009) The Use of Sustainable Irrigation for Poverty Alleviation in Tanzania: *The Case of Smallholder Irrigation Schemes in Igurusi, Mbarali District*. Mkuki na Nyota Publishers
- [51] Mwendera, E and Chilonda, P (2013). Methodological Framework for Revitalisation of Small Scale Irrigation Schemes in Southern Africa. *International Journal of Agricultural Sciences Research Vol 2(3)*, p 67-73
- [52] Narala, A. and Zala, Y.C. (2010). Technical Efficiency of Rice Farms under Irrigated Conditions in Central Gujarat. *Agricultural Economics Research Review. Vol. 23, pp. 375-381*
- [53] Nhundu, K, Gwata , C, Mushunje, A.2010. Impacts of Zimbabwe European Union micro-project programme (Zim/Eu MPP) in funding smallholder irrigation projects on food security and income levels: A case study of Mopane irrigation scheme in Zvishavane, Midlands province, Zimbabwe. *African Journal of Agricultural Research Vol. 5(14)*
- [54] Oates, N., Jobbins, G., Mosello, B., & Arnold, J. (2015). *Pathways for irrigation development in Africa – Insights from Ethiopia, Morocco and Mozambique* (Working paper 119) Future Agricultures.
- [55] Ojeda, M.I., Mayer, A.S., Solomon, B.D. (2008). Economic Valuation of Environmental Services Sustained by Water Flows in the Yaqui River Delta. *Ecological Economics, Vol. 65, pp. 155-166*
- [56] Ortman GF, King RP 2010. Research on Agri-food supply chains in Southern Africa involving small scale farmers: *Current status and future possibilities. Agrekon, 49: 397-417*.
- [57] Orodho, A. J. (2012). Essential of educational and social sciences research methods. Nairobi: *Malosa Publishers*
- [58] Parker, S. and Speed, R. (2010). Agricultural Water Pricing: Australia. *Organisation for Economic Co-Operation and Development, pp.6-19*
- [59] Rahman, K.M.M., Mia, M.I.A and Bhuiyan, M.K.J. (2012). A Stochastic Frontier Approach to Model Technical Efficiency of Rice Farmers in Bangladesh: An Empirical Analysis. *The Agriculturists, Vol. 10, No. 2, pp. 9-19*
- [60] Rogers, P.R., Miller, A., & Judge, W.Q. (2009). Using Information – Processing theory to Understand Planning/Performance Relationships in the context of strategy. *Strategic Management journal, 20. 566 - 577*.
- [61] Sekaran, U., & Bougie, R. (2013). Research Methods for Business. *United Kingdom: John Wiley & Sons Ltd*.
- [62] Storm, H., Heckelei. T. and Heidecke, C. (2010). Demand Estimation for Irrigation Water in the Moroccan Drâa Valley using Contingent Valuation. *Institute for Food and Resource Economics, University of Bonn, Discussion Paper 2010:1, pp. 1-16*
- [63] Sokoni, C and Shechambo, T (2015) Changes in the Upland Irrigation System and Implications for Rural Poverty Alleviation. *A case of the Ndiwa Irrigation System, West Usambara Mountain; Tanzania*
- [64] Tesfaye, A., Bogale, A., Namara, R., & Bacha, D. (2008). The impact of small-scale irrigation on household food security: *The case of Filtino and Godino irrigation schemes in Ethiopia. Irrigation Drainage Systems, 22(2), 145-158*.
- [65] Tekana, S., & Oladele, O. (2011). Impact analysis of Taung irrigation scheme on household welfare among farmers in North-West province, South Africa. *Journal of Human Ecology, 36(1), 69-77*.
- [66] Thairu, N. K (2010) Agricultural Production and Irrigation Management: the Case of Irrigated Rice Production in Kenya (A Research Paper) *Institute of Social Development, Graduate School of Development studies, The Hague, The Netherlands November, 2010*
- [67] Tilahun Haile and Paulos Dubale, (2014). Results to Date Future Plan of Research on Irrigation and its Impact. *Workshop on Impact of Irrigation on Poverty and Environment, Workshop Proceedings, 26-30, April 2004, Addis Ababa*.
- [68] Van-Averbeke, W. (2012). Performance of smallholder irrigation schemes in the Vhembe District of South Africa. In: *Kumar MD (ed.) Problems, Perspectives and Challenges of Agricultural Water Management. In Tech, Rijeka, Croatia*.

- [69] Wagner, Kevin (2012) Status and Trends of Irrigated Agriculture in Texas *Texas water resource institute, Texas, USA*
- [70] Webb, P. (2011). When Projects Collapse, Irrigation Failure in the Gambia from Household Perspective. *Journal of International Development, Washington., Vol. 3.*
- [71] Wendimu, S. and Bekele, W. (2011). Determinants of Individual Willingness to Pay for Quality Water Supply: The case of Wonji Shoa Sugar Estate, Ethiopia. *Journal of Ecology and the Natural Environment, Vol 3, No. 15, pp. 474-480*
- [72] World Bank (2008) Agriculture for Development. World Bank Report, *World Bank Washington DC.*
- [73] World Health Organization (WHO) (2011) Trade, Foreign policy, *Diplomacy and Health Food Security.*
- [74] Yilma, T., Berg, E., & Berger, T. (2008). The Agricultural Technology Market Linkage under Liberalization in Ghana: Evidence from Micro Data. *Journal of African Economies, 17, 62-84.*
- [75] Yokwe, S. (2009). Water productivity in smallholder irrigation schemes in South Africa. *Agric. Water Manage., Vol. 96, 1223–1228.*
- [76] You, L., C. Ringler, G. Nelson, U. Wood-Sichra, R. Robertson, S. Wood, Z. Guo, et al.. 2010. What Is the Irrigation Potential for Africa? *A Combined Biophysical and Socioeconomic Approach. IFPRI Discussion Paper 00993. Washington, DC: International Food Policy Research Institute.*
- [77] Young, A.R. (2015). Nonmarket Economic Valuation for Irrigation Water Policy Decisions: Some Methodological Issues. *Journal of Contemporary Water research & Education, Vol. 131, pp. 21-25*