
Impact of Irrigation Farming Scheme on Farmers' Income: Evidence from Damasak, Borno State, Nigeria.

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Abstract

This study examined the impact of irrigation schemes on farmers' income in Damasak, Mobbar local government area of Borno State. a multi-stage sampling method was used using a sample size of 82 respondents collected through a semi-structured questionnaire administered to randomly chosen farmers. The study employed a paired t-test to compare the mean responses before and after the implementation of the irrigation schemes. The study revealed that the income of farmers involved in the irrigation schemes experienced a significant increase following their participation and the provision of necessary farm inputs. A paired sample t-test was conducted to compare four key crop items from baseline to endline, and the results demonstrated a statistically significant change in all four items. The average production of the crops significantly improved, indicating the positive impact of the irrigation project on farm productivity and income generation for participating farmers. These findings underscore the substantial benefits derived from irrigation schemes, leading to improved livelihoods, increased income levels, and enhanced food security within the study area. The study concludes that irrigation schemes play a crucial role in augmenting household income and ensuring sustainable agricultural development. Therefore, the study recommends the promotion and adoption of irrigation schemes be actively encouraged to foster economic well-being and improve the overall socio-economic conditions of rural communities.

Keywords: Irrigation Schemes, Farmers' Income, Agricultural Productivity, Household Livelihoods.

1. Introduction

Globally, agriculture has a tremendous potential for reducing poverty and creating employment owing it diverse value chain of activities and as such majority of rural dwellers actively engage in the sector. But the sector cannot realize its objectives, without improving the abundance of water resources. This is because agriculture is largely rain-fed, and irrigation water has become a very crucial resources for agricultural output. Historically, East Asia and the Middle East that have succeeded in poverty reduction and have the greatest proportion of irrigated land, as evidenced in many Asian countries, for example, about 35- 40% of cropland in Asia is irrigated and poverty reduction in the 2000s was substantial (Hussain and Hanjra, 2003). Other Asian research findings consistently indicated that irrigation development reduces poverty in rural

areas (Mellor and Desai, 1985; Chambers *et al.*, 1989; Hossain, 1989; Hussain and Hanjra 2003). In Bangladesh and Nepal for example, irrigation has been an effective tool for reducing poverty, increasing cropping intensity, grain production, household incomes, waged labour employment, and livelihood diversification (Angood *et al.*, 2003, 2002; Hussain *et al.*, 2004; Hussain and Hanjra, 2003; Hayati, *et al.*, 2006). Aside from these, there are also stability effects in agricultural production because of reduced reliance on rainfall. Irrigation lowers the variance of yields, output, and employment (Dhawan, 1988). Agriculture is crucial to economic growth: accounting for 4% of global gross domestic product (GDP) and in some least developing countries, it can account for more than 25% of GDP, (World bank, 2022).

Agriculture is the main profession of most of the population living in Sub-Saharan Africa, the greater part of this is rain-fed which is susceptible to drought. The key constraint on further increase in agricultural production is the scarcity of water for agricultural activities. About 85% of Sub-Saharan Africa's poor live in the rural areas and depend largely on agriculture for their livelihoods (FAO, 2022). Yet agriculture in the region remains largely subsistence, production has not kept pace with population growth, and food self-sufficiency has declined.

The occurrence of erratic rainfall has created uncertainty for agricultural production and emphasizes the need for irrigation. Irrigated agriculture in Africa is under renewed attention concerning food security and poverty reduction. It is widely acknowledged to play a major role in improving productivity, reducing poverty, and sustaining rural livelihoods (Hussain and Hanjra, 2004). It enables households to generate more income, increase their resilience and, in some cases, transform their livelihoods (Tucker *et.al.*, 2010). Irrigation contributes to agricultural growth and reduces poverty directly by permitting intensification and diversification, hence increased outputs, and incomes, also increasing agricultural wage employment; and reducing local food prices.

In Nigeria, the agricultural sector experienced a growth of 3.16% (year-on-year) in real terms during the first quarter of 2022, marking an increase of 0.88% points compared to the corresponding period in 2021. Additionally, it saw a decrease of 0.42% points from the preceding quarter, which had a growth rate of 3.58%. Despite these fluctuations, the sector contributed 22.36% to the overall GDP in real terms during Q1 2022. This contribution was higher than that of the first quarter of 2021 but lower than the fourth quarter of 2021, which stood at 22.35% and 26.84%, respectively. Crop Production continued to be the primary driver of the agricultural sector, accounting for 92.05% of the sector's overall nominal growth in the first quarter of 2022 (NBS, 2022).

