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Impact of Irrigation Projects on Rural Community Livelihoods in Rwanda

Narcisse Hakizimana*, Olive Nishimwe, Lamek Nahayo, Abias Maniragaba

Faculty of Environmental Studies, University of Lay Adventists of Kigali (UNILAK), Kigali, Rwanda

Abstract

In Rwanda, about 80% of population works in subsistence agriculture. This study aimed to analyze the extent to which irrigation project contributed to its beneficiaries' livelihoods in Rwamagana district of Rwanda. A purposive or judgmental sampling strategy selected a sample size of 208 people living around and working with the project. The questionnaire was used to collect data which were analyzed by using the Statistical Package for Social Sciences (SPSS) along with Microsoft Excel. The results indicated that 71.6 percent of respondents were male and 70.2 percent were aged between 16 and 30 years old. It was noted that 95.7% of project beneficiaries were single individuals not members of cooperatives growing rice in the irrigation sites under construction. For livelihoods improvement, it was noted that some of informants bought land (16.8%), livestock (39.9%), houses (1.9%), and bicycles (11.1%). The informants indicated that future project management to sustainably contribute to community livelihoods, should base on the protection of irrigation structures (75%), and efficiency use of irrigation water (25%). The analysis suggests government and stakeholders to ensure that local farmers affected by the project are given priority during employment process. This would help them to cover the loss from stopping their agricultural activities where irrigation project is taking place. In addition, delivering training to rice farmer's cooperative about dam maintenance and protection of concrete irrigation structures would sustainably increase agricultural produce and rural livelihoods improvements as well.

Keywords

Irrigation Project, Rural Community, Livelihoods, Rwamagana, Rwanda

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1. Introduction

Irrigation in developing countries tends to be stereotyped as equity reducing, in competition with other uses for scarce water resources, and often resulting in negative impacts for women and other disadvantaged groups [1]. In Sub-Saharan Africa countries where reduction in income inequality comes from land reform and changes in land tenure, it has a tendency to increase agricultural productivity due to the resultant intensification of labor input on land [2]. In recent decades, there have been various levels of emphasis placed on irrigation development by governments and donors around the world. South and East Asian countries saw massive investments into irrigation during the Green Revolution, while the Sub-Saharan Africa, seemingly failed to jump on the bandwagon [3].

The Government of Rwanda (GoR) is pursuing a comprehensive poverty reduction program which includes implementation of various sustainable agriculture projects. Agriculture sector in Rwanda counts for about 39% of the country's GDP and about 80% of the national population engages in the sector [4]. In Rwanda, a high demography coupled with strong reliance on agriculture caused land scarcity, so that the per capita land decreased from 0.95 ha in 1960 to 0.25 ha in 2010 leading to 0.10 ha by 2050 [5]. On the other hand, the small-scale farming is the majority and most of them are under rain-fed whereby the production is very much affected by climate variability. Therefore, irrigation development can be a durable solution as it is less susceptible to the climate condition and it enhances improvement of farmers' stable income [4].

* Corresponding author
E-mail address: hakizimanan21@gmail.com (N. Hakizimana)

In Rwanda, the irrigation development includes small ponds and check dams (water harvesting), reservoirs for fish (aquaculture), livestock watering and other productive activities, where the success of related investments depends in large part on their adaptability to local conditions, local ownership (level of community participation), technical design and construction quality [6].

To boost the agriculture sector, the Government of Rwanda has set a goal in the third Strategic Plan for Agriculture Transformation (SPAT3) for increasing irrigation area to 100 thousand ha by 2018 [7].

Land Husbandry, Water Harvesting and Hillside Irrigation (LWH) projects have been implemented and have registered tremendous progress in increasing productivity and profitability of hillside agriculture across the country, both in irrigated and non-irrigated hillsides. The project benefited and transformed the livelihoods of more than 280,000 people and is considered as one of the most successful projects in Rwanda and in the region [8].

In fact, water scarcity occurs when water supply is insufficient to meet water demand. This condition arises as consequence of a high rate of aggregate demand from all water-using sectors compared with the available supply, under the prevailing institutional arrangements and infrastructural conditions [9].

