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IMPACT OF NASHO1 IRRIGATION SCHEME IN MPANGA SECTOR ON SOCIO-ECONOMIC DEVELOPMENT OF THE RURAL COMMUNITY. "CASE STUDY KIREHE DISTRICT, RWANDA"

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ABASTRACT

In adaptation of unpredictability and climate change, irrigation infrastructure is essential. In the research, the impact of MPANGA Nasho1 irrigation scheme on the socioeconomic growth in rural communities in the KIREHE District from 2013 to 2020 were examined. Identifying the relationship between the Nasho1 irrigation scheme and community development was one of the study's main objective, along with evaluating the state of the irrigation system and the social and economic development of the rural community. From 699 beneficiaries, 87 respondents were chosen using the Yamane formula to get sample size. The statistical package for social sciences, excel and a questionnaire were used to gather the data. The results of the study on the socioeconomic impacts of irrigation showed that beans and maize make 100% of irrigated crops. The output ranged from the lowest of 834,216 kg of maize and 211,125 kg of beans in 2016 to the highest of 1,484,401 kg of maize and 441,106 kg of beans in 2019. In 2011–2012 and 2019–2020, the payment of health insurance was, correspondingly, 47.6% and 86.6%. The correlation between the Nasho1 irrigation scheme and community growth was 0.061, which indicates that the scheme has slightly significant effects on farmer livelihood. The Rwandan government suggested reviving a plan to support agriculture in the KIREHE district by using solar energy and center pivot irrigation systems as energy sources instead of grid power.

Keywords: Drought, KIREHE District, Economic Development, Nasho1 Irrigation Scheme.

Contribution/Originality: This paper helped environmental policymakers in Rwanda and other similar countries set adaptation and mitigation measures to deal with the impact of climate change on the efficient use of water and the prevention of such impacts from drought in order to achieve sustainable agriculture.

1. Introduction

Rural areas, which already experience intense poverty, are more dependent on natural resources and agricultural incomes as a source of income, making them particularly vulnerable to climate change-related events like flooding, severe storms, and drought [6]. In order to adapt to climate change and preserve ecosystem services and biodiversity, effective control of water resources and integrated planning of land use are crucial. This includes setting aside territory for agricultural uses that will be tolerant of climatic changes in the future. Water usage, waste water recycling, and water efficiency should be improved in both industrial and residential areas because they play a significant role in lowering water costs and demand [2]. Irrigation infrastructures are dynamic to adapt to changes in rainfall patterns, particularly changes in the seasons.

After the Ruzagayura famine, irrigation was started in Rwanda in 1945 at Karongi (Kibuye), under Belgian colonial authority. After independence, there were attempts by the general public to halt irrigation, which resulted in damage to the irrigation infrastructure. Once more, the Chinese continued their irrigation efforts in Rwanda in 1968. However, prior to 1980, most wetland recovery initiatives focused primarily on drainage rather than irrigation system planning [8]. In 2024, the area under irrigation and its management will increase to 102,284 ha to promote irrigation scheme models in Rwanda [14].

Economic returns on irrigation investments would frequently be better if the command area were utilized for higher-value horticulture as opposed to food staples [12]. In the Kirehe District, 600ha were covered by the irrigation plan. Raising crop productivity is one way to combat hunger brought on by drought and water scarcity. However, doing so frequently suspends drought events in eastern province, which reduces agricultural output and increases poverty and food insecurity [5]. Between 20 and 150 t/ha of soil was lost due to disasters like erosion, degrading soil, floods, and drought. In the east, which included the Kirehe district, and in the southern parts, drought that resulted in decreased feed and water availability and poor access predominated, which caused production loss [12].

