FACTORS INFLUENCING UNDER-UTILISATION OF SMALLHOLDER IRRIGATION SCHEMES AND OPPORTUNITIES TO IMPROVE THE SCHEMES' PRODUCTIVITY IN LIMPOPO PROVINCE, SOUTH AFRICA

Jabulani Jiyane and Timothy E Simalenga

WATER RESEARCH COMMISSION

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BY

Jabulani Jiyane and Timothy E Simalenga

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AGRI-ENG Consulting (Pty) Ltd

WATER RESEARCH COMMISSION

Obtainable from
Water Research Commission
Private Bag X03
Gezina
0031

orders@wrc.org.za or download from www.wrc.org.za

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EXECUTIVE SUMMARY

In South Africa and the Limpopo Province in particular, a significant amount of investments has been made into small-scale irrigation schemes over the last 20 years. The New Growth Path targets opportunities for 300 000 households in the agricultural smallholder schemes, plus 145 000 jobs in agro-processing by 2020. However, the majority of these irrigation schemes are considered to be underperforming or under-utilized or failed cases and not meeting the expected needs of the planners, policy makers and development agents. No innovative solutions and proposals have been made of the possible interventions required to make these schemes utilised at the acceptable levels, profitable and beneficiary to the farmers.

It is for this reason that Water Research Commission instituted a study to investigate the causes of the under-utilisation of the smallholder irrigation schemes in Limpopo Province and the possible interventions that can turn the schemes into profitable enterprises. The main objective of this study was to identify the factors causing under-utilisation of existing small holder irrigation schemes in Limpopo Province of South Africa.

A participatory action research was adopted and a comprehensive tool to carry out the assessments was used to conduct the study. Semi structured interviews were conducted with the smallholder irrigation committee members and extension officers responsible for the relevant schemes. Furthermore, transect walk of the scheme was carried out where selected features and components of the scheme such as pump stations, balancing dams, infield irrigation and power supply were assessed and pictures taken. GPS coordinates for each scheme were recorded.

Six (6) smallholder irrigation schemes were studied, two (2) from each of the following districts of Limpopo Province: Vhembe, Mopani and Sekhukhune districts. Failed and successful schemes, private owned, communal owned and private-public partnership smallholder schemes constituted the sample size for this study.

The following constitute the summary of the findings that cause the under-utilisation of the smallholder irrigation schemes in the Limpopo Province

a) **Lack of skills relating to irrigation scheduling**: all irrigation schemes rely on the crude and inaccurate methods for determining when to irrigate and how much water to apply. This has a direct implication on the quality of the crop and yields.
b) **The strategic partner approach**: of the two schemes that have failed totally (i.e., Tours and Kolokotela), the study showed that the schemes collapsed immediately after the Strategic Partner left. The same outcome was observed in the study carried out by Jiyane (2011) in the Limpopo Province. The Strategic Partner approach in its current form may be not sustainable and may require further investigation to verify these preliminary findings.
c) **One block one household approach**: two schemes practiced one-block-one household approach and these were Mbahela and Thabina irrigation schemes. Mbahela is using a combination of drip and sprinkler irrigation system while Thabina is using furrow irrigation method. It can be stated that Mbahela irrigation scheme is doing well. Furthermore, it is stated here that Thabina irrigation scheme could be doing well if it had no water supply problems. It is thus concluded therefore that such irrigation methods as floppy irrigation system which does not allow for demarcation into individual blocks is not suitable for smallholder irrigation schemes owned by several beneficiaries.
d) **Lack of business attitude towards irrigated farming**: it was observed that the farmers have no proper and detailed records of the production costs. The farmers were not aware if they had made profit at some point in time. As long as farmers do not have the income/expenditure attitude towards irrigated agricultural production, the level of production at these smallholder schemes will be low.
e) **No record keeping**: it was observed that the farmers do not keep records of the following: seasonal water use, quantities of production inputs purchased and used at any given season. This is considered as the basic way of showing commitment into any business adventure and becomes the primary tool to show the correct performance of the farm or irrigation scheme.

f) **No prior arrangement of markets for the crops/vegetables grown**: the farmers produce the crops/vegetables and look for markets when the crops/vegetables are ready. This leads to produces fetching low prices, or failure to find market in time resulting in the farm produce getting spoiled.

g) **Vandalism and theft problems:** Three schemes i.e. Tours, Kolokotela and Mbahela had experience serious problems related to vandalism and theft of irrigation assets bought for the schemes. This can be attributed to overall management problems and lack of accountability in leadership.

The following are the recommendations of this study:

a. The new strategic direction to support smallholder irrigation schemes must adopt the "One block one household" approach.
b. The current Strategic Partnership model has not produced the intended results and requires further investigation in order to come up with innovative approach.
c. Smallholder farmers must be trained in basic business/irrigation management, marketing and record keeping.
d. There is need for the introduction of easy, affordable but fairly accurate irrigation scheduling methods to assist smallholder irrigation farmers.
e. There is a need to investigate the "floppy" irrigation systems on its sustainability related to operational costs, operational design and profitability
f. Vandalism seen in some of the irrigation schemes needs to be addressed by the owners for sustainability of these and future irrigation schemes
g. Youth should be encouraged to take over from the ageing farmers as demonstrated by Phetwane and Mphaila irrigation scheme approach.

