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Exploring the contribution of the Taung Irrigation Scheme to small-scale farmers' households' food security in Greater Taung Local Municipality, South Africa

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Abstract

While South Africa has been confirmed to be food secure at the country level, the opposite is the case at the household level. Intervention through irrigation schemes that support small-scale farming is one of the country's strategies to address this anomaly, as the right to food is enshrined in its constitution. This study assesses the contribution of the Taung Irrigation Scheme to small-scale farmers' households' food security in Greater Taung Local Municipality. This study followed a qualitative methodology and an exploratory design, which involved semi-structured interviews with one government official, a representative from Vaalharts Water and eight representatives of the primary agricultural cooperative that operates in the scheme. These participants were selected purposively. The data was analysed thematically.

The study's findings indicate that the Taung Irrigation Scheme has positively contributed to the food security of small-scale farmers' households. Access to irrigation allows them to grow crops more frequently, thus ensuring stable and higher yields. Because the farmers could not produce all the types of food that they need, they used the income generated from selling their produce to acquire these. It emerged from the findings of this study that these farmers could even improve the quality and quantity of their produce if crop theft,

tenure of security, high water cost, small farm size, and high cost of the irrigation scheme infrastructure maintenance could be addressed.

Because South Africa's land reform policy makes provision for the government to acquire and lease land to the farmers, this study recommends formalisation of the long-term land use and occupancy rights in the context of rural areas. This reform on its own will not bring any significant change. It is for this reason that this study recommends that government agricultural support must be directly linked to the security of land tenure. This will give farmers access to land and support over a long period of time thus allowing them to focus on improving access to adequate food at the household level. Further to that, the pay-as-you-use system must be introduced to reduce the costs incurred by the farmers to access water.

Keywords: *Small-scale farmers, Taung Irrigation Scheme, Food security, and Household food security.*

Introduction

Ensuring food security is at the core of many nations' development agenda including South Africa, though millions of its citizens continue to face hunger and vulnerability. A report by Statistics South Africa (Stats SA) revealed that in 2015, approximately 1.7 million households and 7.4 million individuals in the Republic of South Africa were food insecure and at risk due to water shortages (Stats SA, 2019). The situation worsened in 2016, with around 1.8 million households and 7.8 million individuals experiencing food access challenges linked to ongoing water scarcity (Stats SA, 2019). Seven years later, the same institution reported that a dire situation was experienced with 3.7 million households and 1.5 million being affected by moderate to severe food insecurity, respectively. While these reports give a clear country-wide picture to which multiple stakeholders contributed, it is important to narrow the focus down to establish the extent to which the small-scale farmers who operate at the community level contribute to their households' food security. This need is triggered by the fact that contribution to the general population's food security may be a tall order because these farmers are resource poor as observed by Mutambara (2016). This paper, therefore, is limited to establishing the contribution of an irrigation scheme to its members' household food security, particularly in this water-scarce country as observed by Fanadzo and Ncube (2018).