In order to maintain agricultural development sustainability, smallholder farmers needed to be given the tools they need to combat climate change and environmental degradation. In Rwanda, sustainable agriculture and agricultural intensification are not only essential but also a necessity for agriculture [12]. So, the irrigation system offers to increase Rwanda's agricultural output [9]. Most of the labor population in Kirehe's economy district is employed in agriculture and livestock production [3]. The objective of the research was to evaluate how the Nasho1 irrigation system impacted the socio-economic growth of the rural community in the Mpanga sector of the Kirehe District.

2. Material and Method

2.1 Description of study area

One of the four regions that make up Rwanda is the eastern province. Between latitude 1°45'00" and longitude 3°30'00" is where it is located. In addition, more than 80% of the people in the eastern province are engaged in agriculture, with the main crops being cereals, grains, horticultural crops, and cattle raising [13]. It is distinguished by an annual rainfall range of 827mm to 1200mm that is split into two seasons. KIREHE district is situated 133 kilometers from Kigali, the country's capital, in the eastern region of Rwanda. with 1,118.5 km2 of land area and 401,575 inhabitants [10]. There are 612 administrative communities and 12 sectors in the KIREHE district. the same the same as the same. the same. the same. the same. the same. the same. the same. the same. the same. the same. the same. the same. the same. The KIREHE district borders the NGOMA district in the west and the KAYONZA district in the north [10].

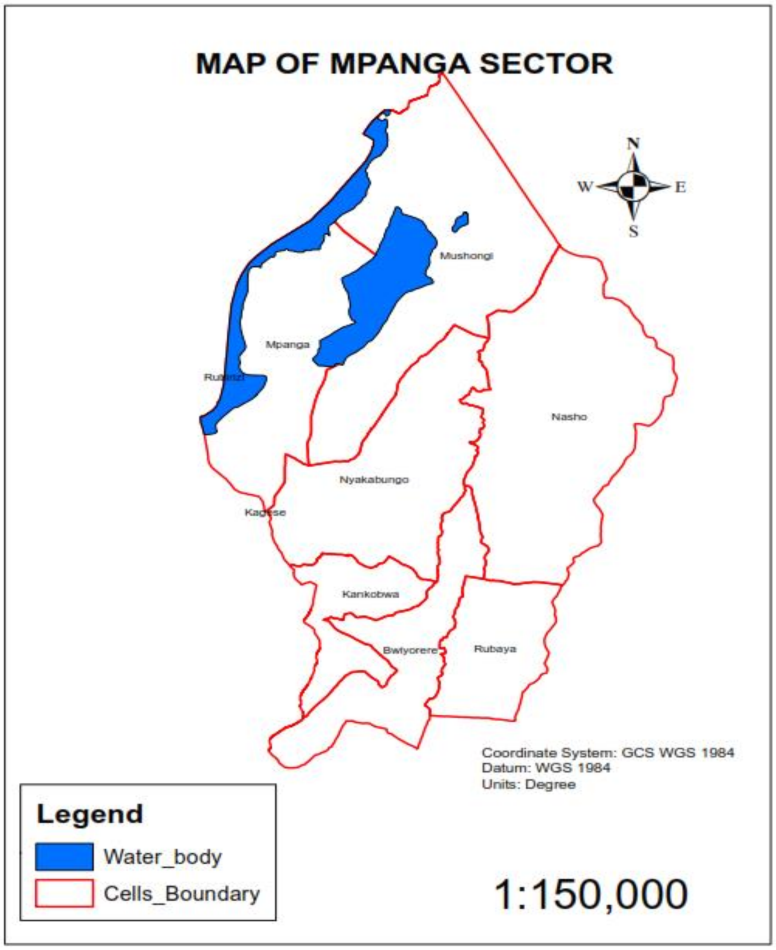

Fig.1. Illustrated Dams location in Kirehe District, Mpanga sector (source author).