This study hereby proposes the following possible interventions for the improvement of performance of smallholder irrigation schemes in Limpopo Province and South Africa in general.

- Training and on-farm demonstrations on the basics of irrigation scheduling
- Training in basic business management with a view towards transforming the mindset of smallholder farmers into entrepreneurs and business people.

- Comprehensive review and investigation into the factors causing the underperforming of the existing strategic partner concept
- Gradual conversion of existing large scale sprinkler irrigation schemes to drip irrigation farming.
- Introduction of Mechanisation Centres as medium term solution for the problems of agricultural machinery, equipment and transport at the farms
- Strengthening the participation of youth and the use of digital agriculture technologies in irrigation farming.

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LIST OF ACRONYMS AND ABBREVIATIONS

DAFF	Department of Agriculture, Forestry and Fisheries
LDARD	Limpopo Department of Agriculture and Rural Development
CASP	Comprehensive Agricultural Support Programme
DRDLR	Department of Rural Development and Land Reform
FAO	Food and Agricultural Organisation
GPS	Geographic Positioning System
Ha	Hectare
kVA	Kilovolt-ampere
NDP	National Development Plan
NGO	Non-government organisation
PTO	Permit to Occupy
TOR	Terms of Reference

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1 BACKGROUND

In South Africa and the Limpopo Province in particular, a significant amount of investments has been made into small-scale irrigation schemes over the last 20 years (Van Averbeke, 2008). The New Growth Path targets opportunities for 300 000 households in agricultural smallholder schemes, plus 145 000 jobs in agro-processing by 2020 (DAFF, 2015).

However, the majority of these irrigation schemes are considered to be underperforming and/or under utilised or failed cases and not meeting the expected needs of the planners, policy makers and development agents (van Koppen et al., 2017; Mpandeli and Maponya, 2014; Jiyane, 2011; Van Averbeke et al., 2011, Bembridge, 2000 and Copeland, 1993). Previous studies that have been carried out in the Limpopo Province (van Koppen et al., 2017; Van Averbeke et al., 2011) have compiled several factors that were identified as the main causes of under-performance and under utilisation of the smallholder irrigation schemes in the province. Some of the factors included: poor status of irrigation infrastructure, fencing, lack of tractors, access to markets and market information, poor road infrastructure, expensive transport system and flood damages (van Koppen et al., 2017; Mpandeli and Maponya, 2014). However, no innovative solutions and proposals were made for the possible interventions required to make these schemes utilised at the acceptable levels, profitable and beneficiary to the farmers.

Investment in agricultural infrastructure is increasingly being recognised as a key factor in reducing food insecurity, malnutrition, poverty, unemployment and hunger, as it has been shown to have greater impact than equivalent investment in urban and industrial development. Furthermore, with adverse impacts posed by climate change, it is no longer an argument that sustainable agricultural growth in the smallholder irrigation schemes for the rural communities of the African continent and South Africa in particular require additional water supply through some form of irrigation.

Experience on the ground shows diverse performance and lower levels of utilisation of existing small-scale irrigation schemes (Jiyane, 2011; Averbeke et al., 2011). Some are successful while others are poorly performing. For sustainable food security,

poverty alleviation and livelihoods enhancement in general, it is critical that the performance of the smallholder irrigation schemes is improved and sustained.

The central problem is to seek for underlying causes of the under-utilisation of these irrigation schemes and the possible interventions or innovative solutions that can turn the schemes into profitable enterprises. Furthermore, options to improve usage of existing smallholder irrigation schemes so as to alleviate poverty, unemployment and agricultural productivity will be explored.

It is expected that the outcome of this work will fulfil the anticipated outcomes of the National Development Plan (2030) of expanding irrigated agriculture to augment dry land farming and boosting rural economies (NDP, 2011). It is against this background that a study was carried out to identify the factors that cause the under utilisation of the existing smallholder irrigation schemes.

1.1 The concept of Agri Parks

Launched in 2015 as one of the cornerstones of rural economic transformation, the Agri-Parks (APs) are conceptualised as one-stop centres for agro-production support, processing, logistics, marketing and training within district municipalities. The Agri Parks concept entails a centrally-planned, state funded, three-tiered model consisting of farmer production support units in each local area from where extension services will take place, and an agro-processing hub in each district municipality linked with a handful of rural-urban marketing centres (Crosby et al, 2017).

The APs system is a relatively new concept to South Africa (SA), but the idea draws from existing models both locally and abroad, which includes: educational/experimental farms, collective farming, farmer-incubator projects, agri-clusters, eco-villages, and urban-edge allotments, as well as market gardens. These models exist in both a public and private capacity, serving as transition or buffer zones between urban and agricultural uses. The use of the word “Park” is intended to convey the role that the Mega AP (nationwide network) will play in open space preservation.

The term “AP” suggests permanent land conservation and recreational use that is synonymous with the description “public park”, it brings to the fore a more traditional model of an agricultural “business park”, or “hub”, where multiple tenants and owners operate under a common management structure. The AP are intended to provide a platform for networking between producers, markets and processors, while also providing the physical infrastructure required for the transforming industries.