Focusing on the food security of households of the Taung Irrigation Scheme's members is pertinent as previous studies (Ekobi & Mboh, 2018) dealt mainly with the general challenges and benefits associated with this scheme. The need for financial capital to acquire inputs such as fertilizers, pesticides, and seeds that enhance production formed part of their key findings. On the other hand, the study by Muchara et al. (2014) had also revealed that smallholder farmers who belonged to an irrigation scheme lacked the irrigation skills which hampered their production. These scholars attribute this to poorly coordinated government support towards farmers involved in small-scale irrigation, despite the significant role they play in food production. Tekana and Oladele (2011) contributed to the debate about small-scale farmers and irrigation schemes by confirming that in the North West (NW) province, small-scale irrigation farming accounts for 2.2% of the Gross Domestic Production (GDP), and 6% of the province's jobs (Department of Agriculture and Rural Development, DARD, 2020a). While these findings shed light on the significant role that these farmers are playing, they do not fill the gap in which the current study is interested. That is, how does an irrigation scheme contribute to the members' household food security. Tesgera and Guluma (2020) observe that irrigation-users are more food secure than non-users because the former have water which allows them to grow crops more frequently and ensure a stable and higher yield that strengthens their food security compared to those who rely mainly on rainfed farming. Nugusse (2013) and Oni et al. (2011), endorse this point by giving an example of how the Vhembe area of Limpopo province in South Africa where small-scale farmers with access to irrigation were more food secure (86.3%) compared to dry land farmers (53%). In the same province and district, Mudzielwana et al. (2020) found that 51.8% of the Tshiombo Irrigation Scheme members were food secure, 7.3% were mildly secure, 19.9% were highly insecure, and 20.9% were severely food insecure. Based on these figures the scholars concluded that irrigation schemes contribute towards improved food security. These are valuable insights about the performance of the irrigation schemes in Limpopo as they confirm the importance and contribution of these schemes as many believe them to be (Oates et al., 2015, Eneyew et al., 2014). These studies provide feedback that the government, which is the main sponsor, and farmers who are the key role players need to determine the opportunities and areas of development associated with the small-scale irrigation schemes. The North West provincial government seem not to have such a valuable

resource. This study therefore intends to provide such details which may be helpful to these key role players as they engage each other in relation to the promise that the Premier made during his visit to the scheme as part his 100 days in office celebration that the scheme will not collapse as it is has an important role to play in the social and economic development agenda (North West Provincial Government, 2024).

The small-scale farmers in the Taung Irrigation Scheme (TIS) hoped to benefit from the Ministry of Agriculture's National Extension Recovery Implementation Plan, which aimed to provide farmers with improved access to information, training, and institutional support. This intervention was designed to empower farmers to contribute to reducing the 9.6% of households that in 2008 reported inadequate access to food nationwide. This intervention seemed incapable of meeting the goal as Stats SA (2025) reported an upward growth of the number of those who experienced moderate food insecurity between 2019 (15,8%) and 2023 (19,17%). The disaggregation by sex also revealed the same pattern of growth where female headed-household figures of those who experienced moderate food insecurity grew from 17.2% to 21,5% in the same period.

At the provincial level, in the North West Province, Stats SA (2025) reported that 26,3% (2019) and 29,7% (2023) of the population experienced moderate food insecurity, despite the existence of the six irrigation schemes, including the Taung Irrigation Scheme. Worth noting is that between 2019 and 2022 the figure decreased from 27, 7% to 25% but grew in 2023 by 4,5%. In terms of settlements, the non-urban settlements where the irrigation schemes are located their figures of those who experienced moderate food insecurity increased from 40,7% to 55%. These figures are aligned to the observation by Senwes Grainlink (2020) that small-scale farmers in the province faced a sudden drop in food production, which fell from 6,150 tons in 2018 to 2,076 tons in 2020. This sharp decline helps explain why 22% of households experienced food insecurity in the Dr.Ruth Segomotsi Mompati District Municipality, where the TIS is located.

Bearing in mind that policy makers and implementers had hoped that by improving these existing small holder irrigation schemes and establishing new ones would enhance food security in response to the erratic nature of rainfall in South Africa (Van Averbeke et al., 2011), it is necessary to determine the extent to which the Taung Irrigation Scheme

contributes to food security for the farmer's households as this forms part of its objectives. This is also a response to the call for targeted interventions aimed at enhancing the contribution of small holder irrigation schemes to food security by Fanadzo, Chiduza, and Mnkeni (2010) for more studies that delve into the specific irrigation scheme contexts. This study therefore seeks to explore the contribution of the Taung Irrigations Scheme to members' household food security. The research questions guiding this study are:

- How does the Taung Irrigation Scheme contribute to the food security of its members' households?
- How does the sale of farm produce affect the food security of participating households?