Agricultural activities play vital roles through employment generation, poverty reduction, food security, and enhancing the standard of living by increasing the income levels of the rural population. The economy of North-Eastern Nigeria is based largely on agriculture with about 70% of the population engaged in agricultural production. Agriculture in this region is beset with a single and erratic rainfall pattern which leads to a poor yield of crops. A progressive decline in the average level of rainfall has been observed (FAO, 2018). Overall, 28.9 percent of households across Borno, Adamawa, and Yobe States were food insecure and 3.1 percent of these households were severely food insecure, (FAO, 2018). This represents an increase of 2.4 percent in the prevalence of food insecurity compared to February 2019. 36.4% of IDP camp residents of Borno State were food insecure, 3.4% of which were experiencing severe food insecurity. Hence, the development of irrigation system is crucial for sustainable agricultural production and for enhancing the resilience of rural communities' post crisis in the region. It is against this backdrop that the study seeks to examine the impact if irrigation scheme on farmers income in Damasak, Mobbar local government area of Borno State, Nigeria.

The Non-International Armed Conflict (NIAC) involving the Boko Haram have led to massive displacement and loss of means of livelihood. Limited access to farmlands, financial inability, loss of productive assets, unavailability of improved seeds and other farming inputs

as well as shortage of irrigation sources and water. All these are factors affecting farmers' agricultural production and accordingly their achieved income, the latter is not enough to cover the essential needs of many farmers. Hence, farmers developed some coping mechanisms such as selling essential household items and farming assets, take children out of schools to find job, reduce meals per day and also taking additional risky jobs to cope with this situation. It has contributed to the deteriorating food security situation and the diverse situations on the ground concerning access, duration of the presence of Boko Haram's dynamics of displacement, etc.

The situation continues to evolve with new areas progressively accessible. In these areas, the humanitarian situation is reported to be extremely serious after ten years of missed harvests and seed security is at a minimum. Improved security has encouraged some farmers to return to their farmlands for the first time in five to ten years. Host communities, where possible, are providing IDPs with access to land. However, the lack of agricultural inputs and irrigation schemes represents a major constraint for many farmers. Without support, they will continue to rely on prolonged and expensive humanitarian assistance to meet their food needs and thus make them dwell in poverty permanently.

Borno is largely dependent on agriculture, a practice which 70% of the population engages in for their livelihoods, thus contributing to about 65% of household income (FAO, 2016).

In connection to this, an irrigation-led strategy has become paramount for regions where rainfall shortage is the most severe. In addition to assessing the effectiveness of irrigation investments, numerous empirical studies have faced challenges in adequately determining the impact of irrigation on household income, livelihoods, and poverty reduction. The major justification for this is to improve utilization of water resources, improve food security, reduce rural poverty, improve rural livelihoods, and stimulate the local economy in general. It is expected that farmers' involvement in irrigation schemes will ensure the production of food all year-round, improve their income, livelihoods and reduce poverty and migration. However, the region still shows higher levels of poverty, unemployment, food insecurity. Living standards, literacy levels, health, and nutritional status are all extremely low and well below the national average, (FAO, 2019). By extension, this has left questions into the minds of many as to whether irrigation has any impacts on household income and livelihoods.

Several studies for example (Isma'il *et al.*, 2014; Bernard, 2012; Leta *et al.*, 2018 and Abdoul-Aziz & Ilkay 2022) on the impact of irrigation scheme on farmers income and livelihood. None of these studies was conducted in Damasak, hence there exists a knowledge gap on the impact of irrigation schemes on farmers' income in Damasak ward of Mobbar LGA of Borno State which this study seeks to fill.

2. Literature Review

2.1 Conceptual Review

Irrigation: Irrigation is the supply of water to crops by artificial means, designed to permit farming in arid regions and to offset the effect of drought in the semi-arid region (FAO, 1997). Similarly, Mutsvangwa and Doranalli, (2006) defined irrigation as the cultivation of land through the artificial application of water to ensure double cropping as well as a steady supply of water in areas where rainfall is unreliable. Irrigation water is applied to ensure that soil moisture is enough to meet crop water needs and thus reduce water deficit as a limiting factor in plant growth (Van Oudenhoven *et al.*, 2018). Irrigation is generally defined as the application of water to the land to supply moisture essential to plant growth. Irrigation is intended to augment the water supply from rainfall.

More so, irrigation is the artificial application of water to the soil through various systems of tubes, pumps, and sprays. Irrigation is usually used in areas where rainfall is irregular or dry times of drought are expected. There are many types of irrigation systems, in which water is supplied to the entire field uniformly. Irrigation water can come from groundwater, through

springs or wells, surface water, through rivers, lakes, or reservoirs, or even other sources, such as treated wastewater or desalinated water.

Irrigation Scheme: Irrigation scheme means a planned and organized system for supplying water to agricultural lands to support crop growth. It typically involves the construction of canals, pipelines, or other infrastructure to deliver water from a water source (such as a river, lake, or reservoir) to the fields. Irrigation schemes aim to efficiently manage water resources, enhance crop yields, and sustain agriculture in regions with insufficient or irregular rainfall.

Farmers Income: Farmers' income refers to profits and losses that are incurred by a farmer through the operation of a farm or agricultural business. A farm income statement (sometimes called a farm profit and loss statement) is a summary of income and expenses that occurred during a specified accounting period. This period is usually the calendar year for farmers (January - December).