2.2 Data collection and Analysis

Due to the fact that the Nasho1 irrigation scheme project (GFI Mpanga) began in 2013, the scope of this study spanned a period of seven years beginning in 2013. Some farmers in the area continued to use their regional irrigation networks. Therefore, the researcher decided to compare the economic growth and crop output of households receiving project benefits from 2013 to 2020. According to three pumping stations with 669 farmers, 362 farmers are members of a cooperative called COVAMIS, which is made up of 243 men and 119 women. These farmers have land in an irrigation system and profit from the rotation of maize and beans.

Since the study used both main and secondary data, it used both quantitative and qualitative research methodologies. 669 farmers from the Nasho1 Irrigation Scheme (GFI MPANGA), who are the program's recipients, were recruited for this study. (GFI MPANGA). The Yamane formula was applied to the 87 representatives of beneficiaries in order to more effectively choose a group of farmers. The stratified sampling method used to divide the population's constituent parts into minute groups (strata) according to how alike they were. The information was gathered using a questionnaire and in-person interviews in the Mpanga Sector. Excel and the SPSS 20 software utility were used for the analysis, which included correlation analysis and percentage calculations. The results were presented in a tabular and graphical ways.

3. The Results

3.2 The status of Nasho1 irrigation scheme (GFI Mpanga)

The section's findings linked to the various irrigation systems used in the Nasho1 irrigation plan and the associated elements that may have an impact on crop production. The project takes up 600 ha in Mushongi and Mpanga cell in Mpanga region of Kirehe. Three pumping stations, two 2000 m3 reservoirs, and a sprinkler irrigation system make up the Nasho 1 irrigation scheme. The irrigation scheme is split into three lots. (lot1, lot2, lot3) the agricultural land area in Kirehe District is 85%, with 85% of the people employed in agriculture. The main crops produced there include beans on 36,736 ha, maize on 26,272 ha, vegetables on 1405 ha, soybeans on 800 ha, and rice on 816 ha. The three (3) cropping seasons in this region are designated as season A, season B, and season C [10].

Fig.1. Demonstrates irrigation reservoir (a), sprinklers system (b) and farmers challenges in daily practices (c and d). source: author.

3.3. Level of crops productivity in Nasho1 irrigation scheme

3.3.1. Maize productivity variation

The study's findings are represented in Fig.3, where the lowest and highest harvests, 1986.23kg/ha and 3534.29kg/ha, respectively, demonstrated that maize productivity levels at all picking levels did not fall within the range of 2500kg/ha to 5000kg/ha predicted by the agricultural agenda. The average trend line demonstrated that maize yield tends to rise over time, from 3272.3 kg per ha to 3303.5 kg per ha, demonstrating that management of the irrigation scheme had a beneficial effect on maize productivity.

