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# IMPACT OF IRRIGATION PROJECT ON THE LEVEL OF FARMERS' LIVELIHOODS AT NGOMA22 DEVELOPED SCHEME, NGOMA DISTRICT, RWANDA.

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**ABSTRACT**
The study examined the impact of irrigation projects on the level of farmers' livelihoods in ngoma 22 developed scheme, Ngoma District, Rwanda. Target population was 3,000 farmers from agricultural cooperatives operating in Ngoma 22 Developed Scheme, while stratified and random sampling techniques were used to select 353 respondents. Data collection instruments were questionnaire, while method of data analysis was correlation coefficient, and multiple linear regression analysis. The results indicated that F-test= 206.763 and p-value=0.000b. The findings confirmed that there are great influences of crop production; irrigation training; and farmers associations in the irrigation projects on the level of farmers' livelihoods Ngoma 22 developed scheme at Ngoma District. The findings stated that crop production has positive and significant effect on the level of farmers' livelihoods Ngoma 22 developed scheme at Ngoma District involved at 10% level of significance (β1= 0.119, t= 2.257; p-value= 0.001 less than significant standard level of 10%). This suggests that a 1-unit change Crop Production leads to 0.119-unit change on level of farmers' livelihoods Ngoma 22 developed scheme at Ngoma District. The irrigation training has positive and significant effect on level of farmers' livelihoods Ngoma 22 developed scheme at Ngoma District involved at 10% level of significance (β2= 0.449, t= 5.918 and p-value = 0.000 less than 10% as significant standard level). This suggests that a 1-unit change irrigation training led to 0.449-unit change on level of farmers' livelihoods Ngoma 22 developed scheme at Ngoma District. The farmer's association in irrigation projects has positive and significant effect on the level of farmers' livelihoods Ngoma 22 developed scheme at Ngoma District involved at 10% as standard level of significance, as (β3= 0.475, t= 7.637 and p-value= .000 less than 10%). This suggests that a 1-unit change farmer's association leads to 0.475-unit change on level of farmers' livelihoods Ngoma 22 developed scheme at Ngoma District.
**Key Words:** *irrigation, projects, farmers, livelihoods, Ngoma 22 developed scheme*

## 1. INTRODUCTION

Agriculture in Africa associated to other developing regions has largely lagged behind. It continues to rely on farming systems founded on family resources with smallholder farmers creating the bulk of the agricultural sector. Even though agricultural output presented growth and mainly driver of economic growth, the yield in farming was not significantly risen when matched to other developing counties. In Africa, Agricultural growth has mostly created from the usage of bordering lands and activating labor, and ensuing in subordinate harvests (NEPAD, 2013).

According to NEPAD (2013) cereal yields in Africa are less than half of the yields obtained in Asia. Agricultural intensification has therefore not occurred in Africa. Conferring to World Bank (2009) reported for example that cereal yields per hectare stimulated from a little over 1 ton per hectare in 1960 to 4.5 tons per hectare in 2005 in South Asia, likened to about 0.9 tons per hectare in 1960 to a little over 1ton per hectare in 2005 in Sub-Saharan Africa. Between 1961 and 2009, cereal harvests in Sub-Saharan Africa grew by 0.95% compared to 2.4% in East Asia, 1.95% in Latin America and Caribbean and 1.95% in South Asia (Chirwa and Dorward, 2013).

The strategic determined and promise AfDB to capitalize in infrastructure in numerous sectors of the African economy remains emphasizing in several strategic documents. The AfDB agricultural sector strategy of 2010-2014 in a bid to raise agricultural productivity engrossed its assets on construction substructure for maintainable agricultural development, counting rural roads, irrigation, storage facilities, and markets (AfDB, 2016).

Africa agriculture used the low use of irrigation technology, investments with a potential lead to greater intensification, crop diversity and agricultural productivity. In recognizing the importance of irrigation development in the transformation of African agriculture and African economies, AU and NEPAD (2003) call for action for increased investments in irrigation and sustainable land and water resource management.

The agriculture sector employs 90% of the population. Rain fed agriculture is largely practiced on small farms of relatively 0.5 hectare produces a relatively low production for subsistence. The low crop yields situation worsened in the 1980's when agricultural policy makers failed to transform from low-value agriculture to high value farming. There were not enough policies to encourage agricultural transformation. Other factors are continuous environmental degradation, soil fertility decline, poor water management, and deforestation (Ministry of Finance and Economic Planning, 2002).