Farm income, in the context of agricultural business operations, represents the financial proceeds generated. It is important to note that for tax purposes, farm income is treated differently compared to non-farm income. In terms of categorization, farm income can be further divided into the following classifications:

- i. Gross Cash Income: the sum of all receipts from the sale of crops, livestock and farm-related goods and services, as well as any direct payments from the government.
- ii. Gross Farm Income: the same as gross cash income with the addition of non-money income, such as the value of home consumption of self-produced food.
- iii. Net Cash Income: the gross cash income less all cash expenses, such as for feed, seed, fertilizer, property taxes, interest on debt, wages, contract labor and rent to non-operator landlords.
- iv. Net Farm Income: the gross farm income fewer cash expenses and non-cash expenses, such as capital consumption and farm household expenses.
- v. Net Cash Income: a short-term measure of cash flow.

2.2 Theoretical Framework

Agricultural Transformation Theory

The Agricultural Transformation Theory serves as a theoretical framework to examine the impact of irrigation schemes on rural farmers' income. This theory posits that the adoption of irrigation systems in agricultural practices can bring about transformative effects on productivity and ultimately contribute to income improvement among rural farmers. By providing reliable access to water resources, irrigation facilitates the cultivation of crops throughout the year, mitigating the risk of drought or inadequate rainfall. This, in turn, increases crop yields and enhances overall agricultural productivity. Furthermore, the integration of advanced irrigation technologies and improved farming practices can optimize resource utilization, reduce post-harvest losses, and enhance agricultural efficiency. These factors collectively contribute to the growth of farmers' income and socioeconomic well-being. The Agricultural Transformation Theory thus emphasizes the pivotal role of irrigation in stimulating agricultural development and enhancing rural farmers' income.

Sustainable Livelihoods Framework

The Sustainable Livelihoods Framework offers a comprehensive perspective for analyzing the impact of irrigation schemes on rural farmers' income. This framework recognizes the multidimensional nature of rural livelihoods and how access to irrigation infrastructure can shape various livelihood assets. The framework encompasses the five key livelihood assets: natural, physical, financial, human, and social capital. Firstly, irrigation schemes provide reliable access to water, a crucial natural capital, enabling farmers to expand their crop production and diversify their income sources. Secondly, the physical capital in the form of

irrigation infrastructure, such as canals, pumps, and water storage facilities, enhances farmers' ability to effectively utilize water resources. Financial capital is augmented through increased income generated from enhanced productivity and market opportunities arising from irrigation. Human capital is developed as farmers acquire new skills and knowledge related to irrigation techniques and management. Lastly, social capital is fostered through collective action, collaboration, and shared learning among farmers participating in irrigation schemes. By considering these various livelihood assets and their interactions, the Sustainable Livelihoods Framework enables a comprehensive assessment of the impact of irrigation schemes on rural farmers' income and overall well-being.

2.3 Empirical Review

The Impact of Irrigation Schemes on Livelihoods

According to Burrow (1987), irrigation schemes have proven to be a viable and attractive option for rural farmers in developing countries. He further asserted that returns from irrigated farming even on tiny plots could greatly exceed returns from rain-fed production. In many developing countries, irrigation schemes were counted on to increase production, reduce unpredictable rainfall and provide food security and employment to poor farmers. GorCornist (1999) stated that some of the irrigation schemes have been discovered primarily for income-generating. It enables farmers to earn an income that enables them to meet some of their basic needs. According to Kundlande, *et al.* (1994), food production from irrigated farms is a major source of wealth creation to the extent that it is the basis for economic growth in several localities.

Irrigation developments have made it possible for other rural infrastructure to be developed in areas that could otherwise have remained without roads, telephones, schools, and clinics. Furthermore, irrigated agriculture is an essential component of any strategy to increase the global food supply. It resulted in lower food prices, higher employment, and more rapid agricultural and economic development. Chitsiko (1999), also argues that irrigation schemes are important in augmenting government policy of reducing rural to urban migration. He noted that irrigation schemes provide a source of self-reliance, livelihoods, and income to some young children who did not intend to move to town. These schemes helped in reducing rural-urban migration by offering the rural population an alternative source of employment and income. Food security is likely to increase in households practicing irrigation farming. Chenje *et al.*, (1998), state that irrigation aims to increase crop production and grow crops in areas where such an activity would normally be impossible due to lack of water.

Irrigation schemes are viewed as a substitute for costly disaster relief by the governments. According to (Kadzombe *et al.*, 1973) instead of importing food relief at a higher cost, farmers are assured of a constant source of food and income by establishing irrigation schemes.

On the other hand, Olaniran *et al* (2019) Assess how irrigation system has impacted on crop production and socioeconomic lives of farmer in Lagos using primary data. The result revealed that most of the farmers (75.53%) were male while the remaining 20.45% were female. The result also showed that all the respondents have at least primary education. Majority of the respondents in the study area agreed that irrigation system has increase their cultivated land for crop production, increased their yields, reduced stress in crop production, extend production period and improve their income. However, farmer's norm and value, little or no training and capital are the major challenges towards effective irrigation usage in the area under study.