Globally, freshwater resources are sufficient for agriculture to meet demand requirements by 2050, given appropriate technologies and investments. However, significant water availability discrepancy is expected between and within countries and substantial water scarcity will persist in the near East, North Africa, South Asia and other areas [10].

The construction of the dam was always expected mainly to boost socio-economic development by using irrigated land for cash crop production such as rice, vegetables like eggplants, onions, and beetroots among others for local and region market [11].

This is the case of Muyanza dam (worthy $16.5 million) constructed in Rulindo district of the Northern Rwanda in 2016 by the China Geo-Engineering Corporation (CGC). The dam benefits 42,549 farmers from 9,096 households from sectors of Buyoga, Ntarabana and Burega. The dam retains enough water to irrigate 1,100 hectares of crop fields throughout the year which benefit all categories of farmers [12].

The study conducted on the irrigation activities in Rwamagana district by Narayanan Kannan (2014), revealed that the sources of water in Rwamagana swamps could supply enough water for the entire irrigated area during the dry season. Unfortunately, poor water distribution occurred over the secondary and primary canals of Rwamagana irrigation system. This poor distribution resulted in major differences in water availability from one tertiary unit to another. Generally, the downstream portions had serious deficiencies of water whereas the upstream sections have excess water resulting in decrease of productivity in a major part of the rice perimeter, which was resulting in permanent conflicts between farmers and even some plots were cultivated once a year [13].

Furthermore, in 2016 the Government of Rwanda (GoR) requested support from the Government of Japan (GoJ) through Japan International Cooperation Agency (JICA) for the rehabilitation of irrigation facilities in 3 marshlands: Cyimpima, Bugugu and Gashara located in Rwamagana district, Eastern Rwanda [7]. And an Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) were conducted to ensure that the project is implemented in an environmentally and socially sustainable manner [14].

However, there has been no study conducted to assess the contribution of irrigation projects in improving rural community's livelihoods. Therefore, the main objective of this study was to analyze the impact of irrigation project on rural community livelihoods, with case of Rwamagana District, Eastern Rwanda.

2. Methods and Materials

2.1. Description of the Study Area

This study was conducted in Rwamagana district, one of seven districts forming the Eastern Province of Rwanda. Rwamagana district is divided into 14 sectors namely Fumbwe, Gahengeri, Gishari, Karenge, Kigabiro, Muhazi, Munyaga, Munyiginya, Musha, Muyumbu, Mwulire, Nyakariro, Nzige and Rubona. The district lies on a total area of 682 Square Kilometers and is inhabited by 313,461 populations [15, 16]. For this study, three marshlands Cyimpima, Gashara, and Bugugu in which the irrigation project is under construction, were chosen as case studies. Those marshlands are interlinked and are located between four sectors: Kigabiro, Mwurire, Munyaga and Rubona of Rwamagana district. The cumulative irrigation area of those marshlands is 170 ha and the rice is the main crop.

Table 1. Characteristics of Rwamagana Irrigation Project.

Characteristics	Project sites			
	Cyimpima	Bugugu	Gashara	Total
Location				
Latitude	1°59'46.24"S	1°58'15.36"S	2° 0'10.31"S	
Longitude	30°26'27.95"E	30°25'18.54"E	30°24'28.04"E	

Characteristics	Project sites			
	Cyimpima	Bugugu	Gashara	Total
Dam water reservoir (m^3)	553,000	451,000	478,000	
Dam Body Level (meter)	1359.9	1386.4	1364.5	
Flow Water Level (meter)	1357.4	1383.5	1361.6	
Concrete irrigation canal length (km)	8.8	7.8	7.1	23.7
Irrigation area before the project (ha)	48	38	47	133
Irrigation area after the project (ha)	56	48	66	170
Number of farmers	256	127	223	606
Main crop	Rice	Rice	Rice	
Annual rainfall (mm)	992.6	992.6	992.6	