In 2004, the Marshland Master Plan was initiated. Marshes were drained and water tanks built to store water for irrigation, especially for rice production. By the end of 2006, almost 11 000 ha of swampland had been reclaimed and used for rice production. By the end of 2020, 40 000 ha of swampland have been reclaimed. Most farmers are unable to exploit the swamps in the natural form since they are often completely flooded and the expense of connecting drainage systems remains unaffordable.

The rehabilitation and construction of irrigation infrastructure in Rwanda remains of paramount importance. Irrigation on hills is situated in the following places: 12 ha in Gashora for cassava production (sprinkler irrigation); 50ha of coffee farms in Ngugu near lake Rwampanga in Kirehe district (sprinkler irrigation); 100 ha of different crops along a stretch of 8 km from Ntaruko, Ndaba, to Rubengera in Karongi District (gravity-fed irrigation).

The majority of farmers engage in traditional ways of farming, they grow food crops for subsistence such sweet potatoes, cassavas, dry beans in highland and wetlands with little irrigation. Currently irrigation sector is being developed due to unpredictable rainfall patterns and also because the Government is investing in rice cultivation in order to increase food production and poverty reduction. The rice is cultivated in the marshlands with sufficient water to irrigate this high-water consuming crop (IFAD, 2009).

**2.Statement of the Problem**

Despite the important of agriculture sector in Rwanda of employing 90% of the labour force, the food and nutrition needed by the population cannot presently be met, as evidenced by the high prevalence of malnutrition (MINECOFIN, 2002). Rwandan agriculture is primarily undertaken at the subsistence level, providing little surplus for local markets. Coffee and tea, the main sources of hard currency in Rwanda, represent less than a fourth of the value of imports. This situation results from both low yields and declining prices in global markets.

According to the Rwanda 2020 Vision, weaknesses in the agriculture sector stem from many factors, some of which are long-standing. In the field of land-use planning, territory is used in an ineffective and unsustainable manner. Housing is scattered, farming activities proceed without pre-established planning and various factors

combine to deteriorate profitability and erode the land.

The self-sufficiency approach to food production has inhibited agricultural modernization and specialization; diversification of income sources at the family level due to the inability to generate income from the land has hampered development of agricultural professionalism; high population growth rate has led to overexploitation of land, soil erosion and loss of soil fertility; the crops under cultivation are unprofitable.

Poverty among farmers limits the purchase of agricultural inputs; Agricultural research and extension are inadequately funded, as are market development and agricultural processing facilities; and production factors such as manpower, elementary tools and water are assigned low value. According to Elias Hakizimana (2018) farmers in Ngoma and Rwamagana districts of the Eastern province are to benefit from a five-year technical project that aims at enhancing the resilience and securing the productivity in the agricultural sector.

Project for water management and capacity building of water user's organizations in the republic of Rwanda, the project targets two main irrigation schemes in Eastern province constructed under Japan International Cooperation Agency (JICA) grant aid projects. It was therefore to cover the gap; the study was undertaken the impact of irrigation projects on the level of farmers' livelihoods in Ngoma22 developed scheme, Ngoma District, Rwanda.

**3. Objectives**

Mainly, the study assessed the impact of irrigation projects on the level of farmers' livelihoods in Ngoma22 developed scheme, Ngoma District, Rwanda. While specifically, the study objectives were:

[1.] To examine the impact of crop production on the level of farmers' livelihoods in Ngoma22 developed scheme at Ngoma District

[2.] To find out the impact of Irrigation training on the level of farmers' livelihoods in Ngoma22 developed scheme at Ngoma District

[3.] To evaluate the impact of farmers association on the level farmers' livelihoods used Ngoma22 developed scheme at Ngoma District.

**4.Research Hypotheses**

This study verified null and alternative hypotheses as follows.

**Ha1:** There is significant impact of crop production on the level of farmers' livelihoods in Ngoma22 developed scheme at Ngoma District;

**Ha2:** There is significant impact of irrigation training on the level of farmers' livelihoods in Ngoma22 developed scheme at Ngoma District,

**Ha3:** There is significant impact of farmers' associations on irrigation project on the level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District.