Isma'il *et al* (2014) conduct a study to determine the socioeconomic impact of the irrigation scheme on farming community in Dakaci, Zaria Area of Kaduna State. The study used data acquired from questionnaire survey, interviews and other secondary sources. Descriptive statistics were used to analyse the data. The result revealed that irrigation scheme largely boosted crop yields and agricultural production in the area thereby improving the

socioeconomic status of the farmers. Moreover, Graciana (2011) assess the impact of improved access and use of irrigation schemes on livelihoods and food security. The study used questionnaire to solicit information from four purposefully sampled communities on: crops grown and irrigated; output, disposal; status of food security; sources and means used to secure food. Comparisons between situations before and after water schemes and between irrigation schemes was conducted. Results show that when irrigation schemes are focused at household level and to the fields around the home, they contribute to income generation and food security. The result further reveals that majority of the farmers (71.8%) irrigated their maize and other food crops, vegetables and fruits. Highest proportions of the food insecure were in communities where irrigation scheme was not focused on household level.

Similarly, Bernard (2012) assesses the impact of small-scale irrigation scheme on the people's livelihoods in Panganai Communal area. Both quantitative and qualitative methodologies were used in the investigation of the impact of the scheme on rural livelihoods. A sample of fifty respondents out of a total of two hundred plot holders was selected using random sampling. interviews, questionnaires and observation in collecting the data. Descriptive statistics was used for the analysis. The Results show that the irrigation scheme create employment, income generation, supply water throughout the year, acquisition of assets such as scotch carts and livestock by farmers and school fees generation by the community. The study found that yields produced have not yet addressed the food security situation of plot holders. This could be attributed to prohibitive water pricing and transport costs which negatively affected their desire to produce at maximum capacity.

Balarane & Oladele (2014) Determine the impact of irrigation farming on livelihood strategies among smallholder farmers in the North West Province, South Africa. Simple random sampling techniques were used to select 66 male farmers from the population of the study and data was collected using a structured questionnaire and subjected to analysis using frequencies, percentage and multiple regression analysis. The results showed that about 9% of the respondents were below the age of 40 years. While 65% of the respondents were above the age of 50 years. The result also showed that 3% of the respondents are divorced while 71.2% were still married. The results showed that only 7.6% of the irrigation land is privately owned and 92.4% belongs to the chief. About 54.5% of respondents survive from government grants and 22.7% survive from seasonal jobs. About 53% of the farmers indicated that they are involved in irrigation farming, only because the existing irrigation schemes is their only source of income. While about 47% of the farmers are in the irrigation farming for personal interest. Farmers showed that they have adequate access to livelihood aspiration such as physical capital, human capital, natural capital and skill training but access to financial capital, which includes credit from the banks, cooperative and government subsidies is not adequate. Significant determinants of livelihood strategies of farmers were marital status (2.43), size of household ($t = 5.41$), nonfarm activity ($t = 1.73$) and income ($t = 6.59$).

Irrigation Impact on Household Income

Irrigation water is a critical production input in agriculture. Irrigation directly impacts household incomes by increasing farm revenues. There are two ways through which irrigation increases farm revenues. Firstly, it increases annual revenue per acre of land through its direct positive effect on total crop production in a given cropping season. Irrigation enhances the use of agricultural inputs (such as fertilizer and high-yielding varieties), which, in turn, improves the productivity of land (Gebregziabher *et al.*, 2009). Moreover, irrigation water reduces crop yield variability, hence stabilizing household incomes (Tyler, 2007; Namara *et al.*, 2008). This induces the possibility of double cropping. Irrigation benefits the landless through higher wages as it results in higher marketed surpluses and increased jobs opportunities (Jin *et al.*, 2012).

Moreover, irrigation benefits the poor as it may lead to lower food prices since they spend a disproportionately large share of their income on food.

In a separate assessment, Zhang *et al* (2021) investigated the management and services of irrigation scheme and analysed its contribution to poverty reduction of smallholder rice farmers and community development in Tanzania through quantitative and qualitative methods. The results showed that the scheme helped smallholder farmers increase the rice production and brought better market opportunities. The farmers' net income was also increased. The result further show that Profit generated from rice farming not only improved the livelihoods of smallholder farmers but also created more employment opportunities in the rural communities. The study also revealed that the scheme was faced with several challenges due to resource and institutional constraints and low-level human capacity for both management and members.

Moreover, Dauda *et al* (2009) conducted a study to assess the income generating potential of irrigation farming which may reduce poverty and hunger and directly achieve an important aspect of the Millennium Development Goals in Nigeria. Primary data were collected from a sample of four hundred and fifty Fadama (irrigation) farmers. The results show that irrigation farming is a profitable venture because farmers realized an average net income (profit) of N109, 750 from irrigation farming. Furthermore, irrigation farming was found to be capable of alleviating poverty among farming households because they were able to live above US \$1/day/person which is the threshold for poverty level. The result from the Ordinary Least Square (OLS) regression further reveals that farm size, years of irrigation experience, seed, labour and fertilizer were found to have significant effects on profit realized from irrigation farming. Major crops grown are vegetables (such as Okra, *Chocorus olitorus*, *Telferia spp* and *Amaranthus*) in the study area.

