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Examining the Effectiveness of Government Irrigation Schemes in Improving Food Production at House Hold Level: A Case Study of Small-Scale Farmers in Njanse Ward of Choma District

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Abstract

This study explored how government irrigation schemes help small-scale farmers in Njase Ward of Choma District improve household food production. Since most people depend on farming for their livelihood, the research examined how accessible, useful, and sustainable these irrigation systems are. Using both surveys and interviews, the study assessed their impact on crop yields, food security, and farmer wellbeing, while identifying key challenges faced by users. The results aim to guide policymakers in strengthening irrigation programs to support sustainable farming and reduce food insecurity in Zambia's semi-arid areas.

Keywords: Government Irrigation Schemes, Small-Scale Farmers, Household Food Production, and Sustainability of Irrigation Systems

1. Introduction

1.1 Background of the Study

Food security remains a serious global issue, with about 733 million people hungry in 2023. In Sub-Saharan Africa, hunger is worsened by poverty, poor infrastructure, and dependence on rain-fed farming, which is easily affected by droughts. Irrigation offers a solution by improving yields and enabling year-round farming, but less than 6% of farmland in Africa is irrigated due to high costs, insecure land, and weak institutions. In Zambia, where farming employs 70% of the population and contributes 19% to GDP, most agriculture still depends on rainfall. Government programs like the National Irrigation Policy of 2019, S3P, and SIP aim to expand irrigation and support smallholders, including women farmers. However, challenges such as poor water access, limited financing, weak extension services, and insecure land persist, especially in Njase Ward, Choma District. This study examines how government irrigation schemes influence food production and household food security in Njase Ward and proposes ways to improve irrigation management and resilience to climate change.

1.2 Problem Statement

Food insecurity remains a major problem in Zambia, particularly among rural smallholder farmers who depend on rain-fed agriculture. To reduce this, the government has introduced irrigation schemes to boost food production and household food security. However, in Njase Ward of Choma District, many farmers still experience low yields and food shortages. Although irrigation is meant to increase productivity, its effectiveness at the local level is uncertain. Reports from the Ministry of Agriculture (2021) and ZNFU (2020) show that poor maintenance, limited technical support, and weak management reduce the success of these schemes. Continued use of traditional farming methods and climate-related droughts worsen the problem. Therefore, this study aims to assess how effective government irrigation schemes are in improving household food production among small-scale farmers in Njase Ward.

1.3 Specific Objectives

1. To determine the level of accessibility and extent of utilization of government irrigation schemes by small-scale farming

households in Njase Ward of Choma District.
2. To establish the types of government irrigation schemes available in Njase Ward of Choma District.
3. To assess the sustainability of government irrigation schemes in enhancing household food production.

1.4 Research Questions
1. To what extent are government irrigation schemes accessible and utilized by small-scale farming households in Njase Ward of Choma District?
2. What types of government irrigation schemes are available in Njase Ward of Choma District?
3. How sustainable are government irrigation schemes in enhancing household food production?

1.5 Theoretical Framework
This study uses Ajzen's (1991) Theory of Planned Behavior to understand why small-scale farmers in Choma District adopt or reject government irrigation schemes. Farmers' attitudes toward benefits, social influences from peers and leaders, and access to resources shape their decisions. Real-world factors like infrastructure, water supply, and government support also affect adoption. Applying TPB helps explain adoption patterns, impacts on food production, and sustainability challenges, guiding interventions like training and community participation to improve irrigation use and food security.

2. Literature Review
2.1 Accessibility and Utilization of Government Irrigation Schemes
Access to and use of irrigation schemes are vital for improving food production among small-scale farmers in drought-prone areas like Njase Ward in Choma District, Zambia. Irrigation increases crop yields, reduces dependence on rainfall, and strengthens resilience to climate change (Amede, 2017). Although irrigated land accounts for only 20% of global farmland, it produces about 40% of the world's food (FAO, 2021). In Africa, government-led irrigation projects in countries like Malawi, Kenya, and Ethiopia have boosted yields but still face high costs, weak management, and land conflicts (Mati & Mutunga, 2017; Kassie *et al*., 2018). In Zambia, programs such as the Irrigation Development and Support Project (IDSP) and Smallholder Productivity Promotion Programme (S3P) have improved irrigation access, with some Njase farmers successfully growing vegetables and improving food security (GRZ, 2019; Phiri & Chilongo, 2021). However, challenges like poor maintenance, limited technical skills, inadequate extension services, financial constraints, and gender inequality persist (Kalinda, 2021; Mulemba, 2022). To ensure sustainability, irrigation schemes require better farmer training, affordable financing, inclusive participation, and strong institutional support to enhance productivity and build resilience in rural communities.