**5. Conceptual Review**

**Crop Production**

Food is the major source of energy. Every living organism on this planet needs food to stay alive and to continue all other essential life processes. Plants are the main source of food on which both humans and animals depend. Crop production is a common agricultural practice followed by worldwide farmers to grow and produce crops to use as food and fiber. This practice includes all the feed sources that are required to maintain and produce crops. Listed below are few practices used during crop production: Preparation of soil; sowing of seeds; irrigation; application of manure, pesticides, and fertilizers to the crops; protecting and harvesting crops; and storage and preserving the produced crops (BYJU'S, 2022).

**Irrigation Training**

Irrigation is the agricultural process of applying controlled amounts of water to land to assist in the production of crops, as well as to grow landscape plants and lawns, where it may be known as watering. Agriculture that does not use irrigation but instead relies only on direct rainfall is referred to as rain-fed. Irrigation has been a central feature of agriculture for over 5,000 years and has been developed independently by many cultures across the globe (Snyder, and Melo-Abreu, 2005).

**Farmers' association**

According to Yuan (2022) a farmer's association operate for such purposes as safeguarding farmers' rights and interests, enhancing farmers' knowledge and skills, boosting the modernization of agriculture, increasing crop yields, improving farmers' livelihood and developing rural economy.

**Canal irrigation contingencies theory**

Contingency theory remains organizational theory privileges that no best way to establish a corporation, lead a company, or make decisions. Action remains contingent (dependent) upon the internal and external situation. Contingent leaders remain flexible in selecting and familiarizing the concise strategies to suit change in situation at a particular period in time in the running of the organization.

Gareth Morgan show main ideas fundamental in contingency where organizations remain open systems need careful organization satisfy and balance internal needs, and adapt to environmental circumstances. Decision theory is the study of an agent's choices. It can be broken into two branches: normative decision theory observes outcomes of decisions or determines the optimal decisions given constraints and assumptions, and descriptive decision theory examines how agents actually make the decisions.

There is a need to work with a broader related to contingency theory to explain the factors that determine the performance of irrigation systems in Ngama 22 developed schemes. This theory helps the study to clarify the primary advantages of contingency include a realistic view of management and organization of agricultural activities; it discards the universal validity of principles; managers remain the situation-oriented and not stereotyped; lends itself to an innovative and creative management style.

**6. Empirical Studies Review**

According to Theodore Dusabimana, (2012) irrigation practices and water management in Rugeramigozi Marshland. With a rapid growing population of Rwanda which has left no land unoccupied for food production except marshlands, irrigation practice is one the key tools to reach harvest security and contribute to integrated water resources management. About 90% of Rwanda's population is involved in agriculture remained biggest water operator in Rwanda accounting more than 70% of the water demand. This study analyzes current irrigation practices and water management of irrigation dam of 270,000 m3 in Rugeramigozi marshland.

The available water can be dispersed to the current water users, evaluate if the available water can content the demands and look for how better irrigation practices can contribute to the management of this finite resource under competition. By using FAO CROPWAT model and literature the crop water crop requirement and water demand for agriculture were determined. The hydrological analysis with the use of SCS Curve Number method helped to determine the inflow to the dam. Taking into account 45litter/sec for domestic water supply by EWSA, the available water is compared to the demands in Rugeramigozi wetland.

The analysis points out that there is enough water for all demands in season B but water scarcity in season A doesn't allow irrigation of rice; even drinking water supply is not met. The solutions could be the re-use of irrigation water from the field, expansion of the reservoir capacity and release of additional water from Misizi dam located in upstream. Irrigation practices are analyzed by using Institutional Analysis and Development (IAD) framework in which the complex interaction between physical setting of the scheme, rules and irrigation staff are discussed.

By using interviews, group discussions and observations the rules behind irrigation practices are discovered and categorized within the framework. The practices follow the management rules, but weakness is identified in lack of awareness of farmers in respecting irrigation turns, too much water is wasted in irrigation; maintenance works doesn't fully meet the needs, low enforcement of irrigation rules and poor involvement of farmers in setting management rules. Furthermore, the stakeholder analysis was used for water allocation to the three water users (KIABR, EWSA and VTC Mpanda) and their participation in water resource management. Drinking water supply is prioritized, maintenance of the system seems to be left in the hands of farmers of KIABR only and sustainable use of water requires an integrated water resource management approach. From these discussions, conclusions and the recommendations are drawn thereafter.