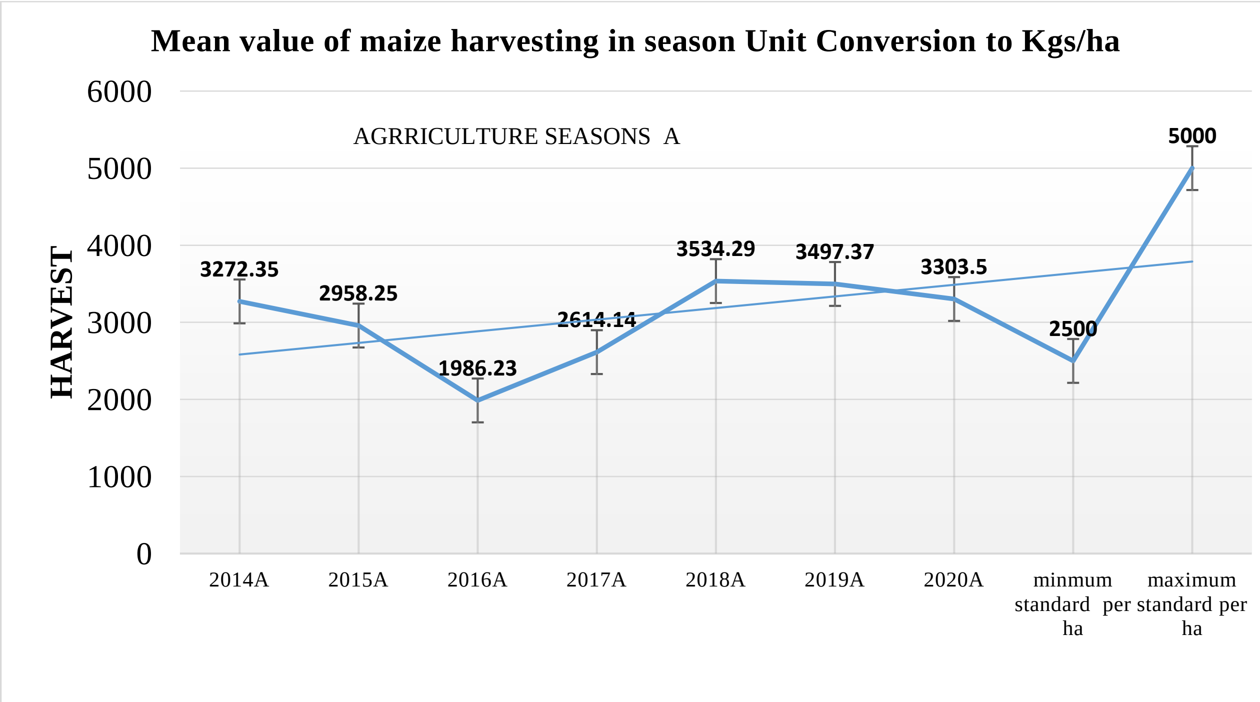

Fig.2. The maize harvesting in season Unit Conversion to Kgs/ha, source: author.

3.3.2. Beans productivity variation

The study's findings are depicted in Fig.4; the lowest and greatest yields were 502.68 kg and 1050.25 kg per ha, respectively, and none of the bean productivity levels were in the range of 700 kg to 1200 kg as predicted by the agricultural agenda. Leguminous crops are used in crop rotation farming methods to improve soil fertility while ignoring the local socio-economic and biophysical contexts, mainly to meet the needs of export crop production and create irrigation systems with donor support [15]. The harvested amounts for 2015B, 2017B, 2018B, and 2019B were within the range that was anticipated by the agricultural plan. However, productivity in the years 2013B, 2014B, 2016B, and 2020B fell short of anticipated average levels. The average trend line demonstrated that bean output tends to rise over the course of years, from 672.76 kg to 1050.25 kg, demonstrating that irrigation scheme management had a beneficial effect on bean productivity.