Abdoul-Aziz & Ilkay (2022) analyses the economic and social impact of small-scale irrigation investment in the reduction of poverty in the municipality of Dabaga in Niger republic. 174 farmers were randomly selected and were classified into two categories according to the main cultivated culture. Descriptive statistics and econometric correlation tests (Pearson method) were used for data analysis. The result show that irrigated agriculture, which is of semi-intensive type, is dominated by the practice of polyculture. It involves the entire surveyed population, which had a negative cereal balance sheet but provides, for 82.18% of the farmers, a satisfactory net monetary income, above the country's monetary poverty line.

Leta *et al* (2018) Assess the impact of small-scale irrigation use on household farm income and asset holding. Primary data were collected from randomly selected 93 irrigation user households and 103 nonuser households drawn based on proportion to population size. Secondary data were collected from review of relevant related literatures. Both descriptive statistics and econometric model were used for analyzing quantitative data of the study. Twelve variables were hypothesized that determine households' probability of participation in irrigation use and seven of them were found significant. The study has found that age, educational level, contact frequency with agricultural development agent, credit access, access to mass media, participation in irrigation related training and livestock ownership were the variables that significantly influence households' use of small-scale irrigation. The result of PSM analysis indicate that participation in irrigation use has increased annual household farm income by 19,474.8 ETB for participant households than non-participant households which is significant at 1% level. Similarly, it has increased their physical asset holding which is measured in Ethiopian birr valued 27,502 ETB at 1% statistically significance level. The sensitivity analysis result showed that the impact results estimated by this study were in sensitive to unobserved selection bias. The study concludes that irrigation has positive and significant impact on annual farm income and asset holding of the rural farming households.

3. Methodology

The study utilized descriptive survey research design. Primary data were collected from the respondents using structured questionnaires and focus group discussions. The target population were purposely selected because they constitute small holders' farmers that engages in irrigation farming of some perishable commodities such as pepper, water melon, tomatoes and onion. A sample size of eighty two respondents out of a total of two hundred plot holders was selected using random sampling. To distribute the questionnaire without issues or biasness simple random sampling was employed. The questionnaire was structured into parts which captures the socio-economic characteristics as well as the topical section.

In order to analyze the data obtained, simple tables, percentages, frequency, pie-chart was used in presenting the data whereas Paired T-Test was employed to compare means between the crop production before and after the irrigation. This analytical approach is appropriate for paired designs where two sets of measurements are dependent and correlated. The paired t-test offers greater statistical power and consistency compared to a two-sample t-test (Hsu and Lachenbruch, 2007).

The mean difference between the "baseline" and "endline" values of the outcome indicators was calculated for each crop, allowing the researcher to quantify the program's impact on variables such as vegetable area (in square meters), production (in kilograms), quantity sold (in kilograms), income (in NGN), and the number of crops grown. To ensure the robustness of the statistical analysis, certain variables were transformed to achieve a normal distribution, as the paired t-test assumes normality of the differences between pairs.

It is worth noting that the paired t-test is not highly sensitive to deviations from normality unless such deviations are pronounced. Hence, any deviations from normality were assessed to ensure they did not undermine the validity of the results. Regarding the income variable, it was decided to focus solely on cash income derived from sales expressed as a percentage. This decision was made to mitigate potential measurement inaccuracies associated with imputing values for consumed products. To facilitate comparability, the nominal income from percentage sales was subsequently converted into real monetary income, ensuring consistency and meaningful interpretation of the income measures.

4. Results and Discussions

Socio-economic and Demographic Characteristics of Respondents (n = 82)

Age of Respondents

The ages of the household heads of the sampled respondents from the survey ranged between 18-59 and 60 years and above. There is no significant difference in the distribution of household head age of the sampled respondents between irrigating farmers from both communities, suggesting age has very little influence on the participation decision. This is attributable to the fact that both groups belong to the same population and the variable in question does not lend itself to change based on irrigation participation or otherwise.

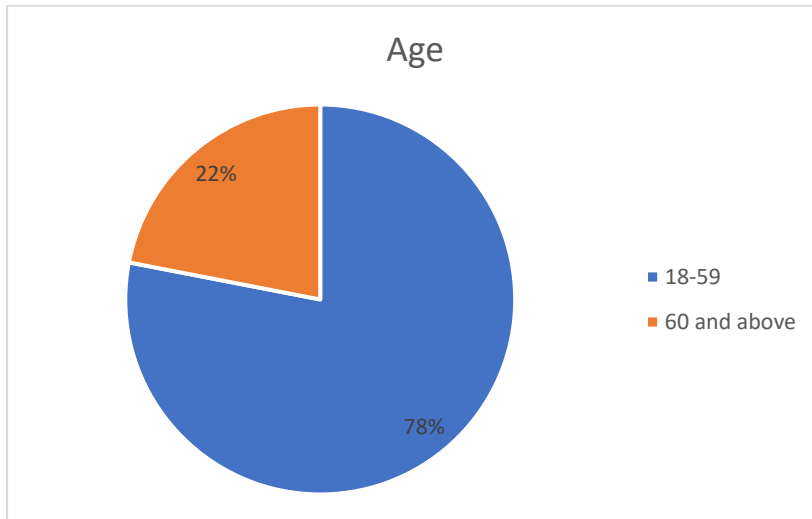


Figure 4.1 Age of Respondents
Source: Own computation, 2023.