2.2 Types of Irrigation Schemes and Their Influence on Food Production
Government-supported irrigation schemes in Zambia, including those in Njase Ward, are divided into public-led and community-managed systems. Public-led schemes are large-scale, government-funded projects, while community-managed systems are smaller and locally run. Globally, irrigation produces 40% of the world's food on only 20% of cultivated land (FAO, 2020) and significantly boosts yields, especially through efficient methods like drip and sprinkler irrigation (Tal, 2020). In Africa, irrigation covers less than 10% of farmland but improves food security and incomes in countries such as Kenya, Malawi, and Nigeria. In Zambia, systems like gravity-fed, pump-based, and drip irrigation are promoted through programs such as the Smallholder Irrigation and Promotion Programme (SIP), which provides subsidies and training. These schemes have increased yields by up to 60% and enabled year-round cultivation of maize and vegetables. However, their effectiveness in Njase Ward is limited by poor maintenance, lack of training, unequal access, and water shortages, highlighting the need for improved management, community involvement, and institutional support.

2.3 Sustainability and Operational Challenges of Government Irrigation Schemes
Irrigation schemes in Zambia, especially in Southern and Central Provinces, use gravity-fed, pump-based, and drip systems that improve crop yields and enable year-round farming, but their success depends on water availability, maintenance, and farmer participation. Despite initiatives like the Smallholder Irrigation and Promotion Programme (SIP), challenges such as poor infrastructure, limited training, high costs, and weak institutional support persist. Similar problems across Sub-Saharan Africa, including donor reliance and poor governance, reduce effectiveness (FAO, 2021). In Njase Ward, social inequalities and low community participation further affect performance. Sustainable irrigation requires strong local governance, climate-smart technologies, and better financing. While Zambia's National Irrigation Policy promotes decentralization and private involvement, weak implementation limits results. Evidence from other districts shows initial gains fading due to poor maintenance. This study addresses these gaps by examining how environmental, social, and institutional factors shape sustainable irrigation and food security in Njase Ward.

2.4 Establishing the Research Gap
A major research gap exists regarding how government irrigation schemes function specifically in Njase Ward of Choma District. Most studies focus on broader regional contexts, overlooking Njase's unique climate, farmer characteristics, and institutional factors that may influence irrigation outcomes. There is little evidence on how different types of schemes impact household food production or on their sustainability in terms of governance, technical support, and climate resilience. This study addresses that gap by analyzing the accessibility, types, and sustainability of irrigation schemes in Njase Ward, generating localized data to guide policy and improve scheme design. The research aims to enhance food security and contribute to Zambia's efforts toward sustainable rural agricultural development.

3. Research Methodology
3.1 Research Design
The study adopted a case study design to assess the operation and impact of government irrigation schemes on small-scale farmers in Choma District. This approach allowed for an in-depth understanding of the real-life interactions between irrigation systems, policy

implementation, and farmers' experiences within a specific socio-ecological setting (Sile *et al*., 2021). By focusing on one ward, the research examined detailed aspects such as scheme performance, management structures, and farmer participation. Case study design is particularly suitable for exploring not only what happens and how it occurs, but also why it happens, offering rich, context-specific insights useful for both policy and practical improvement (Tibezinda *et al*., 2020).

3.2 Target Population

The study focused on small-scale farming households in Njase Ward, Choma District, who benefit from or live near government irrigation schemes. Participants had to be adults actively managing farms for at least two of the past three seasons and residents of the ward for a minimum of two years. Large-scale farmers, non-farming households, and temporary residents were excluded. This ensured the study captured relevant, firsthand experiences of irrigation's impact on household food production.

3.3 Sampling Design

The study used purposive sampling to select participants with relevant experience in government irrigation schemes. Selection considered proximity to irrigation, participation status, gender, and crop type. Local extension officers helped identify households, ensuring diverse perspectives and capturing both positive and negative experiences to provide a comprehensive understanding of irrigation's impact on food production.

3.4 Sample Size Determination

The study had a total sample of 100 participants, comprising 60 irrigation scheme users and 40 non-users living nearby. This size was chosen to allow in-depth qualitative analysis and comparisons between beneficiaries and non-beneficiaries, balancing manageability with rich, credible insights.

3.5 Data Collection Methods

Data was collected using semi-structured interviews, focus group discussions, and key informant interviews. Farmers provided individual perspectives, FGDs captured community experiences, and key informants offered technical and institutional insights. Data focused on crop yields, crop types, irrigation access, and infrastructure functionality to assess irrigation effectiveness and household food production.

3.6 Data Analysis

Data analysis combined descriptive statistics and thematic analysis. Quantitative data on food output, crop diversity, and irrigation use was summarized using frequencies and percentages. Qualitative data was transcribed, coded, and analyzed thematically to identify patterns and insights. Comparisons between user and non-user households and cross-case analyses examined how irrigation access affects farming decisions, food variety, and climate resilience.

4. Findings and Discussion

4.1 Presentation of Results on Background Characteristics of Respondents

This section describes the demographic profile of respondents including age, gender, education level, farming experience, and household size. Understanding these characteristics is essential for contextualizing the responses on irrigation access and use.