According to (Esdras Byiringo, *et al.*, 2020) summarized the results from the impacts and sustainability of irrigation in Rwanda study, conducted between 2014 and 2019. The impact evaluation is a collaboration between the Ministry of Agriculture and Animal Resources in Rwanda (MINAGRI), the World Bank's Development Impact Evaluation (DIME), and the University of California-Berkeley. We examine the impacts of irrigation on smallholder welfare, through the lens of the Land Husbandry, Water Harvesting and Hillside Irrigation (LWH) project, a flagship of MINAGRI.

LWH introduces sustainable land husbandry measures for hillside agriculture on selected sites and develops hillside irrigation for subsections of each site. Irrigation investments create significant economic development opportunities for smallholder farmers who otherwise depend on rainfed agriculture, by increasing yields, adding additional cultivating seasons, and reducing risk. The key evaluation question for this study is: what are the impacts of irrigation on smallholder welfare?

Specifically, they examine impacts of large-scale irrigation on yields, cropping and input choices, expenditures, labor supply and employment, land sales and rentals, migration, and whether those impacts differ by gender. The irrigation study context consists of 4 LWH hillside irrigation schemes and their surrounding terraced land across 5 districts of Rwanda. The study is based on 4 waves of primary data collection across four years following construction of the irrigation infrastructure. They use spatial regression discontinuity analysis to capture the effects of irrigation. In their baseline, collected when only a limited fraction of study sites had access to water, we find balance in household characteristics and modest relationships between irrigation and farm practices, consistent with the limited access to irrigation at that time.

The primary findings are based on the discontinuity in access to water in our follow-up surveys. Over the three years of full irrigation access in our follow-up surveys, they find that irrigation has large, positive welfare impacts for smallholders. However, adoption is inefficiently low, constrained by labor market failures. The key results from the study are: Hillside irrigation increases smallholder yields and cash profits by 70%. Horticultural crops are much higher value than staple crops and shifting production

decisions increases returns. Dry season yields are 90% higher for plots in the command area, compared to plots outside. Profits increase by 400,000 RWF/ha (approximately $435/ha) on irrigated plots. Hillside irrigation primarily impacts dry season cultivation 1 in 4 plots in the irrigation schemes are irrigated in the dry season, compared to only 1 in 20 plots outside the scheme. In the rainy season, irrigation usage is much lower on all plots. Access to irrigation does not increase the likelihood a plot is cultivated during the dry season; however, it does significantly shift which crops are cultivated.

Farmers with access to irrigation are much more likely to grow horticultural crops nearly all irrigated plots are used for horticulture. In the dry season, plots in the irrigation scheme are 4 times more likely to be used for horticulture than plots iii outside. In the rainy season, irrigation is nearly 2 times more likely for plots in the schemes. Horticulture replaces production of staple crops such as bananas.

Despite potential profitability, adoption is partial: only 1 in 4 plots are irrigated, moreover, adoption has not increased over time; 2-4 years after the schemes came online dry season cultivation has remained constant at about 25%. If all plots in the irrigation schemes were irrigated, welfare impacts would be 2-3 times higher. Labor market failures are a key constraint to adoption, most households rely on their own labor for agriculture. However, horticultural production is significantly more labor-intensive than staple production. Thin labor markets present a significant barrier to wider adoption.