Established in 1939 by the South African government, this irrigation scheme was transferred to the Bophuthatswana homeland administration in the 1970s. After the end of apartheid in 1994, it became part of the North West Province and is currently administered by the Department of Agriculture and Rural Development (Tekane & Oladele, 2011). While several critical studies (Tekane & Oladele, 2011; Chiyaka, 2016; Van Averbeke et al., 2011) have examined its administration, technical agricultural aspects, and water quality, its role in enhancing household food security for farmers has received limited attention. This study, therefore, investigates the scheme's contribution to food security among its key stakeholders.

The relationship between irrigation schemes used by small scale farmers and food security

Food security extends beyond the mere availability of food. The Food and Agriculture Organization (FAO, 1996) centred its definition of food security on four pillars which are affordability, accessibility, stability and utilisation. Chitani (2017) also confirms that people are food secure when these components are attained. All these are essential for promoting healthy living, according to the Food and Agriculture Organization (FAO, 2006). The first component which is food availability refers to having sufficient, appropriate and quality food (Santuah & Abazaami, 2023). Food accessibility is defined as the physical, social, and economic ability of households to obtain or produce adequate and quality food as

described by Chitani (2017). Food affordability refers to the capacity of households especially at-risk ones to purchase available, adequate and nutritious food to meet their dietary needs (Hawkes & Ruel, 2020). Food stability means a situation where access, availability, and use of food remain reliable over time without risk of disruption for a population, individual or a household as defined by García-díez; Gonçalves, Grispoldi, Cenci-goga, and Saraiv (2021). Any change in these dimensions can compromise and threaten food security.

Irrigation plays a pivotal role in promoting food security at both household and national levels. At the household level, it enables farmers to mitigate risks associated with rainfall variability and climate change, ensuring stable and reliable crop yields (Vhumbunu, 2022). This reliability is essential for food security, as it provides households with consistent access to nutritious food throughout the year, reducing vulnerability to hunger and malnutrition (Zwane, 2019). Moreover, irrigation empowers farmers to diversify their crop production, including the cultivation of high-value cash crops, which can increase income and enhance livelihood resilience. It also boosts the productivity of agricultural and arable land thus allowing farmers to grow crops year-round and maximize yields without expanding into environmentally sensitive areas such as forest and wetlands. This increased productivity not only meets household food needs but also generates surplus produce for sale in local markets, thereby improving food availability and affordability for the farming community (Yohannes, 2020). Furthermore, irrigation supports sustainable agricultural practices such as crop rotation and soil conservation, helping preserve natural resources and ensuring long-term food security for future generations.

Relying on seasonal rainfall is inherently challenging due to its extraordinary erraticism, including rainless periods, recurring dry seasons, droughts, and floods, all of which pose significant threats to food security as suggested by Mwadzingeni et al. (2020a). To address these challenges, small-scale irrigation schemes have been implemented in many parts of the world, particularly in Africa, where food insecurity is widespread. This intervention was aimed at boosting productivity especially in rural areas (Mapuranga & Muzerengi, 2017) . Supporting evidence comes from Tagwireyi (2017), who reported that in 2016, approximately 83% of small-scale farmers in Zimbabwe recorded increased harvests, with 20% of them producing surpluses because of

access to irrigation. This contribution is significant because even small shortfalls in crop productivity can lead to rising food prices, potentially triggering malnutrition. Therefore, increasing food production through small-scale irrigation is crucial. This requires expanding irrigated areas, improving water supply, and enhancing the efficiency of existing water resources. Without strategic investment in irrigation, boosting food production would be exceedingly difficult (Hanjra & Williams, 2020).

A study in Ethiopia's Sibu Sire District found that small-scale irrigation schemes improved food security. For example, about 73% of irrigation users were food secure compared to 56% of non-users (Abdissa et al., 2017). This aligns with Deribie (2015), showing irrigation's positive impact on food security indicators like dietary diversity and food access. Small-scale irrigation also creates jobs, increasing household income and buying power, which enhances food security (FAO, 2012; ASFG, 2013). For example, Kenya's Small-scale Irrigation and Value Addition Project (SIVAP) created over 215,000 jobs thus benefiting mainly rural women and improved water access, productivity, and livelihoods (Mwadzingeni et al., 2020a, Mwamakamba et al., 2017). In Ethiopia, irrigation farmers earned 33.6% more than non-users, translating into better food access and diet diversity (Eneyew et al., 2014). Further studies (Van Averbeke et al., 2011, Cousins, 2013, Mwadzingeni et al., 2020b) highlight irrigation's role in poverty alleviation and income growth, which are key to combating food insecurity in rural areas.