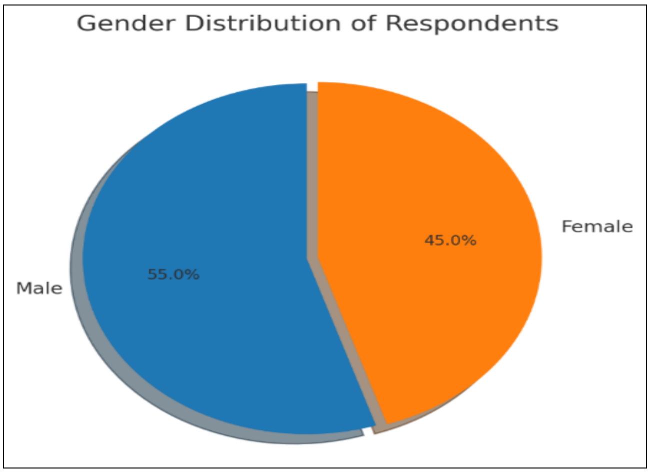

Fig 1: Gender Distribution of Respondents

The study revealed that out of the 100 respondents interviewed, 55% were male, while 45% were female. This distribution suggests a slightly higher representation of men in the sample, reflecting the gender composition of participants involved in irrigation and agricultural activities within the study area. The relatively balanced proportion also allows for meaningful comparisons between male and female perspectives on access to irrigation schemes, decision-making processes, and the challenges faced in enhancing household food security.

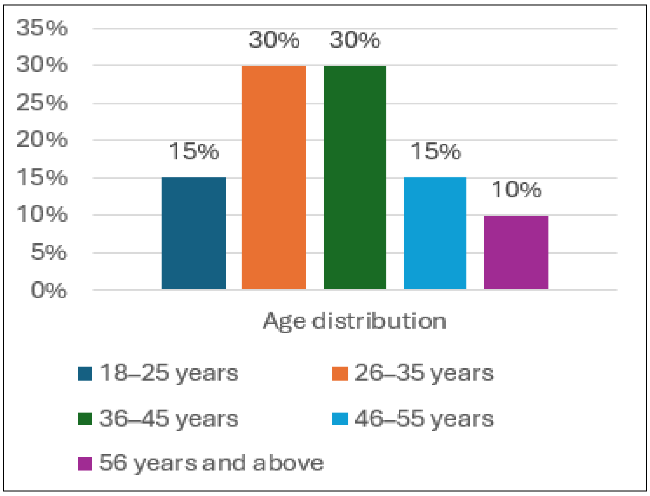

Fig 2: Age Distribution of Respondents

The study revealed the age distribution of respondents as follows: 18–25 years accounted for 15%, 26–35 years for 30%, 36–45 years for another 30%, 46–55 years for 15%, and those aged 56 years and above constituted 10% of the sample. In total, 60% of respondents were within the 26–45 age bracket, representing a youthful and economically productive segment of the population. This age structure indicates that the majority of farmers involved in irrigation activities are in their prime working years, which could positively influence the adoption of innovative farming practices, the effective management of irrigation infrastructure, and overall household productivity. Moreover, the presence of both younger and older farmers suggests a blend of dynamism and experience that can contribute to knowledge sharing and community resilience in agricultural activities.

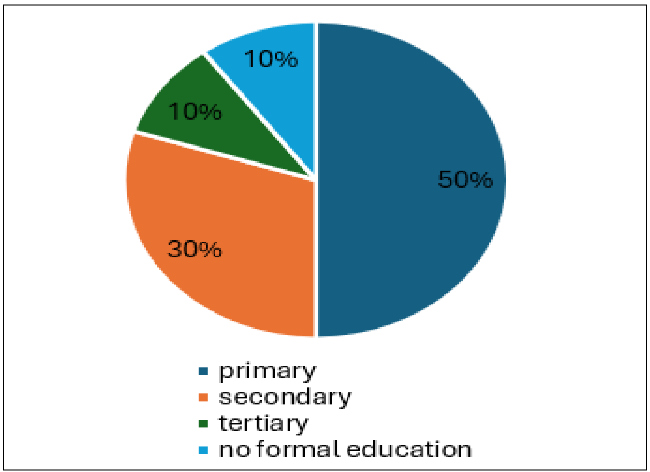

Fig 3: Education Levels Distribution of Respondents

The study indicated that the education levels of respondents were distributed as follows: 50% had attained primary education, 30% had completed secondary education, 10% had no formal education, and 10% had reached tertiary level. This distribution highlights that the majority of respondents possess at least basic literacy and numeracy skills, which can facilitate the understanding and adoption of irrigation practices and agricultural innovations. However, the relatively low proportion of individuals with tertiary education may limit access to advanced technical knowledge and innovative approaches, emphasizing the need for targeted training and extension services to enhance the technical capacity of all farmers regardless of formal education level.