Broadly speaking the aim is to create farmer-owned value chains in conjunction with areas targeted for land reform. Thereby providing not only access to markets and support to land reform beneficiaries, but also to provide them with meaningful ownership and control in the value chain. It is hoped that the initiative will create 300,000 jobs and contribute to transforming both the primary sector as well as the value chain (Urban-Econ, 2016).

These are noble aims, but the ‘nuts and bolts’ of the design reveal a centrally planned structure that largely depends on government support. Whilst we urgently need to promote the growth of a viable intensive smallholder sector that is integrated into a successful value chain, there is concern that the design regresses back to the model of a highly-regulated industry reliant on state support like South Africa had prior to the decision to deregulate the industry in line with the General Agreement on Trade and Tariffs (GATT) (Crosby et al, 2017).

Agri-parks are expected to act as critical hubs for the identification and harnessing of agricultural belts as well as agricultural value-chains. The spin-offs from agri-business development will transform rural towns and villages into vibrant economies.

1.1.1 The guiding principles of Agri Parks

The following constitute the guiding principles of the AP concept (DRDLR, 2017).

- One Agri-Park per district, and rolling-out of Agri-parks will be to all forty-four (44) Districts in South Africa
- Agri-parks must be farmer controlled.

- Agri-Parks will become the catalyst around which rural industrialization will take place.
- They must be supported by government for at least 10 years to ensure economic sustainability.
- Agri-Parks will strengthen partnership between government and private sector stakeholders.
- They will maximise benefits to existing state land with agricultural potential
- They will maximise access to markets to all farmers, with a bias to emerging farmers and rural communities.
- They will maximise the use of high value agricultural land.
- They will maximise use of existing agro-processing, bulk and logistics infrastructure.
- They will support growing-towns and revitalisation of rural towns.

2 OBJECTIVES AND SELECTION OF THE SMALLHOLDER IRRIGATION SCHEMES FOR THE STUDY

2.1 Objectives of the study

The main objective of this study was to identify the factors causing under-utilisation of existing small holder irrigation schemes in Limpopo Province of South Africa. The study aimed at analysing the selected representative small holder irrigation schemes in terms of the current status: crop yields, water usage (amount, availability and quality), irrigation infrastructure, environmental and socio-economic factors.

The main specific objectives are outlined below:

(a) To carry out physical assessment of the status and performance of the existing smallholder irrigation schemes in order to identify the factors causing under-utilisation of the schemes

(b) To develop possible opportunities for the improved use of the existing smallholder irrigation schemes that will result in improved schemes performance.

3. METHODOLOGY FOR THE ASSESSMENT OF SMALLHOLDER IRRIGATION SCHEMES

A work package approach using participatory action research was adopted. A comprehensive tool to carry out the assessments was used to conduct this study (Appendix 1). A similar approach was used by Haileslassie et al. (2016) and Van Averbeke (2012). Semi structured interviews were conducted with a small panel consisting of farmers, preferably members of the scheme management and the extension officers. Following the completion of the interview, a transect walk of the scheme was carried out where selected features and components of the scheme was assessed and pictures taken. Such components included: the soils, general crop appearance, irrigation infrastructure, pump station and power supply.

In order to achieve the two (2) specific objectives of this study, two work packages were identified and they are outlined below.

2.2 WORK PACKAGE 1: Physical assessment of the status and performance of the existing smallholder irrigation schemes to identify the factors causing under-utilisation of the schemes.

2.2.1 The criteria used to select the smallholder irrigation schemes

The AgriEng Consulting team engaged with the Limpopo Department of Agriculture and Rural Development (LDARD) to identify and select the six (6) smallholder irrigation schemes in the three (3) districts of Limpopo Province.

The involvement of the Limpopo Department of Agriculture and Rural Development was done to achieve the following:

- To get the buy-in and ownership of the study by the department right from the inception of the study,
- To make it easier to get support from government officials to assist AgriEng Consulting team to locate and access the farms,

- The LDARD has already expressed interest in this study and the outcomes thereof.

In order to successfully compile and determine the factors that cause the under-utilisation and under performance of the smallholder irrigation schemes in Limpopo Province, different types of smallholder irrigation schemes were planned to be studied. For that purpose, the smallholder irrigation schemes for this study were selected using the following criteria:

- communally owned scheme,
- government initiated, or
- private-public partnership operated schemes, or
- the successful scheme and
- the failed schemes

2.2.2 Selection of the smallholder irrigation schemes

Due to the large number of smallholder irrigation schemes in the Limpopo Province, a sampling technique of the schemes for detailed analysis was used. The smallholder irrigation schemes listed under **Section 3.2.3** below were selected from the list of irrigation schemes in Limpopo Province which are under the Limpopo Department of Agriculture (LDARD). The selection was carried in conjunction with the LDARD district and local officials. The schemes were grouped into communally initiated and owned, government initiated and communally owned, or privately owned, private-public-partnership schemes, the successful and failure schemes and random selection was used to determine the scheme for detailed study.

2.2.3 List of smallholder irrigation schemes for the study

The following is the list of the smallholder irrigation schemes which were selected for this study.