Gender of Respondents

Gender of the household head is an important variable influencing participation decision in irrigation decision making. In total majority of the respondents (77%) were male with (23%) being female. Discussion with sample respondents revealed that male headed households hardly faced labor shortage for irrigation due to physical, technological, and socio-cultural fitness to males than females. Women only provided labour, especially during harvesting and other off- farm activities to supplement household income. single or separated/divorced. The major occupation of the household heads in the study area was found to be farming constituting.

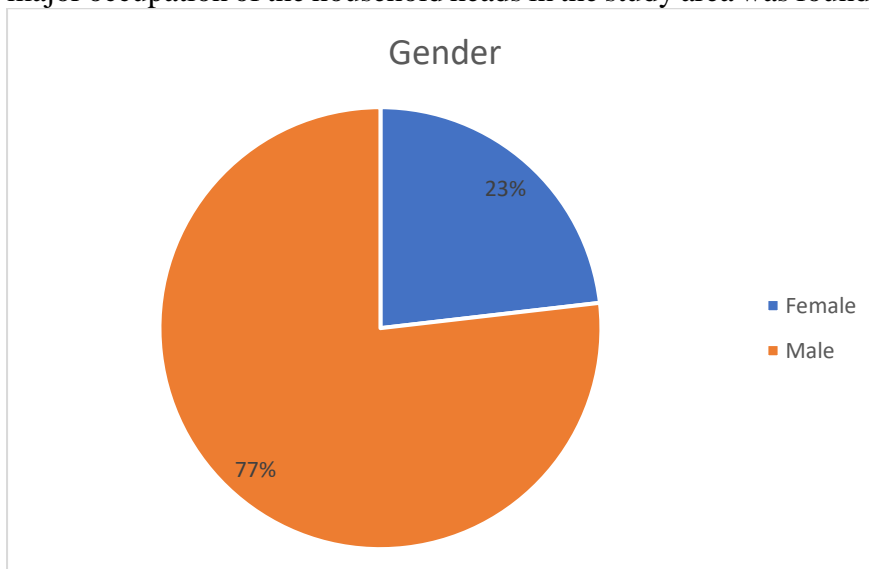


Figure 4.2 Gender of Respondents
Source: Own computation, 2023.

Occupation

Approximately 45% of the respondents are involved in agricultural activities, cultivating crops and tending to livestock. This occupation reflects the significance of agriculture as a primary source of livelihood in the region. Around 30% of the population engaged in trading and commercial activities, contributing to local markets and economic exchange. Additionally, 10% of the respondents hold positions in government employment, serving in administrative roles and public service. Artisans and skilled laborers make up another 10% of the workforce,

providing specialized services such as carpentry, masonry, and blacksmithing. The remaining 5% are involved in a diverse range of occupations, including transportation, hospitality, and other small-scale businesses

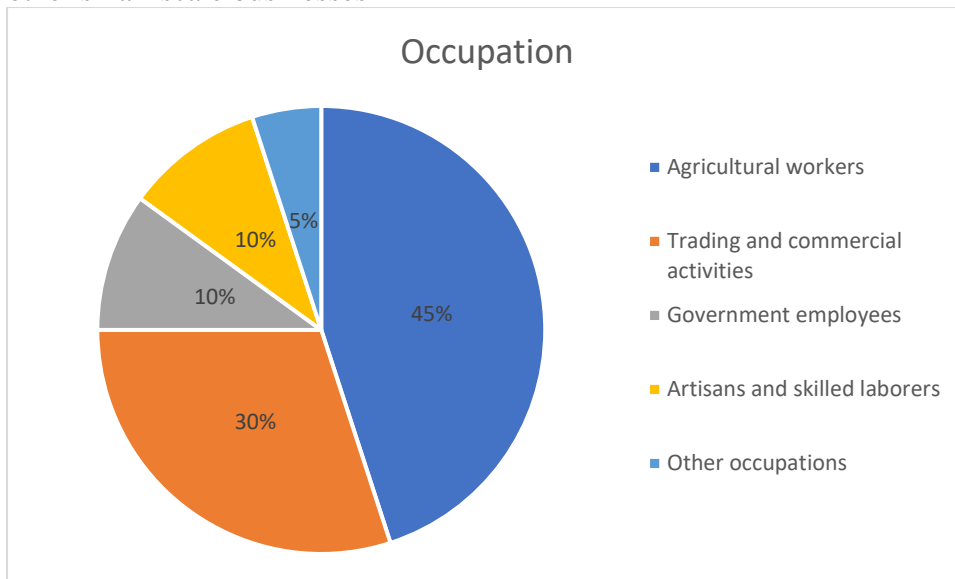


Figure 4.3 Occupation of Respondents

Source: Own computation, 2023.