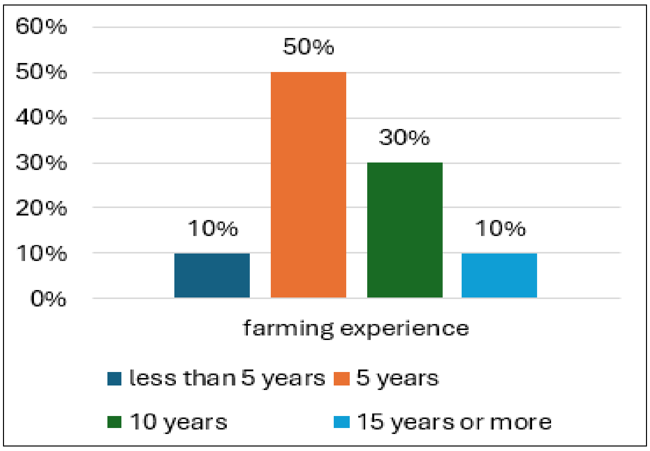

Fig 4: Farming Experience

Fig 4 illustrates the farming experience of respondents, showing that most have substantial experience in agriculture. Specifically, 10% of respondents had less than 5 years of farming experience, 50% had around 5 years, 30% had 10 years, and 10% had 15 years or more. This indicates that the majority of farmers in the study possess at least moderate experience, which can contribute positively to the adoption and effective management of irrigation schemes. Experienced farmers are more likely to apply best practices, troubleshoot problems, and make informed decisions about crop management, while the smaller proportion of less-experienced respondents may benefit significantly from training and extension support to build their technical competence.

4.2 Accessibility and Usage of Government Irrigation Schemes

The study's findings on respondents' access to irrigation schemes revealed several important patterns regarding the types of irrigation utilized, the extent of land under irrigation, and the frequency of water availability. Access to irrigation schemes was uneven, with approximately 65% of respondents reporting regular access to government or community-managed irrigation facilities, while 35% had limited or no access, often due to factors such as distance from the scheme, land tenure issues, or exclusion of marginalized groups, particularly women. Regarding the types of irrigation employed, the majority of respondents (around 55%) relied on surface irrigation methods such as furrow and basin systems, which are common in Njase Ward due to their relatively low cost and ease of implementation. Approximately 30% used sprinkler irrigation, while a smaller proportion (15%) employed drip irrigation, primarily on experimental plots or where investments and technical support allowed. These patterns indicate that simpler, low-cost irrigation methods dominate, although more efficient technologies are slowly being adopted.

In terms of land area irrigated, most farmers reported cultivating small plots, with 50% irrigating 0.5–1 hectare, 30% irrigating 1–2 hectares, and 20% managing plots larger than 2 hectares. This reflects the predominance of smallholder farming in the ward and underscores the need for equitable access to irrigation resources to enhance productivity on limited land. Frequency of water access varied considerably, with only 40% of respondents reporting daily access to irrigation water, 35% accessing water 3–4 times per week, and 25% relying on intermittent or seasonal water supply. Irregular water access was often linked to declining water levels, infrastructure inefficiencies, and competing water demands. Overall, these findings suggest that while irrigation schemes have improved opportunities for crop production, limitations in water availability, technology adoption, and equitable access continue to constrain their full potential.

