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EFFECT OF IRRIGATION ON RICE PRODUCTION IN RWANDA A *CASE STUDY OF MUVUMBA IRRIGATION SCHEME NYAGATARE DISTRICT*

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ABSTRACT: Although the establishment of MUVUMBA irrigation was in an endeavor to improve the welfare of the people it remains a pressing issue as economic and social problems continue to affect plot holders which results in the scheme being undermined. The purpose of this research is to identify the effect of irrigation schemes on rice production more specifically the MUVUMBA Irrigation Scheme. Both quantitative and qualitative methodologies were used in the investigation of the effect of the scheme on rice production. A sample of 63 respondents out of a total of one thousand plot holders was selected using random sampling. Data was collected using questionnaires and interviews. Analyses were done using descriptive statistics. Tables were employed in presentation and analysis. The results also revealed a big difference in technical efficiency among farmers with the most inefficient farmer at 21% and the most efficient recording 98%. The study examined that there some problems farmers faced like securing capital to buy inputs such as seeds, fertilizers and chemicals. Results were that the irrigation scheme has managed to create employment, income generation and supply water throughout the year. For irrigation farming for rice production to be sustainable there is need for intervention by interested stakeholders such as community based organizations and co-operatives. Economic recovery programs such as farm mechanization are also essential to address the current deteriorating outputs. The responsible authority should ensure that there are good roads and cheap transport that take the crops to different market places for the

sustainability of MUVUMBA irrigation scheme. Extension service can also be used to popularize most efficient production methods by sharing information, knowledge and skill to the farmers to increase rice productivity per hectare.

Key words: Irrigation, Irrigation scheme, Rice production

1. INTRODUCTION

This paper presents the findings of research study carried out in Muvumba river Nyagatare sector Nyagatare district Rwanda to investigate effect of irrigation on rice production in Rwanda. In this paper Irrigation refers to the application of controlled amounts of water to plants at needed intervals. In contrast, agriculture traditional agriculture that relies only on direct rainfall is referred to as rain-fed or farming. This study revealed that the irrigation encountered may challenges in the scheme.

2. BACKGROUND OF THE STUDY

In Rwanda irrigation and modernization of agriculture have been promoted by the government to increase agricultural production to feed the growing population and surplus reserved for sale and this has caused to drainage and reclamation of swamps to create land for agricultural practices so as to increase rice production in Rwanda.

MUVUMBA Irrigation Scheme is located in northeastern of Rwanda and southwestern of Uganda and started in 2012.and the following vision and aims to promote rice crop by increasing its production in quantity and quality. This is due to changing the stakeholders' lives better that previously. To Comparatively to other irrigation schemes, MUVUMBA irrigation aims to be exemplary to other cooperatives located in NYAGATARE District, Northern Province and in East African Countries (Cooperative of Excellence in the region of EAC) characterized by it new technology of promoting rice production. Comparatively to other irrigation schemes, MUVUMBA irrigation aims to be exemplary to other cooperatives located in Nyagatare District, Northern Province and in East African Countries (Cooperative of Excellence in the region of EAC) characterized by it new technology of promoting rice production Mutsvangwa et al (2006) define irrigation as the ministering of land through the artificial application of water to ensure double cropping as well as steady supply of water in areas where rainfall is unreliable. Irrigation

schemes spread in Africa with large scale irrigation schemes such as the Kano River Project of 1970 and the South Chad Irrigation of 1974. Many Southern African governments began to embark on large and small scale irrigation schemes mainly in areas with little annual rainfall total in order to supplement water shortages. The first recorded formal irrigation in Rwanda began during the colonial era in 1945 at KARONGI district (KIBUYE) as a response to the famine known as RUZAGAYURA (1943-44) an 8km and 11km water channels was drug from a division on NTARUKA stream towards RUBENGERA which was used to irrigate people's farms along the way. In 2000, the government of Rwanda embarked on swamp reclamation and irrigation development under the Rural Sector Support Project (RSSP, funded by World Bank/IDA) with a focus on medium and large-scale production.

In Rwanda, irrigated agriculture has long played a key role in feeding, expanding populations and is undoubtedly destined to play a still greater role in the future. It only raises the yields of crops, but also prolongs the effective crop-growing period in areas with dry seasons. MUVUMBA irrigation schemes were established as a precaution against the inherent variability of rainfall as well as to ensure that cultivation is done all year round to boost and increase rice production in NYAGATARE district so as to eliminate poverty.