Education

Approximately 40% of the respondents have not received formal education, indicating a significant proportion of the population with limited access to schooling. However, efforts are being made to increase literacy rates and educational opportunities. Around 35% of the respondents have completed primary education, providing them with foundational knowledge and basic literacy skills. Approximately 20% have attained secondary education, equipping them with a broader range of academic knowledge and skills. A minority of 5% have pursued tertiary education, representing individuals who have undergone higher education at universities or vocational institutions.

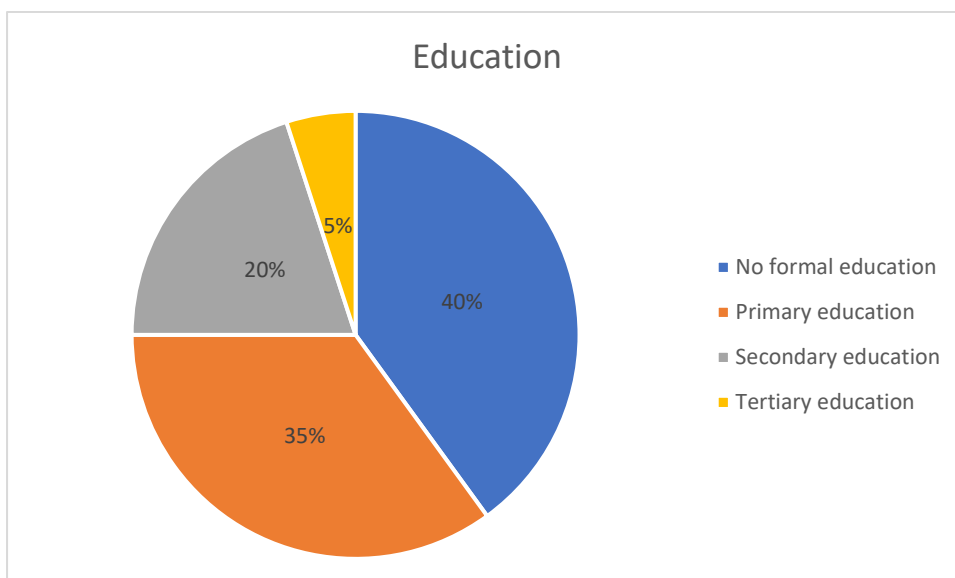


Figure 4.4 Education of Respondents

Source: Own computation, 2023.

Household Income

The income distribution in Damasak reflects a varied economic landscape. Approximately 60% of households fall within the low-income bracket, earning modest incomes that often pose challenges in meeting basic needs and achieving financial security. These households rely heavily on subsistence farming and informal economic activities. Around 30% of households fall within the middle-income range, earning relatively stable incomes that allow for a reasonable standard of living. These households typically engage in a mix of agricultural and non-agricultural activities, contributing to the local economy. The remaining 10% of households are classified as high-income, indicating a higher level of financial stability and prosperity. These households may have diverse sources of income, including commercial farming, government employment, or successful entrepreneurial ventures.

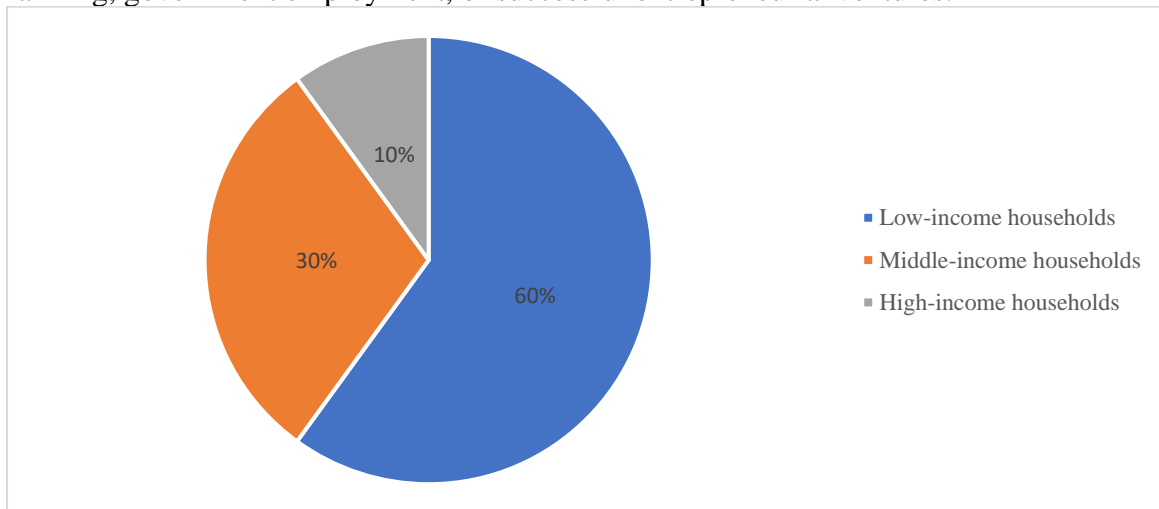


Figure 4.1 Household Income of the Respondents

Source: Authors computation, 2023.