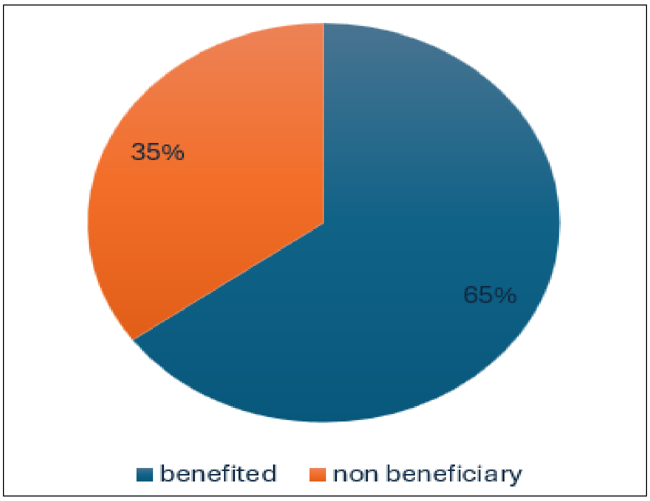

Fig 5: Distribution of the Beneficiary of Govt Irrigation Schemes

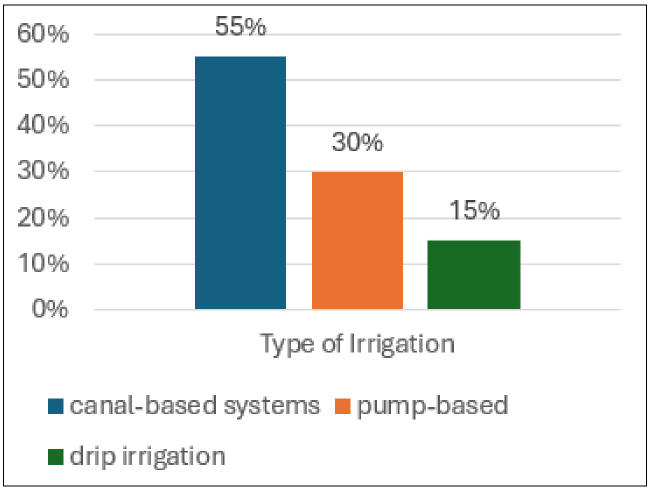

Fig 6: Shows The Distribution of the Types of Irrigation In Njase Ward

The study further revealed that the majority of respondents relied on canal-based irrigation systems, with 55% using this method due to its relative simplicity, low operational costs, and suitability for the smallholder farming plots typical of Njase Ward. Pump-based systems were employed by 30% of respondents, often where water needed to be drawn from rivers or reservoirs located at some distance from the fields, reflecting a higher investment in both equipment and energy costs. Drip irrigation was used by a smaller proportion, 15%, typically on experimental or high-value crops, as it requires greater technical knowledge and infrastructure but offers higher water use efficiency. These findings highlight that while traditional and accessible irrigation methods dominate, more efficient technologies like drip irrigation are slowly being adopted, signaling opportunities for improving water use efficiency and crop productivity through targeted support and training.

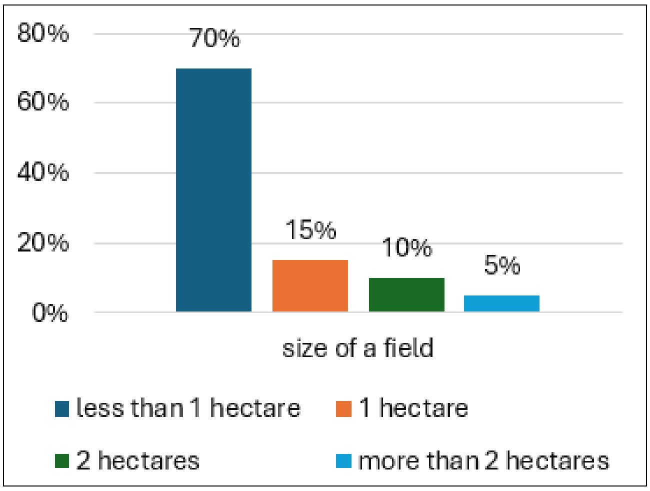

Fig 7: Size of the Field Irrigated

The study further showed that the majority of respondents, 70%, irrigated less than 1 hectare, indicating that most farming operations in Njase Ward are small-scale and limited in scope. Fifteen percent of respondents managed to irrigate 1 hectare, while 10% cultivated 2 hectares, and only 5% had access to more than 2 hectares for irrigation. This distribution underscores the predominance of smallholder farming in the area, where limited land availability and resource constraints restrict the scale of irrigated agriculture. Consequently, the potential benefits of irrigation schemes are constrained by land size, making it essential for policies and interventions to focus on maximizing productivity on small plots through efficient irrigation techniques, crop selection, and water management practices.

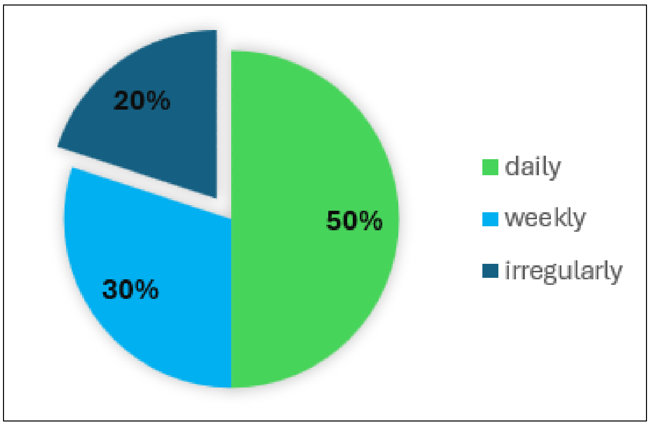

Fig 8: Water Access Frequenncy

The study revealed that respondents' frequency of water access varied considerably, with 50% reporting daily access, 30% accessing water on a weekly basis, and 20% experiencing irregular or unpredictable water supply. This variation highlights significant disparities in the reliability and availability of irrigation water among farmers in Njase Ward. Daily access allows for timely and consistent crop watering, which can enhance productivity and reduce crop stress, while weekly or irregular access may limit crop growth, increase vulnerability to pests and drought, and reduce the overall effectiveness of irrigation schemes. These findings underscore the importance of improving water delivery systems, scheduling mechanisms, and infrastructure maintenance to ensure more equitable and reliable access for all farmers.