Table 1: List of smallholder irrigation schemes studied

Name of Irrigation Scheme	Location	District	Size (Ha)
Tshiombo-Mbahela	Thulamela	Vhembe	100
Mphaila	Makhado	Vhembe	71
Phetwane	Marble Hall	Sekhukhune	52
Kolokotela/ Krododilheuwel	Makhuduthamaga	Sekhukhune	240
Thabina	Greater Tzaneen	Mopani	228
Tours	Greater Tzaneen	Mopani	125

2.2.4 Development of schemes assessment template

An assessment template was developed which was used as a tool towards assessing the smallholder irrigation schemes. This ensured uniformity of data collected from the selected schemes.

The schemes assessment tool or template which was developed aimed at capturing the following key areas:

2.2.4.1 Irrigation hardware

These included irrigation technology used in the smallholder irrigation schemes, design and layout of infrastructure, implementation, technology suitability to the users, crops grown and marketability, irrigation technology vs soil type, water quantity and quality, the farmers' capabilities to operate and maintain the irrigation infrastructure. The impact of the operational costs such as electricity, water, production inputs and labour has on the existing schemes viability.

2.2.4.2 Irrigation software

These included cultural factors, personal perceptions of members, age structure, gender, governance and management approaches, market availability and access, extension services and government support. The “human dimension” has received very little attention in the past studies. Low participation by farmers right from the planning phase has been identified as one of the problems of poor performance of most schemes in Africa (Bembridge, 2000).

2.2.4.3 Value addition activities

The ability to carry out value addition processes on site which tend to improve the farming enterprises has been identified as a critical factor in the sustainability of smallholder farming (Jiyane, 2011). These should include such processes as drying, milling, canning or packaging such that farmers are able to realise higher income from their produce instead of selling it raw.

2.2.4.4 Market availability and ease of access

These include market availability, proximity and road infrastructure have a direct impact on the viability and resilience of farming enterprises. This study assessed the effect of these on the small holder irrigation schemes performances.

2.2.4.5 Environmental Factors

These included water availability; quality and reliability were captured as this has potential to negatively affect the smallholder irrigation schemes performance and operation at satisfactory capacity. Soil types and soil suitability for crop production, the impact of soil type on the performance of the irrigation schemes was captured, its

suitability (drainage, depth, type) for the type of irrigation system used and the crops grown.

2.3 Physical assessment of the smallholder irrigation schemes in the Limpopo Province.

The AgriEng Consulting multi-disciplinary team carried out the farm visits and assessments during the month of October 2018. The team was accompanied by agricultural advisors for each smallholder irrigation scheme. Below is the outline of the studies per each scheme.

2.3.1 Detailed study of selected schemes in Vhembe District

The two smallholder irrigation schemes selected for the study in Vhembe District were Mphaila and Tshiombo-Mbahela smallholder irrigation schemes. The details of the schemes are as follows:

Name of irrigation scheme	Area location	GPS Coordinates	District	Status
Mphaila irrigation scheme	Mphaila, Thulamela	-22.9074; 30.1289	Vhembe	Functional
Tshiombo-Mbahela	Mbahela, Thulamela	-22.804115; 30.452918	Vhembe	Functional

Using a data collection instrument developed, the selected two (2) smallholder irrigation schemes were visited to conduct physical survey and assessment of the schemes. Meetings and interviews with farmers, committee members, extension officers and relevant stakeholders (LDARD officials) were carried out. Furthermore, physical assessment of the schemes infrastructure and general conditions were executed by the researchers in order to extract additional information.

2.3.2 Detailed study of selected schemes in Mopani District

The two smallholder irrigation schemes selected for the study in Mopani District were Tours and Thabina smallholder irrigation schemes. The details of the schemes are as follows:

Name of irrigation scheme	Area location	GPS Coordinates	District	Status
Tours	Tours, Tzaneen	-24.085158; 30.283510	Mopani	Non-operational
Thabina	Khopo, Tzaneen	-23.959525; 30.291118	Mopani	Operational

Using a data collection instrument developed, the selected two (2) smallholder irrigation schemes in Mopani District were visited to conduct physical survey and assessment of the smallholder irrigation schemes. Meetings and interviews with farmers, committee members, extension officers and relevant stakeholders (government) was carried out. Furthermore, physical assessment of the schemes infrastructure and general conditions were executed by the researchers in order to extract additional information.

2.3.3 Detailed study of selected schemes in Sekhukhune District

The two smallholder irrigation schemes selected for the study in Sekhukhune District were Phetwane and Kolokotela smallholder irrigation schemes. The details of the schemes are as follows:

Name of irrigation scheme	Area location	GPS Coordinates	District	Status
Phetwane	Phetwane,	-24.757661; 29.431812	Sekhukhune	Operational
Kolokotela	Kolokotela	-24.693380; 29.445598	Sekhukhune	Non-operational

Using a data collection instrument developed, the selected smallholder irrigation schemes in Sekhukhune District were visited to conduct physical survey and assessment of the smallholder irrigation schemes. Meetings and interviews with farmers, committee members, extension officers and relevant stakeholders (government, NGOs) was carried out. Furthermore, physical assessment of the schemes infrastructure and general conditions were executed by the researchers in order to extract additional information.

2.3.4 Compilation of an assessment report

Reports for the assessed smallholder irrigation schemes from each of the three districts were compiled. A summary of the key findings of the factors that cause smallholder irrigation schemes under-utilisation and poor performance was crystalised with recommendations.