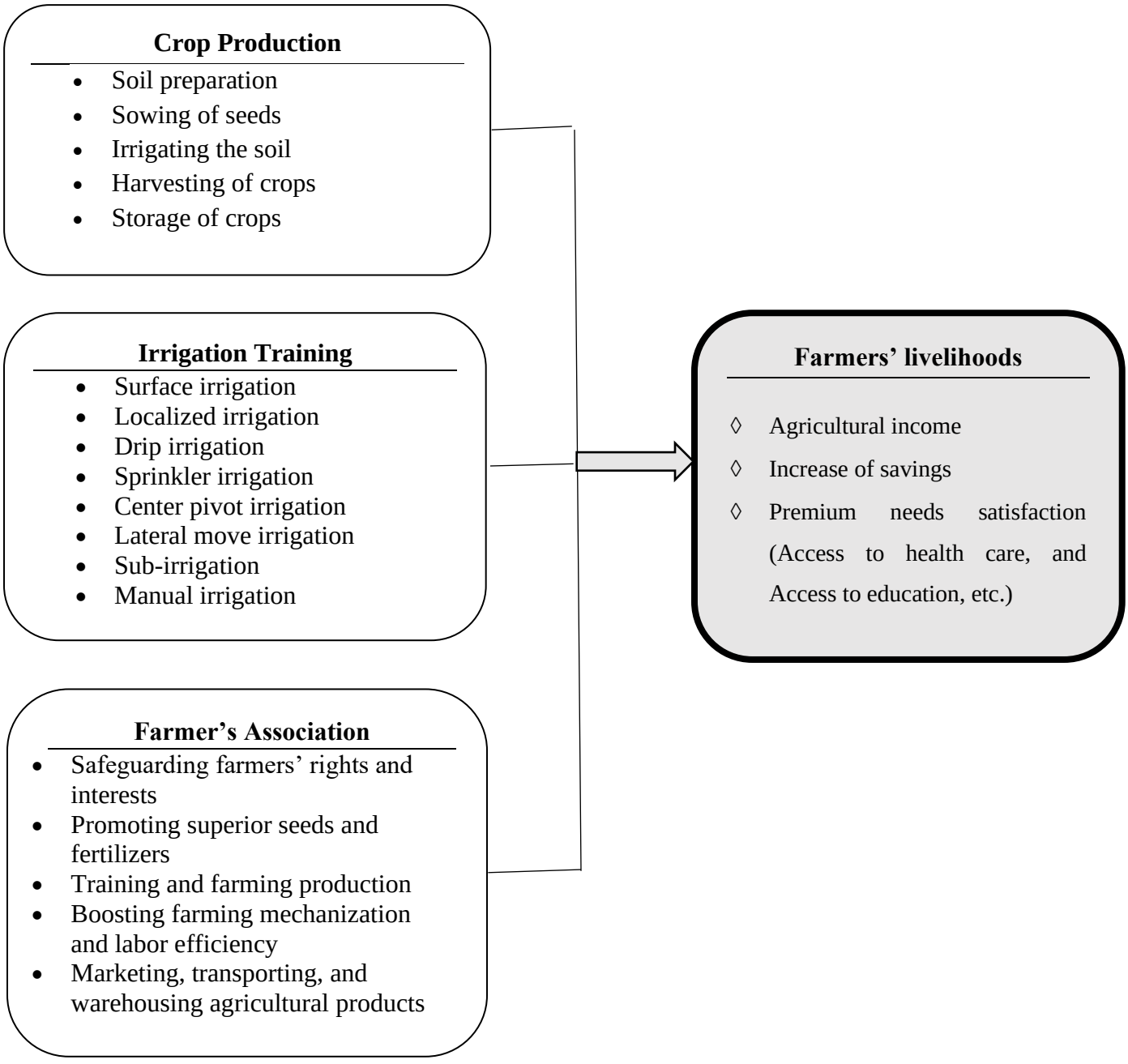
According to (Judt Christine, et al., 2010) evaluate the impact that the modern Hare River irrigation scheme had on household food security as well as on lifestyle changes of the population in the study site Chano Chalba. This was done on the basis of the FAO food security pillars access to food, availability of food, utilization of food and the overall factor of food stability.

RRA tools were used to conduct a before-after comparison, considering a ten years period. The quantitative data was analyzed using SPSS and/or Excel and simple statistical measures such as cross tabulations, frequencies, percentages and means gave a visible overview of the outcomes. The modern irrigation scheme did not affect the livelihood and food situation directly but indirectly through other modernizations that came with and after the construction of the modern main canal, e.g., road, merchants, agricultural office, health centre, drinking water points, school, electricity etc.

The major trigger was the introduction of a new banana type so that farmers changed from food crops to cash crops to earn a higher income. Following, the wealth situation of the population ameliorated but less food crops are produced and people become more dependent on the local market. The infrastructure of the study site developed in a positive way but still education, especially on food issues, are needed to have a sustainable repercussion and to secure people's health and food situation. Further positive changes on the food situation could be able if the higher income was utilized more efficiently and if the construction of the modern irrigation scheme had been more appropriate and by incorporating the farmer's requests.

**7. Conceptual Framework**

The study established relationship between independent variables in terms of irrigation projects, and dependent variables in terms of farmers' livelihoods.