4.3 Perceived Impact on Food Production and Livelihoods

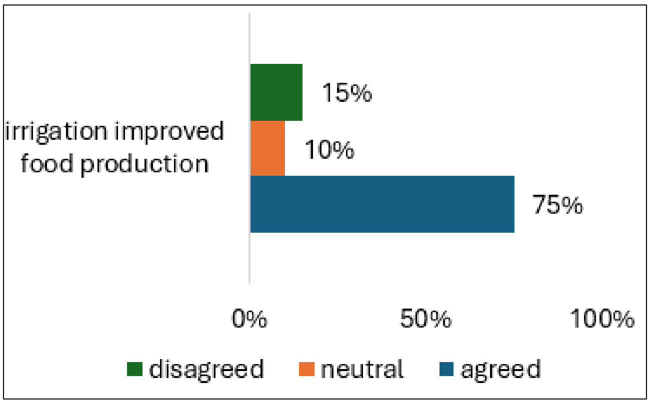

Fig 9: Shows Whether Irrigation Improved Food Production in Njase Ward

The study revealed that the majority of respondents recognized the positive contribution of irrigation to food production. Specifically, 75% of respondents agreed that access to irrigation significantly enhanced their crop yields and overall food availability. In contrast, 15% of respondents disagreed, suggesting that for some households, irrigation had limited impact, possibly due to challenges such as small landholdings, unreliable water supply, or inadequate technical knowledge. Meanwhile, 10% of respondents remained neutral, indicating uncertainty or mixed experiences regarding the benefits of irrigation. These findings highlight that while irrigation is generally perceived as a valuable tool for improving food production, its effectiveness can vary depending on contextual factors affecting individual farmers.

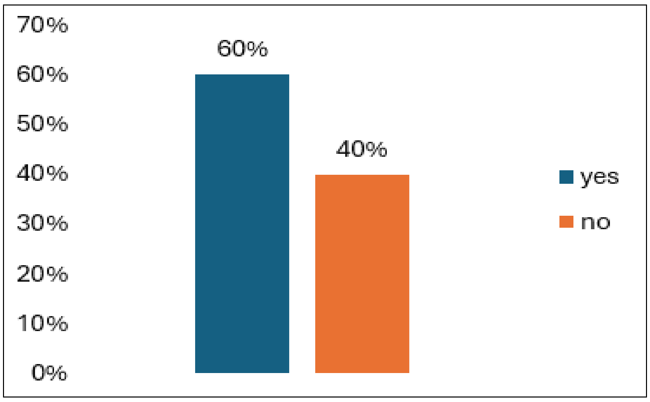

Fig 10: Irrigation Schemes Increased Crop Variety

The research findings indicated that a majority of respondents, 60%, reported that access to irrigation had enabled them to cultivate a greater variety of crops, thereby enhancing agricultural diversity and potentially improving household nutrition and market opportunities. Conversely, 40% of respondents indicated that irrigation had not led to increased crop variety, which may reflect limitations such as small land sizes, inadequate water supply, or lack of knowledge about diversified cropping systems. These results suggest that while irrigation generally supports crop diversification, its benefits are not uniformly experienced across all households, highlighting the need for complementary support measures such as technical training and resource access to maximize the impact of irrigation on agricultural diversity.

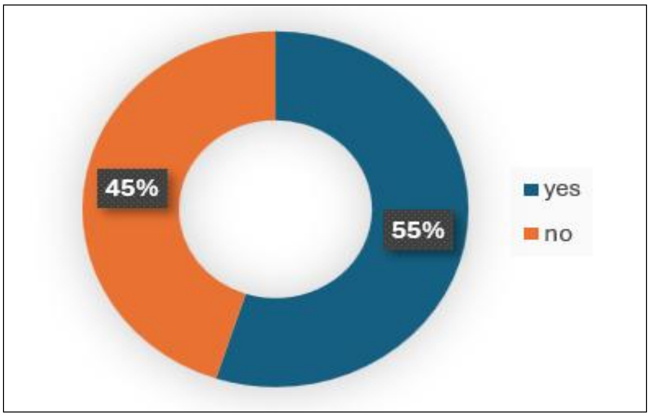

Fig 11: Shows How Irrigation Schemes Enabled Dry Season Farming

The study revealed that 55% of respondents engaged in dry season farming, a practice made possible through access to irrigation, allowing them to extend their cropping calendar beyond the rainy season and increase overall agricultural productivity. In contrast, 45% of respondents did not practice dry season farming, possibly due to constraints such as limited water availability, insufficient irrigation infrastructure, or lack of technical knowledge on off-season crop management. These findings indicate that while irrigation facilitates year-round farming for a significant portion of farmers, barriers still prevent nearly half of the respondents from fully leveraging this opportunity, underscoring the need for improved water management, training, and infrastructure support.

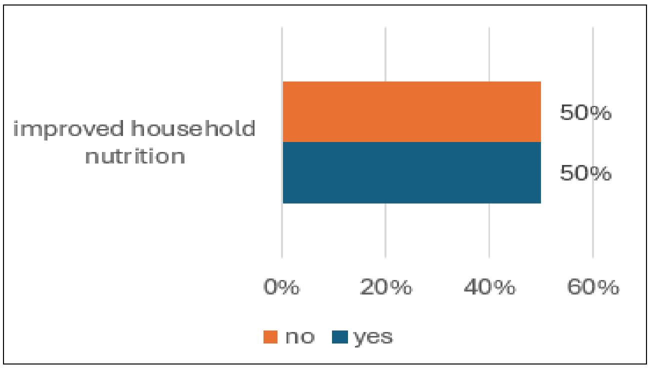

Fig 12: Irrigation Schemes Improved Household Nutrition

The study indicated that half of the respondents (50%) reported that access to irrigation had led to improved household nutrition, likely due to increased crop production and greater availability of diverse food items. Conversely, the remaining 50% disagreed, suggesting that despite irrigation, factors such as limited crop variety, post-harvest losses, or inadequate food distribution within households may have prevented noticeable improvements in nutritional outcomes. This division highlights that while irrigation can contribute to better nutrition, its impact is influenced by complementary factors such as crop choices, household food management practices, and broader socio-economic conditions.