2.4 WORK PACKAGE 2: Development of possible opportunities for the improved use of the existing smallholder irrigation schemes that will result in improved schemes performance.

Reports for the assessed smallholder irrigation schemes from each of the three districts were compiled. A summary of the key findings of the factors that cause smallholder irrigation schemes under-utilisation and poor performance shall be crystallised with recommendations.

This information shall be collated and synthesized and lessons learnt compiled.

2.4.1 Compilation of possible interventions for the improvement of smallholder irrigation schemes in South Africa

After drawing out summaries of the factors identified in **Sections 3.3.1 to 3.3.4** which are causing under-utilisation of the smallholder irrigations schemes, a compilation of the most possible opportunities for the improved use of smallholder irrigation schemes in Limpopo Province was made.

Qualitative assessment methods were used to provide explanations of trends, reasons for success or failure, external events affecting project performance as well as insights on beneficiaries' perceptions, feelings, opinions, and concerns (Angela Orlando, 2013).

3 FIELD OBSERVATION OF THE SELECTED SMALLHOLDER IRRIGATION SCHEMES

A total of six (6) irrigation schemes were visited during the month of October 2018 where the physical assessment of the smallholder irrigation schemes was carried out. Meetings and interviews with farmers, committee members, extension officers and relevant stakeholders (government) were carried out. Furthermore, physical assessment of the schemes infrastructure and general conditions shall be executed by the researcher in order to extract additional information. Pictures and GPS coordinates were captured and recorded.

The details of the field observations for each smallholder irrigation schemes visited and assessed is outlined below.

3.1 Mbahela Smallholder Irrigation Scheme

3.1.1 Summary information for Mbahela Irrigation Scheme

Name of Scheme	Mbahela Irrigation scheme
Scheme Ownership	Mbahela Agricultural Cooperative
Location area	Mbahela Village
Project Activity	Crop/Vegetable Production
Current status	Operational
District	Vhembe
Local Municipality	Thulamela
Scheme size	100 ha
Number of Beneficiaries	85 farmers
Contact Person	Mr A J Tshifularo

:

3.1.2 Background information for Mbahela Irrigation Scheme

Mbahela irrigation is one of the seven (7) which is supplied from the central canal from a weir on Mutal River. Mbahela irrigation scheme was established in 1963 and is located within the Thulamela Municipality under Vhembe District of Limpopo Province, South Africa. Mbahela is part of portion of the Tshiombo Irrigation area which is situated at 22.804115^{o} South and 30.452918^{o} East and is about 35 km (tarred road and 10km gravel road) north of Thohoyandou Central Business District. The following villages share boundaries with Tshiombo: Tshandama, Makonde, Pile and Thengwe. These villages are situated at an altitude of 650 m above sea level, see the Layout map below.

This irrigation scheme occupies an area of about 100 hectares with 85 beneficiaries consisting of 41 females, 44 males and 24 youth. The irrigation scheme is mainly producing cash crops like maize, sweet potatoes, groundnuts, cabbages, and dry beans.

The irrigation scheme is communally owned and the farmers have land rights (P.T.O) for the farm and currently they have planted maize, sugar beans, cabbages, groundnuts and sweet potatoes on 33 hectares of land under floppy irrigation system with the assistance of a strategic partner. The profit shared is on 50/50 basis wherein the partner has to deduct his costs before declaring the dividend.