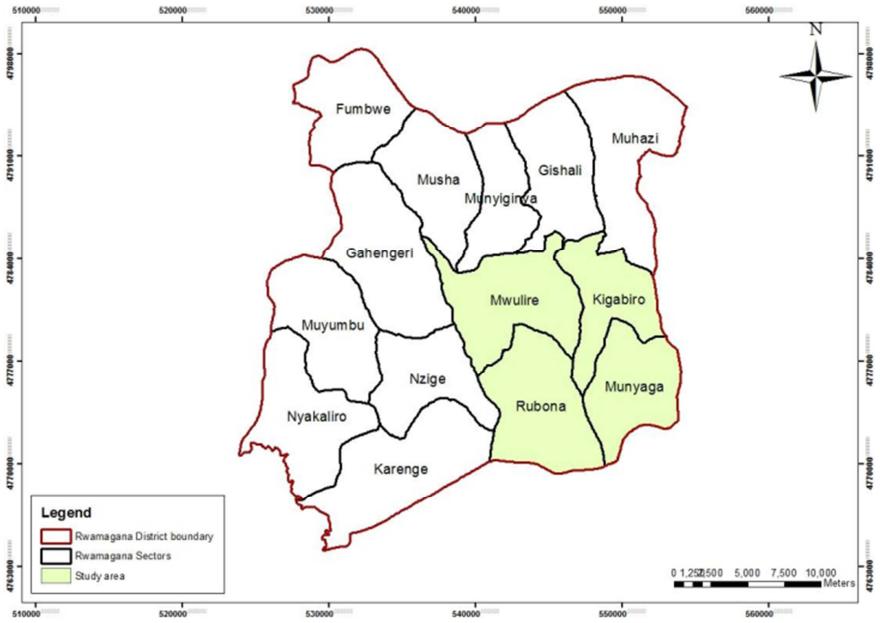

Figure 1. Map of Rwamagana District indicating four sectors in which the irrigation project is located

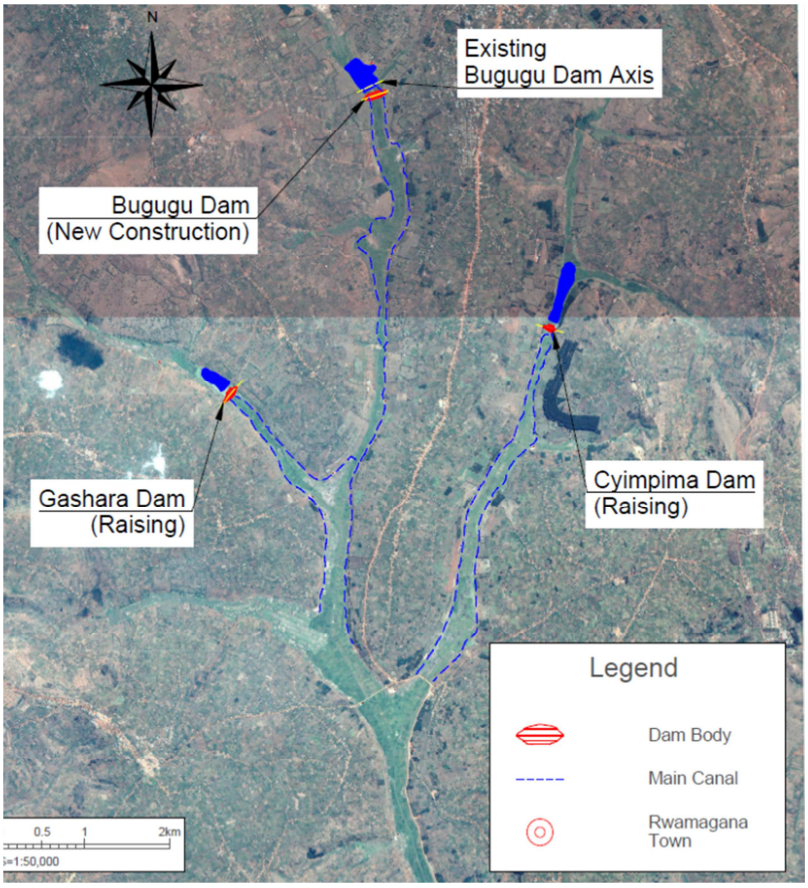

Figure 2. Map of 3 irrigation dam construction sites in Rwamagana District.

2.2. Data Collection and Analysis

The study used secondary information and primary data. Secondary information was collected from literature review of publications, documents, records, and irrigation project monthly reports. The primary data were collected throughout site visit for the observations and surveys techniques. These data were obtained through, to interview with the selected informants. Therefore, the data were processed and analyzed by using the Statistical Package for Social Sciences (SPSS) and Microsoft Excel. The period of this study was basically 12 months of the year 2019.