Design

This study adopted the interpretivism approach and qualitative methodology to explore small-scale farmers' insights about the contribution of the Taung Irrigation Scheme towards their household's food security. A preliminary investigation revealed that a total of five primary cooperatives use the services of the Taung Irrigation Scheme. To get the experiences of these cooperatives, two representatives per organisation were sampled purposively based on the maximum number of years that they were farming in this environment. Willingness to take part in the study was also a key requirement while sex was not a determining factor for inclusion. However, a prospective participant had to be above the age of 21. The chairperson of each cooperative nominated the members who met the criteria. A total of ten farmers then took part in this study. Two key informants who represented the

Vaalharts water and the Department of Agriculture and Rural Development were selected purposively based on having worked closely with the cooperatives associated with the Taung Irrigation Scheme. The head of the two departments of these two institutions recruited these representatives. Principles of anonymity, privacy, confidentiality, and the right to withdraw were observed throughout the study. No payment was offered to the participants for their involvement. The North-West University's Basic Social Sciences Ethics Committee cleared the study. The study used pseudo names SSF1 to SSF8 to de-identify the small-scale farmers. Officials of the department and the Vaalharts Water are identified as O1 to O2. Data from all these participants was sourced through semi-structured interviews and analysed thematically.

As suggested by Creswell and Inoue (2025), the data analysis process began with the transcription of raw data from fieldnotes and audio recordings. This was followed by organising and preparing the material for systematic analysis. The data was then read and re-read to develop a comprehensive understanding of its content and underlying meaning. Initial codes were subsequently generated, refined, and checked to ensure that no meaning was lost in the process. Final codes were then confirmed and compared with the original data for consistency. From this iterative process, the key themes emerged inductively. The themes were confirmed following a thorough reading and comparison with the data.

Regarding study setting, the Taung Irrigation Scheme is in Greater Taung Local Municipality, a category B municipality which is one of five local municipalities in the Dr Ruth Segomotsi Mompati District in the NW Province. Reivilo, Pudimoe and Taung Central are the major towns of this local municipality. The municipality has a total population of 167 827 (Stats SA, 2016). The municipal area is predominantly rural consisting of 106 widely scattered rural areas where most of the residents speak Setswana (Stats SA, 2011).

Agriculture is one of the main industries in this local municipality although the area receives little rainfall (300–400 mm) annually (Chiyaka, 2016). Therefore, the scheme irrigates approximately 3698 hectares of land (Tekana & Oladele, 2011) comprising plots whose sizes range between 7.5 and 10 hectares. The small-scale farmers who are part of the scheme produce crops for both household consumption and market purposes.

Findings

This study's findings are organized under two key themes: (1) from Scarcity to security through smallholder irrigation scheme, and (2) employment through irrigation scheme as a pathway to food security. These themes reflect the central role of the irrigation scheme in transforming local livelihoods and enhancing food security. Verbatim quotations from participants are included to support the themes.

From scarcity to security through smallholder irrigation scheme

The Taung Irrigation Scheme covers approximately 3,698 hectares of land, cultivated by members of five cooperatives. Individual plot sizes range between 7.5 and 10 hectares (Tekana & Oladele, 2011). Farmers grow a variety of crops on these plots and confirmed that

> We can feed our families with basics such as vegetables; we provide for ourselves. The scheme provides small-scale farmers the opportunity to grow crops for their own sustenance (SSF5).