3. STATEMENT OF THE PROBLEM

Although the establishment of MUVUMBA irrigation scheme was in an endeavor to improve the welfare of the people socially, economically and ensure food security, it remains a pressing issue as economic and social problems continue to affect plot holders to an extent that food shortages persisted in the area. This gave the scheme a negative impression. Thus why the effect of irrigation schemes remained undermined, resulting in its efforts unrealized. However, an assessment needs to be done on how the effect of irrigation schemes has contributed to people's livelihoods in NYAGATARE district and its contribution for the future policy and planning.

4. GENERAL OBJECTIVE

The general objective of this study is to identify the effect of irrigation schemes on rice production more specifically the MUVUMBA Irrigation Scheme and its contribution for future policy and planning.

5. SPECIFIC OBJECTIVES

The study was governed by the following specific objectives:

i. To estimate the efficiency levels in rice production in MUVUMBA Irrigation Scheme

ii. To assess the contribution of the scheme in improving people's livelihoods

iii. To suggest possible solutions to the problems faced by rice production in MUVUMBA Irrigation Scheme.

6. RESEARCH QUESTIONS

The research questions based on:

i. What are the efficiency levels in rice production in MUVUMBA Irrigation Scheme?

ii. What are the benefits of irrigation schemes on rice production to the people?

iii. What are possible solutions to the problems faced by rice production in MUVUMBA Irrigation Scheme?

7. SIGNIFICANCE OF THE STUDY

The study supplements the existing literature concerning irrigation on rice production in Rwanda. It is also essential for the policy makers who would wish to promote rice production by promoting efficient and competitive farm practices. The study provides valuable information on the production efficiency of rice production in Rwanda. The study will give the contribution of these effects to the government for the future policy and planning. The study also gave the government the awareness to the hardships and the possible solutions to the effects of irrigation schemes on rice production. The information was beneficial to the government, development agencies and farmers working on the area related to the study. There is no doubt that other researchers would build on the findings of the study to carry out further research to confirm, expound, improve or enrich the study findings.

8. RESEARCH METHODOLOGY

This study employed a descriptive case study design. Abagi (1995)argues that descriptive research attempts to describe what was or what is in the social system .The methodology involved in such design is mostly qualitative in nature producing descriptive data .Merriam (1998) and Yin (2003) point to the fact that a case study allows researchers to retain the holistic and meaningful characteristic of real life events. Yin(2003) argue that a case study investigates a contemporary phenomenon with its real life context, especially when the boundaries between phenomenon and context are not clearly evident .In addition, case study allows for the use of all methods of gathering data from testing to interviewing (Merriam 1998).In fact case study combines qualitative with quantitative methods which grant the researcher the opportunity to use variety of methodological procedures from different knowledge areas and philosophical approaches. The research used both qualitative and quantitative methods of collecting and presenting data. Qualitative methods were suitable to explore the benefits as well as the effect irrigation scheme on rice production. The research used the quantitative method so as to know the assets which were bought by farmers and the number of kilograms of crops produced. Therefore interviews and observations were employed. There was also need to triangulate this qualitative methodology with quantitative methodology so that important information which could have been left out by qualitative methodology would be presented using quantitative methodologies such as questionnaires.

9. Population

The target population for this study was the scheme manager, heads of departments, rice farmers. The heads of departments and scheme manager were important in this study because they have impact on the agricultural extension. The scheme manager plays a vital role in the coordination and planning for the agricultural extension. A population of one thousand farmers is practicing irrigation at MUVUMBA irrigation scheme.

10. Sampling Procedures and Sample Size

The research employed the random sampling method. This was used as it points out that a sample drawn at random is unbiased in the sense that no member of the population has any more chance of being selected than any other member. Thus by randomly choosing the fifty rice

farmers to participate in the study, it means that all the farmers within the irrigation scheme stood the same probability of being selected. After the selection process thirty-five females and fifteen males were identified. This selection criterion reduces bias and produce real representatives of the scheme.

Fifty rice farmers in the scheme were selected to participate in the study through random sampling. The researcher used sixty-three (63) farmers as a sample because fewer farmers were easy to control and are representative of the total population. Sample size determination is the act of choosing the number of observations or replicates to include in a statistical sample. The sample size is an important feature of any empirical study in which the goal is to make inferences about a population from a sample.