The term 'population' in the study refers to a totality of units such as people, organizations, communications departments, brands, media reports or advertisements [17].

The target population in this study was a total of 102,937 people residing in four sectors [15, 16] bordering the irrigation project sites. In order to select the sample size, the authors applied a purposive or judgmental sampling which is a strategy in which particular settings persons or events are selected deliberately in order to provide important information that cannot be obtained from other choices [18, 19].

Thus, authors considered 208 people residing in the sectors surrounding the project sites and working for the project as sample size.

3. Results

3.1. Demographic Characteristics of Informants

Table 2. Description of informants by age, education and farming cooperatives.

Age	[16-30]	[31-45]	[46-60]		TOTAL
Frequency	146	50	12		208
Percentage	70.2	24	5.8		100
Gender	Male	Female			
Frequency	149	59			
Percentage	71.6	28.4			
Education Level	Primary school	TVET	Secondary school	Illiterate	
Frequency	111	9	76	12	208
Percentage	53.4	4.3	36.5	5.8	100
Household size	[3-5]	[6-8]	>8		
Frequency	97	103	8		208
Percentage	46.6	49.5	3.8		100
Cooperative member	Yes	No			
Frequency	9	199			208
Percentage	4.3	95.7			100

As shown in the above Table 2, among 208 informants, 71.6 percent of them were male and the majority of them (70.2%) were aged between 16 and 30 years old. A high rate of informants (53.4%) attended primary school, 4.3 percent attended Technical and Vocational Education and Training (TVET) among others. The results (Table 2) also showed that 95.7% were not members of cooperatives growing rice in the subjected marshlands.

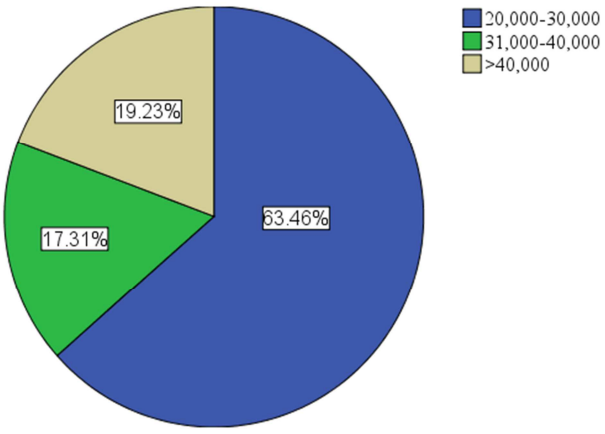

Figure 3. Family monthly income of project workers.

3.2. Economic Benefits from the Project

The informants' economic benefits are based on workers monthly wages, household achievements and saving in financial institutions. In Rwandan rural area, a person gets the minimum of wage per day of 1,500 Rwandan Francs with regards to the quality of work and the experience [7].

3.2.1. Family Monthly Income of Project Workers

The results of this study in Figure 3 indicated that 63.46 percent of respondents get a monthly income ranging between 20,000 and 30,000 Rwandan Francs. The results also showed that 17.31 percent got a monthly income ranging between 31,000 and 40,000 Rwandan Francs per month, and 19.23 percent of them received a monthly income higher than 40,000 Rwandan Francs.

3.2.2. Family Achievements from the Project

After getting the monthly wages from the irrigation project, the informants in this study stated that their achievements are based on rural capital such as baying a piece of land, house, livestock, paying health insurance and school fees of children

and themselves for young people.

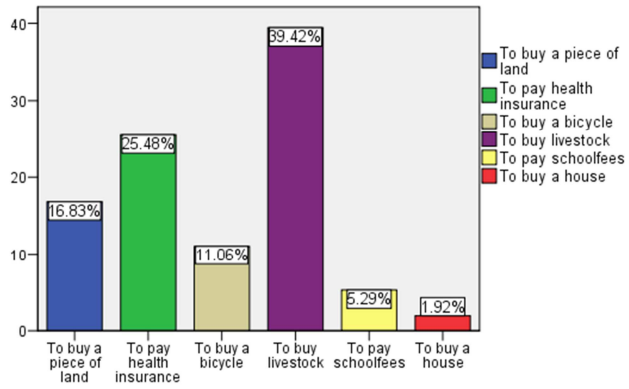

Figure 4. Family monthly income of project workers.