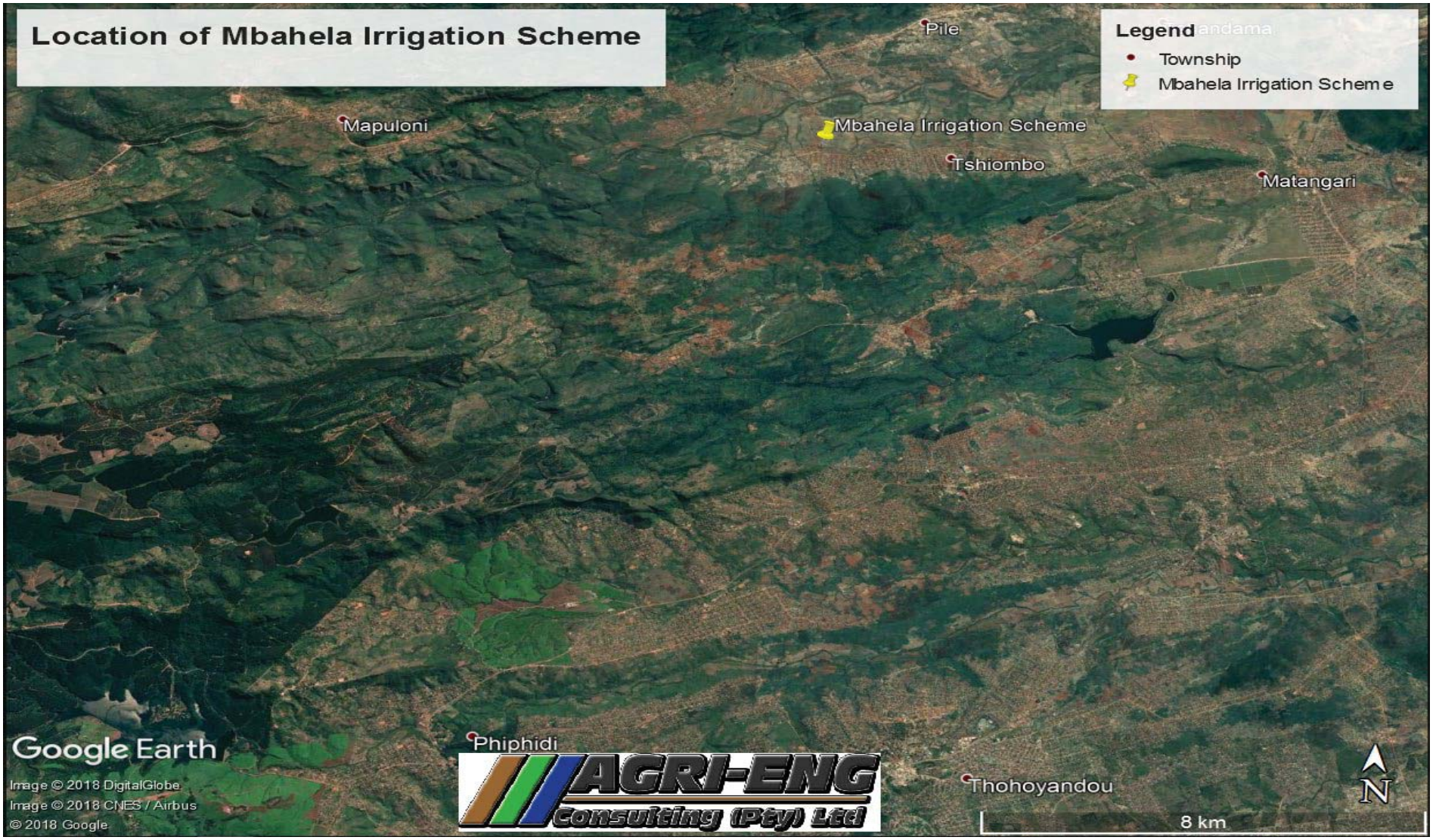

Figure 1: Location map for Mbahela irrigation scheme

Figure 2: The sign board showing the Tshiombo irrigation scheme offices.

From the year 2008, the Limpopo Department of Agriculture revitalized the Mbahela scheme from flood irrigation system to floppy system of irrigation so that farmers will be able to practice their farming in a commercial way. In 2009, they started to work with the Strategic Partner called Mr Arthur Creighton where they were producing potatoes and maize. It was agreed that the profit sharing ratio shall be 1:1. The contract with the Strategic Partner ended in the year 2012.

The following year of 2013 to 2014, the Limpopo Department of Agriculture made a provision of fertilizers, maize seeds and mechanization so that they can produce maize in 100 ha on their own and sell to Progress Milling in Polokwane.

In the year 2016, another Strategic Partner (Freshmapp) came and produced cabbages, spinach and sweetcorn. The business failed largely because of lack of transparency and accountability. Crops were sold and the partner did not disclose the profits realised thereafter and no profits sharing was made as agreed during the signing of the contract. Since the vacation of the Freshmapp Partner, the Committee and the LDARD engaged the strategic partner so that he clarifies to the beneficiaries

on the project performance. In response the strategic partner indicated that a full report detailing all the production cost will be submitted.

Currently the project has received funding from the Department of Rural Development and Land Reform. They have recently purchased inputs, a tractor and erected a fence. Their biggest challenge is the floppy irrigation system which is not functional at the moment due to stolen system components at the pump station. The farmers have resorted to opening channels from the canal that run through the field and diverting the flow onto the fields using make-shift furrows due to the absence of a proper irrigation system. This procedure is now resulting in soil erosion as the soils are sandy.

Figure 3: The current floppy irrigation systems used Mbahela irrigation scheme.

3.1.3 The available resources for the scheme

3.1.3.1 Soil types

The area is characterized by fertile sandy loamy soil. The soils are suited for irrigated agriculture, deep and well drained. The soil has demonstrated over the past that it has the capacity to produce wide variety of vegetables and crops as highlighted in the sections below. No soil analysis was carried out for this study.

3.1.3.2 Vegetable and crop production

Mbahela Primary Cooperative has specialized mainly in the production of a variety of crops and vegetables. For the 2016/17 season, the crops grown on the farm included sweet potatoes on 20ha, maize on 50ha, sugar beans on 15ha, cabbages on 10ha and groundnuts on 30ha. All these have a ready market locally.

3.1.3.3 Availability of water

The irrigation water requirement was estimated to be 757,000 m^3 per annum. The irrigation water is sourced from the perennial Mutale River through the canal system. Water is delivered into the unlined balancing dam with capacity of approximately 4,500 m^3 which is located on the upslope of the farm. The farm uses existing floppy irrigation system to irrigate a portion of the farm and also uses the flood irrigation system.

3.1.3.4 Availability of markets and technical advice

Mbahela Agricultural Cooperative is very fortunate indeed to be closer to markets in and around Thohoyandou town. Technical inputs are provided by the agricultural extension staff who have offices close to the scheme.

3.1.3.5 Power availability

Mbahela irrigation has a three (3) phase electrical power supply though a transformer for the irrigation has been vandalised and needs to be repaired. The size of transformer could not be established as it was vandalised.