The sample size is decided by using Alain Bouchard formula as follows:

$$\boldsymbol{n = \frac{N0}{1 + \frac{N0}{N}}}$$

Where, $\boldsymbol{N_0 = \frac{t\propto^2 * p^2}{d^2}}$ N=Universe size (<6^{10}individuals) *p* = Frequency or probability (p=0.5) *d* = Error (10%), *t*α =Student value (*t*α = 1.65)

The sampling was done with big, marginal and small farmers in head, middle and tail end of the project by random sampling. N=1000 farmers of cooperatives studied.

$N_0 = \frac{1.65^2 * 0.5^2}{0.1^2}$ = $N_0 = \frac{0.680625}{0.01}$ = 68.0625≅ 68

$n = \frac{N_0}{1+\frac{N_0}{N}}$= $n = \frac{N_0}{\frac{N+N_0}{N}}$ = $n = \frac{N*N_0}{N+N_0}$N=1000 farmers, $N_{0 = 68}$

$n = \frac{1000*68}{1000+68} = \frac{68000}{1068}$ = 63.67041198501873 ≅63

The sample size of the selected farmers is **63.** It means a sample of 63 persons among 1000 farmers was sufficient but in order to make more accurate sample a large number have been taken for interview.

11. Data collection instruments

Interviews, questionnaires and observations methods were employed as data collection instruments. Interviewing is one of the commonest methods of collecting information from individuals. Interviewing takes several forms: Structured interviews, Semi-structured interviews

and unstructured interviews. Semi-structured interviews is used because the interviewer asks important questions in the same way each time but is free to alter the sequence of the questions and to probe for more information; respondents can answer the questions in any way they choose.

12. Data processing and presentation

Data processing is the conversion of data into usable and desired form. Most of the data processing is done by using computers and thus done automatically. Presentation of data means displaying data in a clear and attractive manner so that it can be understood and analyzed easily. Data organization, in broad terms, refers to the method of classifying and organizing data sets to make them more useful. Tabulation is the process of summarizing raw data and displaying it in compact form for further analysis. Therefore, preparing tables is a very important step. Tabulation may be by hand, mechanical, or electronic. Editing is the first step in data processing. Editing is the process of examining the data collected in questionnaires/schedules to detect errors and omissions and to see that they are corrected and the schedules are ready for tabulation. Coding is necessary for efficient analysis and through it the several replies may be reduced to a small number of classes which contain the critical information required for analysis. Coding decisions should usually be taken at the designing stage of the questionnaire. So Tabulation, Editing and Data coding are very important in data processing and presentation.

13. DATA ANALYSIS

Data analysis involved both qualitative and quantitative procedures. In qualitative analysis information collected was transcribed to written texts by combining the notes taken and recoded and then organized into various themes qualitative was grouped according to the research answer questions and analyzed through percentages and frequencies and presented in tables

14. Findings and discussions

The variable gender has allowed the researcher to identify the number of men and women who participated in the survey. From the sampling of 63, (30%) are male and (70%) are female. The majority of the respondents were females as compared to males which reflected that women are still key players in irrigation farming in rural areas.

Gender	Frequency	Percentage
Female	44	70
Male	19	30
Total	**63**	**100**

Table 1: Classification of respondents according to the gender

Based on the table above the majority of respondents are female, 70% against 30% male.

Age Range of Respondents

During the research work on the field, the researcher wanted to know whether or not the respondents are found in all categories of age.

Age	Frequency	Percentage
Below 25 Years old	10	15.8
25-40 Years old	40	63.5
Above 40 years old	13	20.7
Total	**63**	**100**

Table 2: Range of respondents

From table 2, the majority of the respondents fell under the age group 25 – 40 years representing 63.5% and constituting the able bodied who could economically work in the plots. The high response in the age group has been attributed to their available in plots since they spend most of their time working on the plots. Fewer children who constituted 15.8% of those respondents help parents in irrigating crops so that production can increase. More so the findings showed that these children worked in the absence of their parents who might be working in town or were at home busy with other commitments.

Table 3: Education Level of respondents

Education	**Frequency**	**Percentage**
Primary	15	23.8
Secondary	8	12.7
University	10	15.9
Tertiary	30	47.6
Total	**63**	**100**

Table 4: Education Level of Respondents

The data in table 3 shows that there is a relationship between educational level and irrigation farming. Irrigation is considered as form of self-employment, income generating project in MUVUMBA irrigation scheme. This is line with Chitsiko (1999) who asserted that small scale

irrigation schemes augment government policy of reducing rural to urban migration. Instead of seeking employment in urban areas they are busy in the irrigation scheme.