The findings in Figure 4 showed that 16.83 percent of informants bought pieces of land, 25.48 percent paid health insurance, 11.06 percent bought bicycles, 39.42 percent bought livestock, 5.29 percent paid school fees, and 1.92 percent only bought houses.

3.2.3. Project Workers Saving in Financial Institutions

For this study, the ways of saving money considered among informants were bank institutions, and social saving groups (known as Ibimina in Rwanda). The findings of the study in Table 3 revealed that 75 percent saved money in banks, and 23.1 percent do not save in banks nor in social saving groups (Ibimina).

Table 3. Project workers savings types.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bank	156	75.0	75.0	75.0
	Social Saving Group (Ibimina)	4	1.9	1.9	76.9
	None	48	23.1	23.1	100.0
	Total	208	100.0	100.0	

3.3. Community Perception on the Project

3.3.1. To Get Job from the Project for Local Farmers

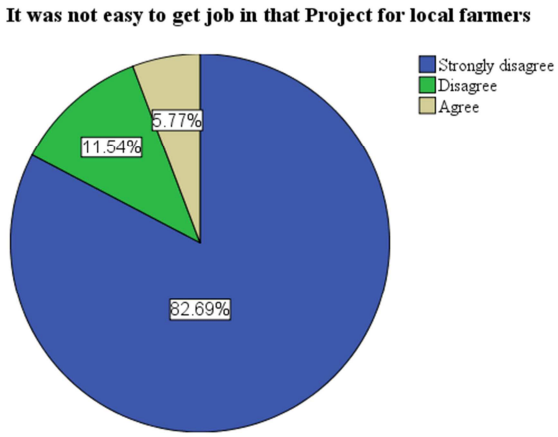

Figure 5. To get job from the project for local farmers.

This study, as illustrated in Figure 5 revealed that 82.69 percent of informants strongly disagreed that it was not easy to get job from the irrigation project. However, 11.54 percent of them disagreed and 5.77 percent agreed with the statement.

3.3.2. Compensation for the Taken Land and Damaged Crops

The findings of the study in Figure 6 revealed that 80.77 percent of informants strongly disagreed that the compensation of the taken land and damaged crops was not fair, 11.54 percent disagreed. Nevertheless, 7.69 percent of informants agreed with the statement. This low percentage of people agreeing with the statement results from the fact that marchlands are the state owned property, and that the farmers are users. Thus, the land should not be compensated.

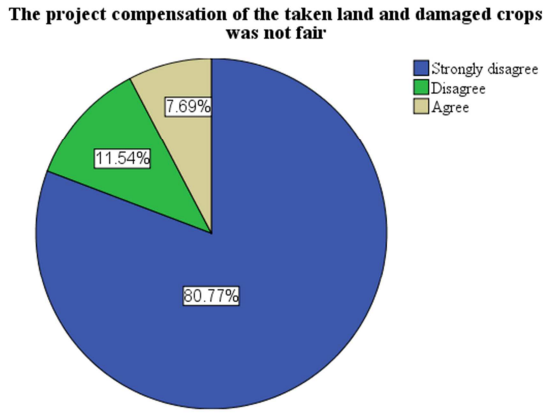

Figure 6. Compensation of project for the taken land and damaged crops.

3.3.3. Impact of Project Implementation on Farmer's Livelihoods

The implementation of the irrigation project caused farmers to stop cultivating rice in two years. This could result into rise of rice price and vegetables which were cultivated in the subjected marshlands.

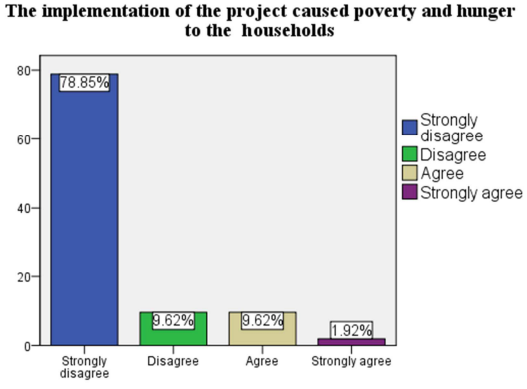

Figure 7. Impact of project implementation on farmer's households.