**Source:** *researcher conceptualization (2022)*

Figure 1: Conceptual Framework

## 8. Materials and Methods

The study applied qualitative and quantitative research (descriptive), and correlation research designs. Target population was 3,000 farmers from various agricultural cooperatives operating in Ngoma22 Developed Schemes. The stratified and random sampling techniques were used to select 353 respondents from target population in the farmers of Ngoma22 developed scheme. The instrument of data collection was questionnaire technique, while methods of analysis of data was correlation coefficient matrix analysis that was applied to test the relationship between variables, and the study used the multiple linear regression analysis to test analysis of variance on the irrigation projects in terms of "crop production; irrigation training; and farmers' associations" as independent variables, within farmers' livelihoods in terms of "high agricultural income; increase of saving; premium needs satisfaction (access to health care, and access to education, etc.); and food security" as dependent variables. The models are X= independent variables were irrigation projects, while Y= dependent variable = farmer's livelihoods. Based on this functional relationship the following econometric models has been formulated using multiple regression or polynomial models: $Y=f(X)$ therefore, $y= \beta0+\beta1x1+\beta2x2+\beta3x3 +\varepsilon$; where, $\beta0$= Constant, $\beta1$-$\beta3$ are coefficients of determination.

## 9. Findings and Discussion of the Results

Questionnaires were distributed to 353 respondents from Ngoma 22 developed scheme at Ngoma District. During collection of answered sheets of questionnaires from farmers, the findings indicated the participation rate was 97.2% of responding. This means, 343 out 353 questionnaires come back and the remaining are missed.

### Profile of Respondents

The gender data indicated the analyzed data and its results on ages, education level, marital status, experience of respondents participated in the survey at Ngoma22 developed scheme at Ngoma District. Table No1 confirmed the social demographic function of respondents

***Table 1: Social Demographic Characteristics of Respondents***

| Items | Data | Frequencies | Percentages |
|---|---|---|---|
| **Marital Status** | Single | 86 | 24.4 |
| | Married | 159 | 45.0 |
| | Widow (er) | 98 | 27.8 |
| | **Total** | **343** | **97.2** |
| **Ages** | 21-30 years | 44 | 12.5 |
| | 31-40 years | 9 | 2.5 |
| | 41-50 years | 266 | 75.4 |
| | 51years and above | 24 | 6.8 |
| | **Total** | **343** | **97.2** |
| **Education level** | Primary level | 105 | 29.7 |
| | Professional's trainings in Agricultural career | 101 | 28.6 |
| | Secondary school | 67 | 19.0 |
| | Bachelor's degree and above | 32 | 9.1 |
| | Unschooling/illiterates | 38 | 10.8 |
| | **Total** | **343** | **97.2** |
| **Experiences** | Less than 2years | 20 | 5.7 |
| | 2-3years | 57 | 16.1 |
| | 4-5years | 19 | 5.4 |

| | | | |
|---|---|---|---|
| | 6-7years | 201 | 56.9 |
| | 8 years and above | 46 | 13.0 |
| | **Total** | **343** | **97.2** |

**Source:** *Primary Data, Field results (2022)*

Findings in Table 1 illustrate social demographic characteristics of respondents in Ngoma22 developed scheme at Ngoma District. The results show 86 or (i.e., 24.4%) of respondents were single; 159 or (i.e., 45.0%) of respondents were married people; while 98 or (i.e., 27.8%) of respondents were widow (er) among the respondents.

The findings showed that 44 or (i.e., 12.5%) of respondents have age between 21 and 30 years old; 9 or (i.e., 2.5%) of respondents have age between 31and 40 years; 266 or (i.e., 75.4%) of respondents have between 41-50 years, while 24 or (i.e., 6.8%) of respondents have age of 51years and above old. Education level of respondents exposed by 105 or (i.e., 29.7%) of respondents have Primary level; 101 or (i.e., 28.6%) of the respondents have professional's trainings in agricultural career, and other certificates; 67 or (i.e., 19.0%) of respondents have secondary school level, 32 or (i.e., 9.1%) of respondents have bachelor's degree and above, while 38 or (i.e., 10.8%) respondent were unschooled people in the Ngoma22 developed scheme at Ngoma District.

Findings showed 57 or (i.e., 16.1%) of respondents have experiences from 2-3years; 201or (i.e., 56.9%) of respondents have between 6-7years of experiences; 46 or (i.e.: 13.0%) of respondents have experience of 8years and above; 19 or (i.e.: 5.4%) of respondents have experience between 4-5years, while 20 (i.e., 5.7%) of respondents have experience of Less than 2years.