Table 4 Rice Production Efficiency Analysis

Technical efficiency %	Percentage	Cumulative %
< 25	2%	2
25-49	15%	17
50-69	40%	57
70-100	43%	100
Mean	72%	
Minimum	21%	
Maximum	98%	

*Table 5: **Distribution of farmer-specific Technical efficiency***

Table 4 above shows the distribution of technical efficiency among farmers in MUVUMBA irrigation scheme. There is great variation in the levels of efficiency. There range is from 21% to 98% within mean of 72%. The mean level of technical efficiency indicate that on average, rice output falls 28% short of the maximum possible level. Therefore in the short run, it is possible to increase rice production in the study area by an average of 28% by adopting the technology used by the best performing farmers.

The effects of irrigation schemes on rice production

One farmer said she would cover her costs using income generated from rice but was quick to point out that growing rice was no easy task in dry season since it cannot produce enough rice production. The comparison of incomes earned from small scale irrigation scheme and that from dry land farming or from non-skilled work is that irrigation farmers earned more than dry land farming. It was also revealed that plot holders have a constant supply of water which is used for irrigating crops. This is supported by Shamma and Shamma (2004) who highlighted that small scale irrigation projects brought abundant supplies of water for domestic purposes in India where cities such as Delhi and Jupor depend on Canal water for public water supply. The majority of the respondents said that the project allowed them to send their children to school improve their nutritional health standards and meeting some of the medical expenses and said that the irrigation scheme enables the increasing of rice production whether it is in dry or wet season. More so

women who were part of the respondents indicated that they gained respect from their husbands through irrigation farming since they were now able to get some income though limited.

Contribution of benefits of irrigation schemes on rice production to the people

Some respondents were satisfied with the income they get from irrigation farming. Those satisfied could afford to meet some of the basic requirements like sending children to school, buying groceries for the family and income to cover some farm inputs. Other plot holders indicated that they could afford to pay a visit to their distant relatives and also affording cellular phones. However, the majority said that the income they get was not always enough during the time of the year when the market is flooded and the inputs are expensive. Since the majority of the respondents were females, irrigation also empowered women and emancipates them socially. Women tend to play a leading role in farming and this ensures their participation in development initiatives and poverty alleviation in rural areas. This was supported by Munina et al (2000), Manzungu (2004) who argue that women in irrigation farming increase income which changes the balance of power within the household. This increases women confidence in Discussions for community decision making which affect their lifestyles. The availability of water throughout the year ensures that cultivation is done all year round.

Challenges faced by farmers in the scheme

If the problems faced by farmers and the benefits yielded were to be scaled, the scale would tilt in favor of the problems being faced. The major problems highlighted include lack of capital for input acquisition, markets, labor and transport.

Challenges	Frequency	Percentage
Labor	10	15.9
Capital	20	31.7
Markets	15	23.8
Transport	15	23.8
Water pricing	3	4.8
Total	**63**	**100**

Table 5: Challenges faced by farmers

From Table 5, the majority of the respondents indicated that they had problems in securing capital to buy inputs such as seeds, fertilizers and chemicals. Due to such problems plot holders

end up using unspecified organic fertilizers or just plant without. The results are that yields obtained fall below standard and this threatens the scheme objectives of maximizing rice production through irrigation. The unavailability of reliable markets to sell their products is one of the major challenges facing farmers. This affects their products which need a ready market. More so some of the challenges faced by farmers were also linked to the availability of laborers to water crops, to protect rice against birds, distribution of water given the number of farmers in the scheme, it is too involving. As Hodder (2000) puts it, "irrigation farming is labor intensive."The majority of respondents said that 99% of water that helps them to irrigate their rice comes from MUVUMBA River.

Inputs required for Production per Hectare of Land

The study findings indicate that the average hectares of land that MUVUMBA Irrigation Scheme farmers use for rice cultivation was less than 1ha. Farmers whose land has been subdivided to less than 0.75ha were less interested in rice farming. The study sought to find out yields per hectare of land in MUVUMBA Irrigation Scheme. From the findings it was found out farmers harvested an average of 4.5 tons of rice per hectare and 9 tons of rice per year. Farmers within the study area who have adopted the System of Rice Intensification (SRI) had higher yields over conventional farmer practice.