The findings in Figure 7 revealed that 78.85 percent of informants strongly disagreed that the implementation of the project caused poverty and hunger to the households, 9.62 percent disagreed. However, it was noted that 9.62 percent agreed, 1.92 percent strongly agreed with the statement.

3.3.4. The Government Assistance to Prevent Losses Among Local Farmers

Based on the results of this study in Figure 8, it was realized that 3.85 percent of informants strongly disagreed that there was government assistance to prevent loss of local farmers during implementation of the irrigation project, 32.21 percent disagreed, 62.02 percent agreed, and 1.92 percent strongly agreed with the statement.

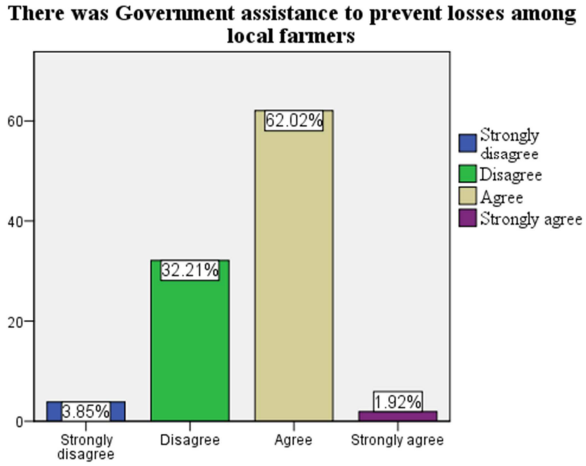

Figure 8. The government assistance to prevent losses among local farmers.

3.3.5. The Management the Project to Sustainably Contribute Community Livelihoods

Table 4. Informants' opinions on sustainable management of irrigation project.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Efficiency use of irrigation water	52	25.0	25.0	25.0
	Protection of irrigation structures	156	75.0	75.0	100.0
	Total	208	100.0	100.0	

The results in Table 4, as asserted by 75 percent of informants, the protection of irrigation structures will sustainably enable the project to rural community livelihoods. Also, 25 percent pointed out efficient use of irrigation water after the completion of the irrigation project.

4. Discussion

In developing counties, the irrigation projects are often resulting in negative impacts for women and other disadvantaged groups [1]. This is not similar in Rwamagana district of Rwanda. This is due to the fact that, as shown by results of this study (Table 2), only 28.4 percent were female. Recent studies revealed that in Sub-Saharan Africa countries where reduction in income inequality comes from land reform and changes in land tenure, it has a tendency to increase agricultural productivity because of the resultant intensification of labor input on land [2].

In Rwanda, the land law and related policies promote gender balance, where they give both male and female equal right on land ownership. Therefore, women are key players in the Rwandan agricultural economy, producing food both for their families and the market for the social and economic development purpose. This is emphasized by the current study's results which revealed that 78.85 percent of informants strongly disagreed that the implementation of the irrigation project caused poverty and hunger to the households while 9.62 percent disagreed with the statement (Figure 7).

In Rwanda, a high demography coupled with strong reliance on agriculture caused land scarcity, so that the per capita land decreased from 0.95 ha in 1960, 0.25 ha in 2010 leading to 0.10 ha by 2050 [5]. However, it can be possible for people working for the irrigation project in Rwamagana district to solve the problem of family land scarcity by buying new land. This can result from the fact that, as indicated by the results of this study (Figure 4) for livelihoods improvement, 16.8 percent of informants bought land.

The World Bank (2013) reported that irrigation development can be a durable solution as it is less susceptible to the climate condition and it enhances improvement of farmers' stable income. This is in line with the results of this study (Table 4) where informants indicated that future project management to sustainably contribute to community livelihoods should base on the protection of irrigation structures (75%), and efficiency use of irrigation water (25%).