The scheme enabled small-scale farmers to cultivate a variety of crops and vegetables, which, according to SSF5, help them feed their families. They therefore relied heavily on their farms to provide for their families. This finding aligns with that of Mdoda et al. (2022), who found that most small-scale irrigated farmers in South Africa's Eastern Cape Province grow vegetables such as spinach for household consumption, which contributes significantly to their dietary needs.

The scheme made a difference regarding food access among the farmers' household members in that

> The Taung Irrigation Scheme enables some of our households to have access to food as compared to before engaging in the irrigation scheme. Before we produced 30 tons now 60 tons barley, but there are a lot of expenses (SSF2)

SSF2 explained that before joining the scheme, they typically produced 30 tons of barley. This figure has now doubled to 60 tons, thanks to the water supplied by the scheme. The additional produce is sold to generate income, which supports the farmers' households. This finding

demonstrates that these farmers' food shortages motivated them to adopt a relevant irrigation method which even brought unanticipated results in the form of a double yield. While their experience is aligned to what Zhang et al. (2021) reported from their study in Rorya District, northern Tanzania, where most small-scale farmers improved from 26 to 40 bags of rice production upon an irrigation scheme, they were outproduced by this Tanzanian case. While farmers were pleased that barley production had doubled, concerns about rising input costs were noteworthy. However, the specific cost details were not provided despite further probing by the researchers. Bureau for Food and Agricultural Policy (2023) similarly reported that input cost levels have remained higher than those observed before the COVID-19 lockdown period. Comparable to the Taung Irrigation Scheme small-scale farmers, Bureau for Food and Agricultural Policy did not disclose the specific breakdown of these input costs.

Further positive contribution of the Taung Irrigation Scheme to household's food security was confirmed by a participant who reported that

> Although I have a large household to support through this Taung Irrigation Scheme, hunger is now a distant thing. My household can eat three times a day" (SSF8). This view was supported by SSF3 who indicated that "Some of us can afford two meals a day; something we could not earlier (SSF3).

SSF3 and SSF8 observed that, despite having large households, they can now afford two to three meals a day, something they struggled to do before. The scheme has enabled small-scale farmers to provide sufficient food for their families. This scheme seems to be reliable in this regard as it assists households to have consistent access to nutritious food throughout the year, reducing vulnerability to hunger and malnutrition as also observed by Zwane (2019).

SSF8 noted that food production among these farmers is now growing to the extent that it meets some of their food needs which they attribute to the innovations and technological advancements of the irrigation scheme. These findings align with those of Dlangalala and Mudhara (2020), who confirmed that small-scale irrigation schemes play a key role in improving food availability, especially in poorer

communities. These farmers, therefore, rely heavily on their farms for food and only purchase items they cannot grow themselves, such as cooking oil and flour as was mentioned by SSF5.

The crops that farmers produced in the study area are significant contributors to key aspects of food security particularly in a poverty-stricken and arid region like Taung. This point was emphasized by one participant, who said that

> Taung is a dry area; this irrigation gave us the opportunity to produce own food and various types of food such as beans, yellow maize, white maize, wheat, sunflower and ground nuts, which takes care of food poverty. When we compare ourselves with other people from surrounding villages without access to irrigation schemes, such as this one, we see ourselves producing more compared to them (SSF6).

Although this study is not aimed at comparing members and non-members of the scheme's experiences, participants did the comparison and realized that the scheme allowed them to produce a variety of crops, such as groundnuts and yellow maize which are a nutrient-rich food source providing a good balance of protein and healthy fats. Similarly, Tesgera and Guluma (2020) confirmed that farmers using irrigation are more food secure than non-users.

> The scheme allowed me to cultivate crops such as watermelon, tomatoes, potatoes and spinach. My children and I now have enough to eat unlike before hunger was the order of the day (SSF8).

SSF8 added that thanks to the scheme, the farmers and their families have enough food to eat, as it provides space to cultivate crops like watermelon and spinach. This finding is consistent with a study by Oni et al. (2011), which found that in the Vhembe District of Limpopo Province, South Africa, small-scale farmers with access to irrigation produced a wider variety of crops, resulting in improved food security (86.3%) compared to dryland farmers (53%). This finding also supports the conclusion by Deribie (2015) that small-scale irrigation schemes can increase and sustain food security, particularly in poorer communities.