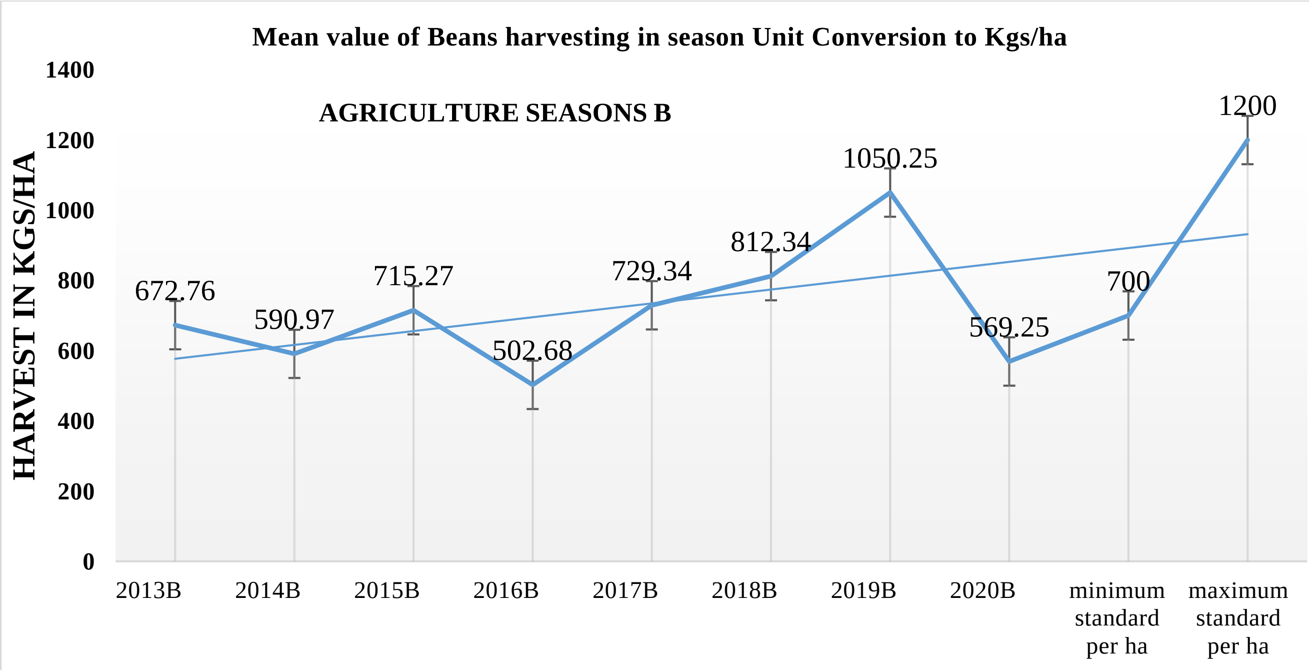

Fig.3. Beans harvesting in season Unit Conversion to Kgs/ha; source: author.

The findings in Tab.1; demonstrated the productivity of the Nasho1 crops prior to the promotion of the irrigation scheme and the productivity under the irrigation scheme. For instance, Tab.1; shows that before the irrigation scheme, bean production was 450 kg per hectare and increased to 1,050 kg per hectare. In a similar, the production rose from 1,120 Kg per hectare to 1,500 Kg per hectare of maize. Farmers used a mix-cropping method before using irrigation systems. This illustrates how the irrigation plan boosted crop output.

Tab. 1. Crop production of project beneficiaries

Crop name	Crop productivity (kg/ha)	
	Before irrigation	After irrigation
Maize	800	3,500
Beans	450	1,050

Source: KIREHE district annual reports of COVAMUS 2021-2022.