5. Conclusion

This study assessed the impact of irrigation projects on rural community livelihoods and a face-to-face interview was conducted with two hundred and eight (208) respondents working in the irrigation project in 2019. The sample size was selected from 102,937 population of four sectors of Rwamagana district (Kigabiro, Mwurire, Munyaga and Rubona), bordering the irrigation project sites namley; Cyimpima, Bugugu and Gashara marshlands. The collected data were analyzed by using the Statistical Package for Social Sciences (SPSS) and MS Excel. The results indicated that after working with the irrigation project, some of them

bought land (16.8%), livestock (39.9%), houses (1.9%), and bicycles (11.1%). The informants indicated that future project management to sustainably contribute to community livelihoods should base on the protection of irrigation structures (75%), and efficiency use of irrigation water (25%). The analysis suggests that government and stakeholders should insure that local farmers affected by the project are priority while employing the project workers. This would enable them to cover the loss from stopping their agricultural activities. Accordingly, it is good to ensure provision of training to rice farmer's on dam maintenance techniques and protection of concrete irrigation structures in order to sustainably increase agricultural produce, and rural livelihoods improvements. Further studies are suggested to analyze the impact of irrigation on rice production (before and after) its implementation.

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Conflict of Interest

The Author declares no conflict of interest.

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References

[1] Smith, L. E. (2004). "Assessment of the contribution of irrigation to poverty reduction and sustainable livelihoods." International journal of water resources development 20 (2): 243-257.

[2] Mwabu, G. and E. Thorbecke (2004). "Rural development, growth and poverty in Africa." Journal of African Economies 13 (suppl_1): i16-i65.

[3] Kadigi, R. M., G. Tesfay, et al. (2012). "Irrigation and water use efficiency in Sub-Saharan Africa." Policy Research Paper 4.

[4] WORLD BANK (2013). Agricultural Development in Rwanda. [On line]. Available at World Wide Web: <http://www.worldbank.org>, retrieved on the 6th March2020.

[5] Nahayo, L., L. Li, et al. (2016). "Agricultural impact on environment and counter measures in Rwanda." African Journal of Agricultural Research 11 (25): 2205-2212.

[6] MINAGRI, (2018). Strategic Plan for Agriculture Transformation 2018-24.

[7] MINAGRI, RAB and JICA (2016). Resettlement Action Plan (RAP) for the Proposed Project of Rehabilitation of Irrigation Facilities in Rwamagana district, Republic of Rwanda. Final report.

[8] MINAGRI (2017). Sustainable Agricultural Intensification for Improved Livelihoods, Food Security and Nutrition Project (SAIP)

[9] FAO, (2017). Water for Sustainable Food and Agriculture. A report produced for the G20 Presidency of Germany.

[10] Noemi M., Richard L. Snyder et al. (2017). Water Scarcity and Future Challenges for Food Production.

[11] KTPRESS, (2018). Muyanza Water Dam: Rwanda Creates A New Agricultural Wonder. [On line]. Available at World Wide Web: <http://www.ktpress.rw>, retrieved on the 26th February 2020.

[12] Xinhua net,(2018). Chinese-built second highest dam in Rwanda to benefit farming sector: official. [On line]. Available at World Wide Web: <http://www.xinhuanet.com>, retrieved on the 26th February 2020.

[13] Narayanan, K. (2014). "Impact of participatory irrigation management–case study: Cocurirwa Cooperative, Rwamagana Rice Project, Rwanda." Advances in Plants & Agriculture Research 1 (3): 00013.

[14] JICA (2017). The Preparatory Survey on the Project for Rehabilitation of Irrigation Facilities in Rwamagana district, in the Republic of Rwanda. Final report. February, 2017.

[15] National Institute of Statistics of Rwanda (NISR), Ministry of Finance and Economic Planning (MINECOFIN) [Rwanda]; 2012. Rwanda Fourth Population and Housing Census.

[16] Rwamagana district Website, visited on the 10th March2020.

[17] Twagirimana Jean Claude (2014). The impact of water shortage to human development. A case study of Kigali City. UNILAK. Master of Business Administration, Option of Project Management, 2014.

[18] MAXWELL, J. A. (1996). Qualitative Research Design: An Interactive Approach London, Applied Social Research Methods Series.

[19] Taherdoost, H. (2016). "Sampling methods in research methodology; how to choose a sampling technique for research." How to Choose a Sampling Technique for Research (April 10, 2016).