Another participant indicated that

> Taung is a dry area, fresh produce is hard to find from the farms around since most farms are into livestock. With the irrigation, I have full-time profession of supplying vegetables such as cabbages and spinach every month of the year. This is my full-time job where I get my income through selling fresh produce (SSF3).

In the same vein, SSF4 acknowledged the positive role that the TIS plays in making them food secured by stating that

> …producing a variety of crops such as tomatoes, cabbages and lucerne enabled me to generate income. However, I normally use the money I get from selling the farm produce to buy other foods, which cannot be met by farm production.

SSF3 highlights that because Taung is a dry area resulting in fresh produce being difficult to find, the introduction of the irrigation scheme has provided some small-scale farmers with full-time employment as they produce spinach and cabbages for household consumption and sell the surplus to other community members throughout the year. This shows that the irrigation scheme has expanded income generating opportunities which empower them to make up for the food needs which their farms cannot meet as mentioned by SSF4. To prove that the small-scale farmers were able to produce to meet their food demands, SSF7, alluded to the point that

> …in summer we sell to make income to provide for our basic needs such as clothing and shelter.

The experience of the Taung Irrigation Scheme small-scale farmers is aligned to the findings by Darko et al. (2016) who confirmed that small-scale irrigation schemes were mostly developed in the arid and semi-arid lands where they enhanced employment and food security to the ever-growing population. Chikazunga and Paradza (2013)support these observations by stating that farm irrigation is a direct employment and income creation mechanism especially in rural areas where agriculture is the backbone of social and economic development. That is because it affords the farmers the opportunity to provide various fresh food for

themselves and still be able to sell what they cannot consume to make income that is used to satisfy their other basic needs.

The officials from the Department of Land reform and Rural Development also confirmed the significant contribution that the scheme plays towards food security by stating that

> The irrigation scheme has improved small-scale farmers' produce. Without access to the scheme, farmers would not have enough food to feed their families and the community at large. Besides, the Illima-Letsema programme introduced in the scheme by the Department of Agriculture and Rural Development to provide funds and inputs such as fertilizers and seeds to farmers have helped increase food production (O1).

The ministry's official (O1) contributed to the conversation by indicating that irrigation has significantly improved small-scale farmers' food production. As a result of the scheme, farmers have enough food to feed their households and contribute to the broader community's food needs through buying the surplus produce from the farmers. This partially resulted from the contribution by the DARD Illima-Letsema programme, which supports farmers with inputs such as fertilizers and seeds. This finding aligns with the solutions proposed by modernization theory, which argues that technological advances like irrigation, fertilizers, and high-yielding crop varieties boost production and reduce food insecurity (Wolde, 2021).

Participant O2 hold the view that the use of irrigation technology contributes to making land useful which would have not been used in the absence of such an input and states that

> Irrigation is an age-old means of increasing agricultural productivity. The Taung Irrigation Scheme has expanded the arable area, improved yield and increases cropping frequency. It sometimes enables two or three crops a year compared to when farmers rely only on rain fed production/farming (O2).

The observation by O2 is that the scheme has improved the production capacity of land by enabling farmers to cultivate two or three crops a year rather than relying solely on rain-fed agricultural system that could have allowed them to grow just one crop. Access to irrigation significantly

enhanced productivity and crop diversity and frequency. The findings are affirmed by Dlangalala and Mudhara (2020) and Egger et al. (2020) who hold the view that irrigation technology allows farmers to produce diverse crops in a specified period.

Employment through irrigation scheme as a pathway to food security

The participants emphasized the irrigation scheme as a key mechanism linking employment to food access. The scheme made it possible for them to get jobs in the cooperatives. While these jobs are a good source of income, they also give them to access food on continual basis thus ensuring stability as well. This was emphasised by a participant who stated that

> I was unemployed for a long time, and I saw that people who are part of the scheme were at least earning something. I decided to join the scheme. I can comfortably say the scheme provided full time employment for me through which I am able to access basic food stuff that we need for survival (SSF5).