3.4.2: Community socio-economic development

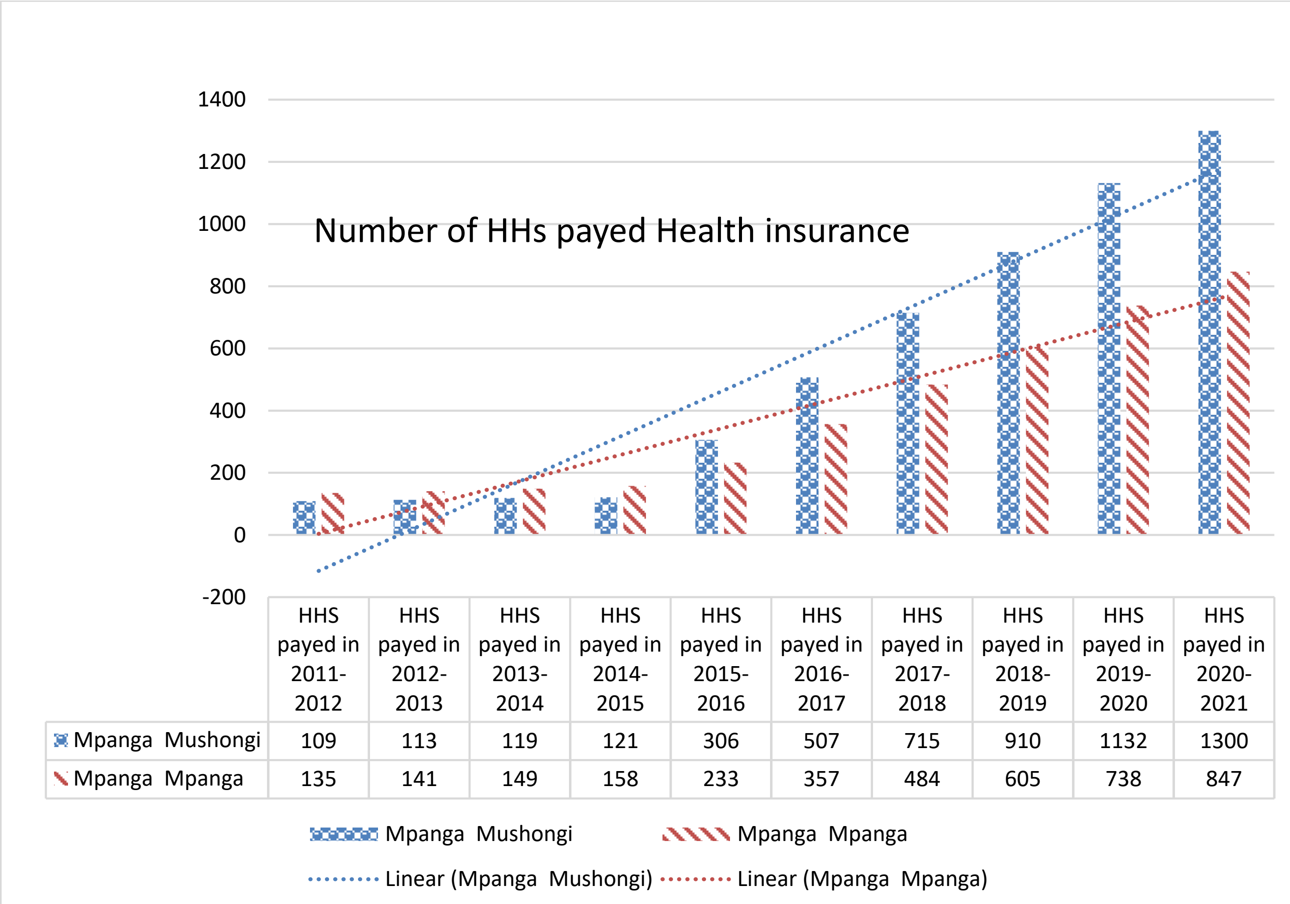

Figure 4. Proof of social development (Payment of health insurance before and after Nasho 1 irrigation scheme). Source: RSSB (Rwanda social security board)

Figure 5 depicts the farmers in the Mpanga sector, Mushongi and Mpanga cell, which are covered by the Nasho1 irrigation scheme, and shows that in 2011–2012, their contribution of health insurance prior to the irrigation scheme was very low at 47.6%. However, following the start of the irrigation program, the amount paid for health insurance increased, as shown in the years 2012–2013 with a rate of 48.7%, 2014–2015 with a rate of 46.73%, 2015–2016 with a rate of 52.43%, 2016–2017 with a rate of 59.58, in 2017–2018 with a rate of 61.58, in 2018–2019 with a rate of 76.43, and in 2019–2020 with a rate of 86.93%.

3.5. The relationship between the Nasho1 irrigation scheme and community development.

As mentioned in the methodology section, the researcher used the Pearson Correlation analysis to determine the strength of the link between the Nasho1 irrigation scheme and community development for this part. The researcher was able to accept or reject the suggested study hypotheses based on the findings from table 5. The study in Tab.2; produced a Pearson correlation of 0.061 and a P-Value of 0.00. This states that the Nasho1 irrigation system promoted societal growth.

Irrigation system and community growth have a weakly positive relationship, according to Table 5's Pearson's correlation matrix; at ($r = 0.061$, $p< 0.00$).