**Findings on Testing Hypothesis (Inferential statistics)**

During this study, through a linear regression analysis and descriptive statistical methods applied to analyze the data, the study shows $Y = a + b\,X$, where $X$ is the explanatory variable and $Y$ is the dependent variable (i.e.: farmers' livelihoods used Ngoma22 developed scheme) where the $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$; the $X_1$ represents Crop Production, $X_2$ represents Irrigation Training, $X_3$ is Farmer's Association, and ε represents standard error.

***Table 2. Correlation coefficient between the independent variables over dependent variable***

| | | Crop Production | Irrigation Training | Farmer's Association | irrigation projects | farmers' livelihoods used Ngoma22 developed scheme |
|---|---|---|---|---|---|---|
| Crop Production | Pearson Correlation | 1 | .790** | .666** | .850** | **.552**** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 |
| | N | 343 | 343 | 343 | 343 | 343 |
| Irrigation Training | Pearson Correlation | .790** | 1 | .855** | .952** | **.761**** |
| | Sig. (2-tailed) | .000 | | .000 | .000 | .000 |
| | N | 343 | 343 | 343 | 343 | 343 |
| Farmer's Association | Pearson Correlation | .666** | .855** | 1 | .926** | **.780**** |
| | Sig. (2-tailed) | .000 | .000 | | .000 | .000 |
| | N | 343 | 343 | 343 | 343 | 343 |
| irrigation project | Pearson Correlation | .850** | .952** | .926** | 1 | **.771**** |
| | Sig. (2-tailed) | .000 | .000 | .000 | | .000 |
| | N | 343 | 343 | 343 | 343 | 343 |
| farmers' livelihoods used Ngoma22 developed scheme | Pearson Correlation | **.552**** | **.761**** | **.780**** | **.771**** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | |
| | N | 343 | 343 | 343 | 343 | 343 |

***. Correlation is significant at the 0.01 level (2-tailed).*

The correlation coefficient matrix test in table 2 of correlation coefficient between the independent variables over dependent variable show that there is a significant, positive and strong correlation between crop production in the irrigation projects and farmers' livelihoods used Ngoma22 developed scheme as Pearson correlation is **0.552****with the p-value of 0.000, which is less than standard significance level of 0.01. This indicates that, out of the considered other factors impact farmers' livelihoods used Ngoma22 developed scheme, only Crop Production in irrigation projects have significant impact of 55.2% on farmers' livelihoods used Ngoma22 developed scheme.

The results show that there is a significant, positive and very strong correlation between Irrigation Training and farmers' livelihoods used Ngoma22 developed scheme as Pearson correlation is **0.761****with the p-value of 0.000 which is less than standard significance levels of 0.01. This indicates that out of the considered other factors of farmers' livelihoods used Ngoma22 developed scheme, only the Irrigation Training have significant relationship of 76.1% within farmers' livelihoods used Ngoma22 developed scheme.

Findings show also that there is a significant, positive and very strong correlation between Farmer's Associations in irrigation projects and farmers' livelihoods used Ngoma22 developed scheme as Pearson correlation is **0.780**** with the p-value is 0.000, which is less than standard significance level of 0.01. This indicates that, out of the considered other factors influencing the farmers' livelihoods used Ngoma22 developed scheme., only farmer's associations have significant and positive relationship of 78.0% on the farmers' livelihoods used Ngoma22 developed scheme.

General findings show that there is a significant, positive and very strong correlation between irrigation projects and farmers' livelihoods used Ngoma22 developed scheme as Pearson correlation is **0.771****with the p-value is 0.000, which is less than standard significance level of 0.01. This indicates that, irrigation projects represented by Crop Production, Irrigation Training, and Farmer's association impact 77.1% on the farmers' livelihoods used Ngoma22 developed scheme.

***Table 3. Model Summary between independent and dependent variables***

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .804[a] | .647 | .643 | 2.58144 |

a. Predictors: (Constant), Farmer's Association, Crop Production, Irrigation Training

The results in table 3 indicates that $R^2$= **0**.647 representing 64.7% change from farmers' livelihoods used Ngoma22 developed scheme come from irrigation projects represented by Farmer's Association, Crop Production, and Irrigation Training. This means that 35.3% of farmers' livelihoods used Ngoma22 developed scheme come from other variables which are not included in this Model of the research.