SSF3 shares the same view and highlight that the scheme provides with self-employment and employment for the others as well by stating that

> The Taung Irrigation Scheme is of great benefit. The scheme creates job opportunities not only for me but also others who were retrenched. The irrigation scheme provides the opportunity of growing crops throughout the whole year. We able to take care of our families compared to when we were unemployed.

Based on the responses above, the TIS has proved that it has the potential to create permanent employment for farmers, including those who have been retrenched in the community, thereby reducing the incidence of food poverty. Participants like SSF5 were motivated by their predecessors' successes to join an agricultural cooperative. To their surprise, they were also able to get employment through they got access to fresh produce and income on whose basis they survived.

Similar sentiments were echoed by SSF7 who said that

> I was unemployed, and I decided to use the land I inherited from my parents to earn a living and provide for my family. The scheme creates job for me because I see people still going around looking for job.

The participants in this study hold the view that the irrigation scheme served as a springboard for them to be self-employed. As noted by SSF7, unemployment pushed them to use the land they inherited from their parents to earn a living and provide for their families.

> The scheme generated employment for some of us even though it is temporal because we do have season (winter) that we do not plant anything. During that time, some of us look for job elsewhere to survive (SSF8).

SSF8 mentioned that while the irrigation scheme generates temporary employment for small-scale farmers during the main cropping seasons, there is little to no cultivation in winter. Overall, the scheme has created employment opportunities that have allowed farmers to maintain their livelihoods. The government official also confirmed the seasonal work opportunity that the scheme creates to the unemployed as follows,

> The scheme has successfully reduced poverty incidence among small-scale farmers' households and the community at large through full and temporary employment and food production thus, livelihoods.

These temporary opportunities are a means to access food during such periods. However, at the end of the seasons, these members must seek alternative jobs to sustain themselves. This finding aligns with studies by Mudzielwana et al. (2020) and Mwadzingeni et al. (2020b), which found that small-scale irrigation schemes generated temporary employment for more than 215,000 people in Kenyan farming communities among who, 50% were black rural women.

Apart from using the irrigation scheme for food to be consumed by household members and communities, the small-scale farmers grow products such as lucerne. However, their concerns are that

> …we do experience shortage of lucerne to sell to our clients and feed our livestock between June and August because the last cutting month

> of lucerne is April then we must wait for the month of September. This reduces the income we make and livestock feed" (SSF7).

Lucerne does not directly benefit the household members of small-scale farmers. Instead, it is primarily used as fodder for their livestock, which in turn provides essential protein, minerals, and vitamins. Any surplus lucerne is sold to other community members. The income earned from these sales is then reinvested in the household, enabling the purchase of food items that cannot be produced on the farm, especially during the off-season.

Discussion

Irrigation scheme is acknowledged by the participants as a necessary intervention since the study area is dry because of the erratic nature of the rainfall. The scheme enables them to grow beans, yellow and white maize, wheat, sunflower, barley, vegetables and ground nuts. While there was general appreciation of this valuable contribution, it is with noting the nutritional values of these crops. For example, beans, barley and sunflower are a source of protein, and fibre, while yellow maize has a high carotenoid content as confirmed by Aguk, Onwonga, Chemining'wa, Jumbo, and Abong' (2021). This confirms that the scheme has, therefore, offered the community members an opportunity to produce and have access to food that has nutritional value.

Shortage of food at the household level motivated some participants to join the cooperatives that operate on this small irrigation scheme and become farmers. While their goal was merely to be able to produce food for consumption by family, when they compared their before and after joining the scheme yield, they realised that they were able to double their output because of being part scheme. Such an outcome has been confirmed by Zhang et al. (2021) in their study that they conducted in Tanzania.