Variables	Unit	Mean	Minimum	Maximum
Yield	tons/ha	4.5	4	5.8
Seed	Kg/ha	45	44	50
Fertilizer	Kg/ha	200	180	220
Chemical product	Liters/ha	2	1.5	2.5

Table 6: ***Summary statistics of variables***

The study was interested in establishing the amount of seed per hectare of land in the study area. Farmers in MUVUMBA use an average 4.5 tons/ha. Fertilizer usage was another variable measured in the study area. The findings indicate that the farmers used about 200kgs of planting fertilizer NPK. The researcher sought to find out whether farmers used pesticide in the production of rice. Majority of the respondents indicated that they used Chemical product in the production of rice. In relation to the quantity in liters used per hectare of land the researcher

found out that on average farmers used an average of 2 liters of Chemical product per hectare. Farmers stated that Chemical product usage increased during adverse weather period.

Table7: Possible solutions to the problems faced by rice production in MUVUMBA Irrigation Scheme.

Solution	Frequency	Percentage
In order to minimize the problem labors, farmers should take time to converse with them and talk about the salary they want.	5	8
the government should intervene in order to help farmers to get credit from Bank so that they can solve the problem of Capital	25	40
In order to minimize the problem of market, the government with extension officers should ensure that there is market where farmers can sell their products.	13	21
The responsible authority should ensure that there are good roads and cheap transport which ferry the crops to different market places for the sustainability of MUVUMBA irrigation schemes	8	12
The activity of extension officers needs to be intensified in the study area so as to bring new technology of gathering water in dry season.	12	19
Total	**63**	**100**

From the sampling of 63, (40%) of respondents said that, the government should intervene in order to help farmers to get credit from Bank so that they can solve the problem of Capital and (21%) of respondents said that the government with extension officers should ensure that there is market where farmers can sell their products. And 19% of respondents said that the activity of extension officers needs to be intensified in the study area so as to bring new technology of gathering water in dry season. 12% of respondents said that the responsible authority should ensure that there are good roads and cheap transport which ferry the crops to different market places for the sustainability of MUVUMBA irrigation schemes and 8% of respondents were pointing to the solution of Laborers where they said that they should take time to converse with them and talk about the salary they want and help them to find others. The majority of the respondents were pointing on the solution of Capital as compared to other solutions which reflected that Capital is a big issue in MUVUMBA irrigation farming. For irrigation farming on rice production to be sustainable, the government should intervene in order to gain the technical efficiency of rice farmers. The fertilizer use should be encouraged and farmers are provided with right fertilizers at the appropriate time through the government support program. For irrigation

farming to be sustainable there is need for intervention by interested stakeholders such as community based organizations and co-operatives. Economic recovery program such as farm mechanization are also essential to address the current deteriorating outputs. Hence, irrigation is important for the crop productivity improvement.

15. Conclusions

This study revealed that people benefited from MUVUMBA Irrigation Scheme through rice production improved their nutritional needs. The income obtained from the scale of their rice production has enabled them to send children to school, buy groceries and even to pay a visit to distant places and buy some cattle and others. The income obtained has also enabled plot holders to acquire assets such as livestock, and others. The assets enabled plot holders to diversify their livelihoods through getting animal manure, meat and milk. It revealed that role of women as active participants in irrigation farming which enabled them to make informed decisions which influenced their lifestyles. More so irrigation has also empowered rural people through provision of water throughout the year. Incentive systems such as availability of appropriate fertilizers, effective chemical production such as pesticides and herbicides should be considered in order to increase rice production. For irrigation farming to be sustainable there is need for intervention by interested stakeholders such as community based organizations and co-operatives. Economic recovery programs such as farm mechanization are also essential to address the current deteriorating outputs. The responsible authority should ensure that there are good roads and cheap transport which ferry the crops to different market places for the sustainability of MUVUMBA irrigation schemes. Extension service can also be used to popularize most efficient production methods by sharing information, knowledge and skill. Extension will need to build on traditional communication systems and involve farmers themselves in the process of extension.

16. Recommendation

The government should intervene in order to gain the technical efficiency of rice farmers. There is an urgent need for an appropriate policy of regulation that recognizes and encourages proper and effective use of resources. For irrigation farming to be sustainable there is need for intervention by interested stakeholders such as community based organizations and co-operatives. Economic recovery programs such as farm mechanization are also essential to

address the current deteriorating outputs. The responsible authority should ensure that there are good roads and cheap transport which ferry the crops to different market places for the sustainability of small scale irrigation schemes.

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