***Table 4. ANOVA[a]***

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 4133.495 | 3 | 1377.832 | **206.763** | **.000[b]** |
| | Residual | 2259.035 | 339 | 6.664 | | |
| | Total | 6392.530 | 342 | | | |

a. Dependent Variable: farmers' livelihoods used Ngoma22 developed scheme

b. Predictors: (Constant), Farmer's Association, Crop Production, Irrigation Training

The results from table 4 indicated that the F-test= **206.763** and p-value=**0.000[b].** This implies that independent variables are jointly significant. Therefore, the findings confirmed that there are great impacts of crop production; irrigation training; and farmers' associations in the irrigation projects on the level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District.

***Table 5. Coefficients for the variables under study between irrigation projects and level of farmers' livelihoods at Ngoma22 developed scheme in Ngoma District***

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | .670 | .599 | | 1.118 | .001 |
| | Crop Production | .248 | .110 | **.119** | **2.257** | .001 |
| | Irrigation Training | .903 | .153 | **.449** | **5.918** | .000 |
| | Farmer's Association | .926 | .121 | **.475** | **7.637** | .000 |

**a. Dependent Variable:** farmers' livelihoods Ngoma22 developed scheme at Ngoma District

The findings in Table 5 stated that Crop Production have positive and significant effect on level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District involved at 10% level of significance (β1= **0.119**, t= **2.257**; p-value= **0.001** less than significant standard level of 10%). This suggests that a 1-unit change Crop Production leads to **0.119**-unit change on level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District. These findings above help to confirmed that the researcher has retained alternative hypothesis (**Ha1**) stated that "Crop Production has a statistically significant effect on the level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District."

The Irrigation Training have positive and significant effect on level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District involved at 10% level of significance (β2= **0.449**, t= **5.918** and p-value= **0.000** less than 10% as significant standard level). This suggests that a 1-unit change Irrigation Training led to **0.449**-unit change on level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District. These results indicated that, we have retained the

alternative Ha2 which stated that "Irrigation Training have a statistically significant effect on the level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District."
Farmer's Association in irrigation projects have positive and significant effect level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District involved at 10% as standard level of significance, as (β3= **0.475**, t= **7.637** and p-value= **.000** less than 10%). This suggests that a 1-unit change Farmer's Association leads to **0.475**-unit change on level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District. The results imply that independent variable is jointly significant. However, we have retained $\mathbf{Ha_3}$ which confirmed that "Farmer's Association have a statistically significant effect on the level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District."

**Conclusion**

According to the general findings showed that there is a significant, positive and very strong correlation between irrigation projects and farmers' livelihoods used Ngoma22 developed scheme as Pearson correlation is 0.771** with the p-value is 0.000, which is less than standard significance level of 0.01. This indicates that, irrigation projects represented by crop production, irrigation training, and farmer's association impact 77.1% on the farmers' livelihoods used Ngoma22 developed scheme. The results indicate that $R^2 = 0.647$ representing 64.7% change from farmers' livelihoods used Ngoma22 developed scheme come from irrigation projects represented by farmer's association, crop production, and irrigation training. This means that 35.3% of farmers' livelihoods used Ngoma22 developed scheme come from other variables which are not included in this Model of the research.
The results indicated that the F-test= 206.763 and p-value=$0.000^b$. This implies that independent variables are jointly significant. The findings confirmed that there are great impacts of crop production; irrigation training; and farmers' associations in the irrigation projects on the level of farmers' livelihoods Ngoma22 developed scheme at Ngoma District.

**Recommendations**

Awareness of irrigation practices and water management need to be created among farmer. This could be could be improved by delegating responsibilities and enforcing collaboration between Irrigators and the Leader of the Block. This can be done if the landowners and their leader make a rotation schedule of irrigation in such a way one or two farmers could irrigate the whole block, and they rotate on the next irrigation. In this way the farmers in charge of irrigation should make sure that they irrigate according to the rules and the Leader of the block should come in the evening to check if the irrigation has been done accordingly.

Re-use of irrigation water from the field and irrigation canal by WASAC: this will contribute to water saving and minimizing water demands especially in drought period. This water can be treated and supplied for domestic uses. WASAC and SAIP/RSSP as main users of the reservoirs could expand its storage volume. In this enough water can be retained and used when water becomes scarce. Allowing crop rotation: RAB as a research organization could find other crop consuming water which can be growing in season A and rice can be grown in wet season.

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