Reduction of hunger has been highlighted as one of the outcomes resulting from reliance on the irrigation scheme by the farmers. The participants alluded to the point that they can eat two to three meals a day which they could not do prior to take part in the scheme. This addresses two components of food security which are stability and accessibility.

Income generation is one of the positive outcomes of participating in the scheme. Farm owners were able to produce sufficient food for their

households and sell the surplus to other member of the community. The income generated from selling the surplus produce was used by the farmers to purchase other basic food items that they needed. This ensured consistent and stable supply of food among the household members. For non-farm owners, they managed to get an employment opportunity in the farms which are part of the scheme. As a result, they received income which empowered them to afford food that their household members needed.

While the farmers were able to access, afford, and utilize the food produced through the intervention of the Taung Irrigation Scheme, they could have done more if it was not for the tenure of security issues. This hindered their ability to produce more because they could not use the farms as collateral when applying for loans to maintain their farms and sustain production. They were further challenged by high costs of maintenance as they had to pay for it from their own pockets. Because their far sizes were small, they could not increase the quantity of their produce. This is where they could have intervened with innovation to maximise production in the same small pieces of land.

Conclusion and recommendations

The association among farm irrigation, income generation, and food security in the study area is indisputable. The need to feed members of their households encouraged and motivate small-scale farmers to adopt technologies such as a modern irrigation system. This irrigation infrastructure ensures a consistent water supply, which has made farming in Taung adaptable and resilient to hash and dry climatic conditions. This was demonstrated through diverse products that the farmers produced which included beans, spinach, cabbage, barley, tomatoes, yellow maize, potatoes, and sunflower. The farmers and their households were therefore able to have access to these foods in a stable and consistent manner.

The irrigation scheme has created new opportunities for continuous vegetable and crop production in the study area. Through this irrigation scheme, farmers' households were able to meet their food needs and supplement any dietary shortfalls in their own production by purchasing additional food using the income earned from surplus earnings. In cases where their farms could not meet their food needs, they used the income that they earned from selling the surplus produce to augment their supplies thus ensuring food stability. These actions by the farmers in this

study area demonstrated innovation in that they addressed the food utilisation component of food security by transforming their surplus produce into cash thus ensuring food sufficiency. This scheme enhances food access, and availability thus heightening the level of food security in the study area.

For the sustainability of this small-scale farming that is dependent on an irrigation scheme, the lack of security of tenure, high costs of theft, aging infrastructure and associated high-cost maintenance, and small farm size must be addressed. The fact that farmers forge on despite these hindrances confirms their commitment to making sure that there is sufficient food in the context of their households. Their continued involvement was largely motivated by the tangible benefits that outweighed these obstacles. The intervention by the Department of Agriculture through the Letsema programme played a supportive role in addressing some of these challenges.

Consistent with the Land Tenure Act of 1996, this study recommends that the lack of security of tenure in rural areas be addressed through the formalisation of long-term land use and occupancy rights. The process for allocating land, issuing certificates, and maintaining correct land records at the community level should be clearly stipulated in implementation guidelines. These guidelines should also specify the roles and responsibilities of traditional councils, community structures, and relevant government departments, as well as the oversight and dispute resolution mechanisms needed to ensure transparency, clarity, accountability, and equitable access to land. Once the recommended transformation of the Land Tenure Act has been implemented, it must be strictly enforced to ensure compliance at all levels. To enhance the contribution of these reforms toward the sustainable production of food for both farmers' households and the broader community, this study further recommends that the government agricultural support be directly linked to the security of land tenure. Strengthening this connection will encourage long-term investment in farming activities and promote food security contribution by small-scale farmers in rural areas.

To check the quality of their produce, it is recommended that the small-scale farmers must collaborate with higher education institutions' research stations such that they can maintain and improve their standards where necessary. Further to that, the public agricultural extension services must be availed to the small-scale farmers on a continual basis. If all suggested changes are implemented collaboratively manner, it is anticipated that this small-scale farming in the Taung Irrigation Scheme will enhance the quality and quantity of the agricultural production thus improving the food security level.

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