3.1.4 The status of the existing irrigation infrastructure for Mbahela

The existing irrigation infrastructure for Mbahela consists of a floppy system covering the entire 100 ha land, a pump station and the balancing dam.

3.1.4.1 The balancing dam

The balancing dam is in a good state and is currently being used to store water for use using the flood irrigation system adopted by farmers.

3.1.4.2 The pump station

Currently, the irrigation scheme is not functional due to vandalism of the pump station. The pump station was vandalised, the centrifugal pumps stolen and the overhead pipes damaged. Furthermore, the transformer was vandalised and stolen.

3.1.4.3 The floppy irrigation system

The overhead floppy irrigation pipes have been damaged due to non-use. The farmers have reverted back to the previous flood irrigation method to keep their crops in good conditions on a small portion of the field. It was observed that the makeshift flood irrigation system was beginning to cause significant soil erosion which was a concern to the farmers and local government officials. The system does not allow for individual blocks demarcation for farmers.

3.1.5 Challenges faced by farmers of the irrigation scheme

During the study, the farmers indicated the following key challenges they face:

a) The operational costs for the floppy irrigation systems are high. The 315 kVA transformer for the irrigation scheme is too big. The farmers indicated that the average electricity bill of R13,000 per quarter was unsustainable.
b) Theft and vandalism of the pump station, transformer and the overhead floppy irrigation pipelines causing the farmers to revert back to the original flood irrigation method.
c) Theft of crops.
d) Availability of water for irrigation.
e) The floppy irrigation system is perceived to be expensive to maintain
f) The floppy irrigation system does not allow for demarcation into individual blocks. The farmers preferred to have individual blocks where each farmer will take full responsibility for the crops grown per season.
g) The flood irrigation method used by farmers due to the vandalism of the floppy irrigation system has produced a negative impact on the farm by causing soil erosion.
h) The farmers do not have their own transport to deliver produce to the market, they rely on hiring and that means the farmers are not in control of delivery times. This sometimes compromises the quality of their produce.
i) The strategic partner was unfaithful: not willing to work with the executive committee and hence the farmers terminated the contract. During the period of study, the farm was under new management/ executive committee.

Figure 4: A farmer pointing to the vandalized motors at the water pump house: All 3 motors were stolen

Figure 5: Soil erosion challenges at the scheme due to flood irrigation

3.1.6 Challenges observed by the researchers

The following are some of the challenges observed by the researchers that have significant impact on agricultural productivity of the land under irrigation for smallholder irrigation farms:

a) **Problems of irrigation scheduling**: The irrigation scheduling methods are very unreliable. The farmers use the crop condition to determine when to irrigate the crops, that is, when the plants show signs of wilting that is when the farmers irrigate.
b) **Lack of business attitude towards irrigated farming**: it was observed that the farmers have no proper and detailed records of the production costs. The farmers were not aware if they had made profit at some point in time. As long as farmers do not have the income/expenditure attitude towards irrigated agricultural production, the level of production at these smallholder schemes will be low.
c) **No record keeping**: it was observed that the farmers at Mbahela irrigation scheme do not keep records of the following: seasonal water use, quantities of production inputs purchased and used at any given season.
d) **No prior arrangement of markets for the crops/vegetables grown**: the farmers produce the crops/vegetables and look for markets when the crops/vegetables are ready. This leads to produce fetching low prices.
e) **Vandalism of irrigation assets and crops**: This is one of serious problem facing the irrigation scheme. The executive committee has not found any remedial measure to control the situation.

3.1.7 Factors affecting the irrigation scheme performance

As indicated under **section 4.1.3** above, the Irrigation scheme is currently experiencing low performance of production and productivity due to a number of factors. These are:

- Theft of crops and vandalism of the irrigation infrastructure
- Conflicts of interest between the strategic partner and the beneficiaries
- Lack of business attitude towards irrigated agriculture
- Problems of irrigation scheduling
- Operational costs of the floppy irrigation system which is too high
- The floppy irrigation does not allow for demarcation into individual blocks
- Availability of water
- Soil erosion due to flood irrigation system

3.2 MPHAILA IRRIGATION SCHEME

3.2.1 Summary information for Mphaila smallholder irrigation scheme

Name of Scheme	Mphaila Irrigation trading as Chime Agricultural Cooperative
Area Situated	Nzhelele Village
Project Activity	Crop and Vegetable Production
District	Vhembe
Municipality	Makhado
Hectares	71 hectares
Number of Beneficiaries	62 farmers
Contact Person	Mr Mphephu Edwin Ranganani

3.2.2 Background information for Mphaila irrigation scheme

Mphaila irrigation scheme was established in 1988 and is situated in Vhembe district of the Limpopo Province. The scheme operates as a Chime Agricultural cooperative and was established by beneficiaries from the Mphaila area with the sole aim of improving farming. The water source is a perennial Mutshedzi river.

The famers currently own a piece of land through the permission to occupy (P.T.O) arrangement. The total extent of the scheme is 70.6 ha and there are 62 households in the scheme each owning an average of 1 ha. Farmers at Chime Cooperative applied for funding to the Department of Rural Development and Land Reform and R2.5 million was approved for the revitalisation of the irrigation scheme. That meant the conversion from the predominantly sprinkler irrigation system and introducing the drip irrigation system. At the moment, the scheme has both drip and sprinkler irrigation systems.