Tab.2. Contribution of irrigation project on beneficiaries' economic development

		Nasho1 irrigation scheme benefit your family.	Paying schools of children
Nasho1 irrigation scheme benefit your family.	Pearson Correlation	1	0.061
	Sig. (2-tailed)		0.000
	N	87	87
Paying schools of children	Pearson Correlation	0.061	1
	Sig. (2-tailed)	0.000	
	N	87	87

Source: author

The researcher concluded that the H1: Irrigation scheme and its associated factors add to the economic development of farmers was accepted by this study based on the analysis presented above. However, since the initiative aided in people's economic development, the hypothesis H0: Irrigation and its related factors do not improve the economic development of farmers was rejected.

The Pearson correlation between the Nasho irrigation scheme and community growth is 0.061, indicating a weakly positive correlation between the Nasho irrigation scheme and farmers.

4. Discussion

Irrigation systems can only be effective if operational constraints from water resource management were addressed [11]. The results indicate that the productivity of the maize crop was very high in the Mpanga Sector in seasons A and B 2020 and that all farmers in the irrigation scheme used both organic and chemical fertilizers. However, in season A 2016, the productivity of the maize crop was very low due to the drought, which was reflected in the lower amount of water in the irrigation scheme because of the shifting low number of pipes. The outcome demonstrates once more that productivity for beans in season A 2016 was extremely low due to the drought, and in season B 2020 productivity was low due to water logging and an increase in the water level in Rwampanga Lake as a result of higher rainfall in North Province, which hindered water pumping stations from operating.

Irrigation improved economic conditions through its anticipated financial return, high export commodity prices, and advantageous trade terms [7]. Agribusiness investments increased, and producers developed greater specializations [2]. In this manner, the Mpanga sector's low correlation with community development pointed to an increase in agricultural investment. The irrigation schemes are intricate systems that can only work effectively as a part of a functioning rural economy that is connected to markets, transportation, and information systems and within the parameters of the available water supply [11]. Figure 2 demonstrates that farmers use a shifting system during irrigation because irrigation infrastructures like pipelines, sprinklers, and pumps are very old. This has led to irrigation practices becoming more challenging and less effective.

5. Conclusion

The findings of the research demonstrated that maize productivity increased throughout all of the periods when irrigation systems were used. The expected productivity per ha in agriculture must be between 2500kg and 5000kg, as demonstrated by the range. While the productivity of beans only slightly increased in the first two (2) years, it was anticipated that it would increase between 700kg and 1200kg in the following years. These findings clearly demonstrated the positive impact of the Nasho1 Irrigation Scheme (GFI MPANGA) on crop productivity, specifically on maize productivity as opposed to bean productivity. Whereas the trend line indicated that maize productivity tends to increase over time, going from 3272.3kg to 3303.5kg per ha at the lowest and highest yields, respectively, were 1986.23kg and 3534.29kg per ha. The lowest and greatest harvests for beans were 502.68 kg and 1050.25 kg per ha, respectively, while 700 kg and 1200 kg were anticipated by the agricultural agenda. The average trend line demonstrated that the output of beans increased from 672.76 kg to 1050.25 kg over a period of years.

Correlations in socioeconomic and agricultural development showed that health insurance payments and crop sales had a perfect correlation of 1 (r = 1), as required by leaders' program implementation. Therefore, there was no significant correlation between the sale of crops and other sources of income or government programs in the range of p-value (0.000), indicating that the irrigation scheme had a greater contribution to the Mpanga sector's high selling of crops as basic income than other income sources. (0.05). The farmers' comprehension ability is the issue. The leaders should organize harvest markets, add value to products, and diversify other related economic activities with the involvement of financial institutions in order to increase the capacity of the farmers and citizens in general. This will help fight hunger caused by drought and water shortages and raise crop productivity.

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Conflict of Interest: The authors clarify that they have no competing interests.

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