4.2 Nexus between Irrigation Scheme and Farmers Output

Mean Comparison Test of Paired Data (Baseline and End line)

To conduct a paired sample t-test, the researcher calculates the difference between the two measurements (baseline and endline) for each item, and then perform the t-test on these differences. The following table shows the differences and the results of the paired sample t-test:

Table 4.1. Paired t-test comparison of outcome variables before and after intervention.

Item	Baseline (%)	Endline (%)	Difference (%)	t-value	p-value
Pepper-Atarugu	48.06	325.69	277.63	4.81	0.018
Tomatoes	78.25	225.00	146.75	3.28	0.048
Onion	47.75	271.56	223.81	4.51	0.023
Watermelon	26.81	664.25	637.44	7.19	0.004

Source: Authors computation, 2023.

The paired sample t-test results show that all four items had a significant change from baseline to end line, as indicated by the p-values less than 0.05. The t-values indicate the magnitude of the change, with larger t-values indicating larger changes. Therefore, the study concluded that there was a significant difference between the baseline and end line measurements for each of the four items. The p-value is less than the usual alpha level of 0.05, which means the null hypothesis can be rejected and conclude that there is a significant difference between the

average crop production before and after the implementation of the irrigation project in Damasak.

Pepper-Atarugu

The baseline percentage for Pepper-Atarugu cultivation was 48.06%, which significantly increased to 325.69% at the endline assessment. This indicates a substantial difference of 277.63% in the cultivation of Pepper-Atarugu between the baseline and endline periods. The t-value of 4.81 and p-value of 0.018 suggest that this difference is statistically significant, implying a positive and significant impact of the intervention on Pepper-Atarugu production. Translating the result into monetary value between the baseline and endline periods. The baseline value of N3,844.80 per basket rose to N26,055.20 per basket at the endline. This increase in value is statistically significant, indicating a positive impact of the irrigation scheme on the income potential of Pepper-Atarugu farmers in Damasak.

Tomatoes

The baseline percentage for Tomato cultivation was 78.25%, which increased to 225.00% at the endline assessment. This shows a difference of 146.75% in Tomato cultivation between the baseline and endline periods. The t-value of 3.28 and p-value of 0.048 indicate that this difference is statistically significant. In monetary value between the baseline and endline periods. Translating into monetary terms, the baseline value of N9,390.00 per basket increased to N27,000.00 per basket at the endline. Thus, the intervention has had a positive and significant impact on Tomato production.

Onion

The baseline percentage for Onion cultivation was 47.75%, which significantly increased to 271.56% at the endline assessment. This represents a substantial difference of 223.81% in Onion cultivation between the baseline and endline periods. The t-value of 4.51 and p-value of 0.023 suggest that this difference is statistically significant, indicating a positive and significant impact of the intervention on Onion production. In monetary the baseline value of N2,626.25 per basket rose to N14,935.80 per basket at the endline. This increase in value is statistically significant, indicating that the irrigation scheme has positively influenced the income potential of Onion farmers in Damasak.

Watermelon

The baseline percentage for Watermelon cultivation was 26.81%, which experienced a significant increase to 664.25% at the endline assessment. This reflects a substantial difference of 637.44% in Watermelon cultivation between the baseline and endline periods. The t-value of 7.19 and p-value of 0.004 indicate that this difference is statistically significant. Thus, the intervention has had a positive and significant impact on Watermelon production. In monetary value the baseline value of N1,608.60 per basket increased to N39,855.00 per basket at the endline. This increase in value is statistically significant, underscoring the positive impact of the irrigation scheme on the income potential of Watermelon farmers in Damasak.

Consequently, the results indicate significant improvements in the cultivation of Pepper-Atarugu, Tomatoes, Onion, and Watermelon due to irrigation schemes. The substantial differences observed in the endline percentages compared to the baseline percentages, along with the statistically significant t-values and p-values, suggest that the irrigation has positively influenced the production of these vegetables which subsequently resulted to increase in farmers income. This demonstrates the effectiveness of irrigation in promoting agricultural productivity and potentially enhancing farmers' income and livelihoods.

5. Conclusion and Recommendations

The study concluded that irrigation schemes have significantly contributed to the augmentation

of household income and livelihood, leading to enhanced income, improved livelihoods, and ultimately, ensuring food security within the study area. Based on the findings from the study, the following recommendations were suggested as thus: There is need for expansion of irrigated areas (small-scale, medium, and large-scale schemes) by the farmers so as to include more farmers in the irrigation activities as this will result to an increase output as well as income. Secondly, there is need for both financial and technical support from government and non-governmental organization so that these farmers can adopt modern irrigation technologies. Thirdly, farm inputs such as improved seeds and pesticide or insecticides needs to be distributed to this category of farmers as these will significantly improve their production. There is need for proper training on cash management on these rural farmers as these will improve the way and manner, they handle cash from sales and lastly, there is need formulation of farmers' friendly policies especially in the areas of risk management when unforeseen situation occurs.

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