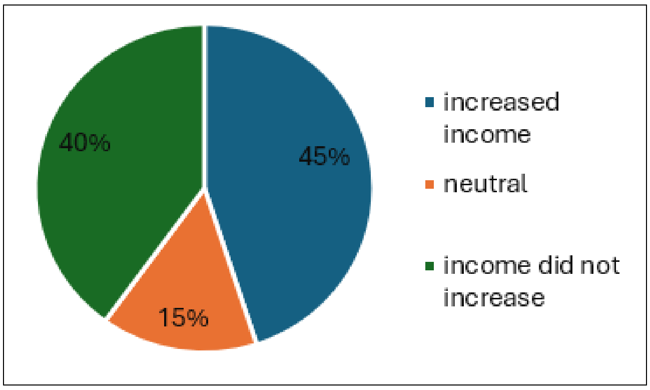

Fig 13: Income From Surplus Sale Affected Household Finances

The study showed that 45% of respondents reported an increase in income due to surplus crop sales made possible by irrigation, indicating a positive economic impact for nearly half of the farmers. Meanwhile, 15% of respondents were neutral or unsure about income changes, reflecting either limited market access or variability in crop yields. Conversely, 40% disagreed, suggesting that for a significant portion of farmers, irrigation had not translated into higher income, possibly due to factors such as small landholdings, low market prices, high input costs, or post-harvest losses. This distribution underscores that while irrigation has the potential to enhance household earnings, its benefits are unevenly experienced across the community.

4.4 Sustainability and Operational Challenges

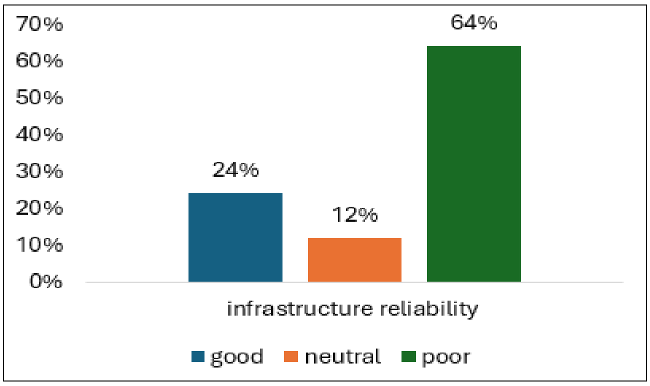

Fig 14: The Infrastructure Reliability

The study revealed that a majority of respondents 64% rated the reliability of irrigation infrastructure as poor, indicating significant concerns about system breakdowns, inconsistent water flow, and overall functionality. Meanwhile, 12% of respondents remained neutral, suggesting uncertainty or mixed experiences regarding the infrastructure, and only 24% rated it as good, reflecting limited satisfaction with current systems. This distribution underscores that most smallholder farmers face challenges in depending on the irrigation infrastructure to support consistent agricultural production, highlighting the need for improvements in maintenance, monitoring, and system upgrades to enhance reliability and usability.

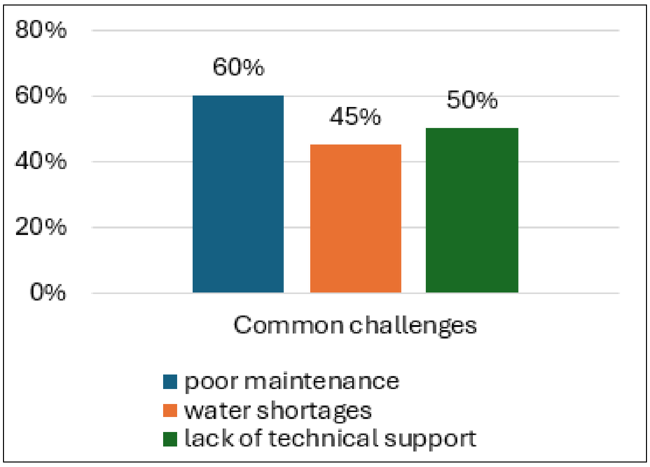

Fig 15: Common Challenges which Respondents Faced

Multiple responses were allowed, and the study revealed that respondents experienced several common challenges affecting the effectiveness of irrigation schemes. Poor maintenance was the most frequently cited issue, affecting 60% of respondents, highlighting the deterioration of canals, pumps, and other essential infrastructure. Lack of technical support was reported by 50% of respondents, reflecting insufficient guidance from extension officers and limited knowledge on managing irrigation systems effectively. Water shortages affected 45% of respondents, indicating problems with water availability and distribution, particularly during dry spells. These challenges collectively constrain the productivity and sustainability of irrigation schemes, emphasizing the need for targeted interventions in maintenance, technical support, and water resource management.

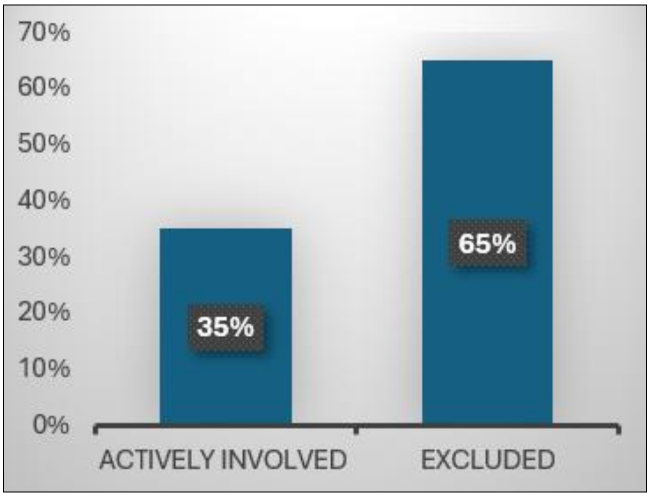

Fig 16: Participation In Decision-Making

The study indicated that only 35% of respondents reported being actively involved in the management of irrigation schemes, while a significant majority of 65% felt excluded from decision-making processes. This limited participation suggests that many farmers, particularly women and marginalized groups, have little influence over how irrigation resources are allocated, maintained, or utilized. Such exclusion can undermine the effectiveness of irrigation interventions, as farmers who are not involved in management may lack ownership, motivation, and accountability, ultimately affecting the sustainability and equitable benefits of the schemes.

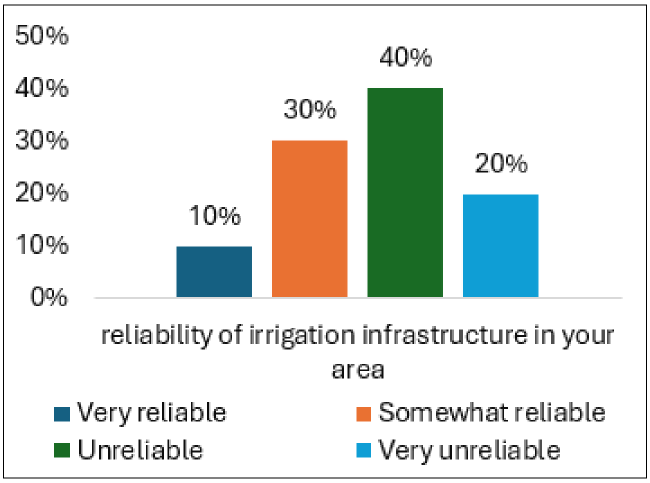

Fig 17: The Reliability of the Irrigation Infrastructure in the Area

Fig 17 illustrates that only 10% of respondents considered the irrigation infrastructure very reliable, 30% viewed it as somewhat reliable, 40% found it unreliable, and 20% rated it very unreliable. This indicates that the majority of farmers experienced challenges with the dependability of the irrigation system, which could negatively affect crop production and overall scheme effectiveness.

4.5 Discussion of Research Findings

The study of government irrigation schemes in Njase Ward, Choma District, showed that they improved crop yields, supported crop diversification, and enabled dry season farming, enhancing household food availability and resilience. About 75% of farmers reported higher yields, 60% grew more diverse crops, and 55% practiced dry season farming, often generating additional income. However, effectiveness was limited by insecure land tenure, gender and socio-economic disparities, poor infrastructure maintenance, weak governance, limited community participation, and inadequate extension services, with climate variability further affecting reliability. Male-headed and wealthier households benefited more, while women and land-poor farmers faced systemic barriers. The findings indicate that irrigation alone cannot ensure food security; achieving sustained, equitable, and resilient agricultural productivity requires integrated interventions including secure land rights, inclusive access, capacity-building, continuous maintenance, participatory governance, and climate-resilient infrastructure.

5.2 Recommendations

The effectiveness and sustainability of irrigation schemes in Njase Ward depend on well-maintained infrastructure, farmer training, community participation, secure land tenure, and inclusive access. Reliable canals, pumps, and water storage, coupled with climate-resilient technologies, prevent system failures and support consistent production. Capacity-building through participatory training improves technical skills, adaptive capacity, and productivity, particularly for women, youth, and marginalized farmers. Inclusive local management strengthens ownership, accountability, and equitable water distribution, while secure land rights encourage investment and long-term engagement. Promoting access for disadvantaged groups through subsidies, credit, and gender-sensitive policies ensures broader participation and decision-making influence. Together, these measures enhance productivity, food security, and the sustainability of irrigation schemes, contributing to rural development, climate resilience, and poverty reduction.

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