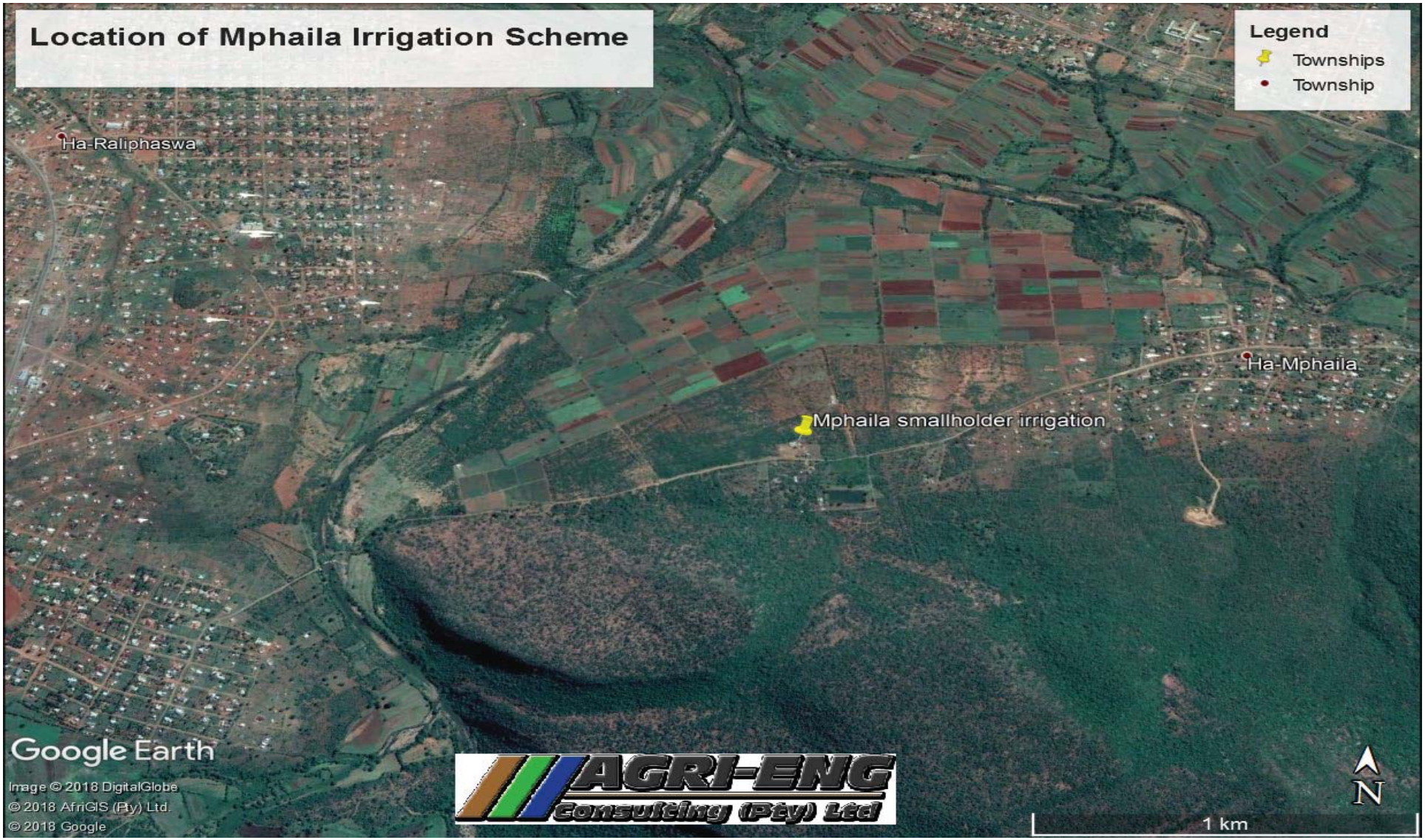

Figure 6. Location map of Mphaila Irrigation Scheme

Through this funding, their aim was to fulfil their objectives as stated below.

- To improve farming practices in the scheme
- To move from emerging to commercial farming
- To contribute to economic growth of the country through crop production
- Improving livelihoods of people
- Increasing farming yields
- Job creation
- Skills development through learner-ships and internships

Mphaila irrigation scheme is demarcated into blocks for individual household farmers.

Figure 7: A Welcoming sign board to Mphaila irrigation scheme.

The farmers have land rights (P.T.O) for the farm and currently they plant tomatoes which fetches 120 tons per hectare, cabbage, beans and maize. The land is under drip irrigation system and overhead sprinkler system.

Figure 8: The drip irrigation systems used at Mphaila irrigation scheme.

Figure 9: The sprinkler systems used at Mphaila irrigation scheme.

During the study, it was reported that the scheme is in the process of changing the sprinklers to drip irrigation due to the challenges of high wind speeds prevalent in the area. Currently both systems are being used as shown in Figure 8 and 9.

The Limpopo Department of Agriculture is proactively providing extension services and also assists farmers on a continuous basis during the production season since this is an agricultural enterprise and is one of the department's competencies.

3.2.3 The available resources for the scheme

3.2.3.1 Soil types

The irrigation scheme is characterized by fertile red loamy soils. The soil in the area has demonstrated over the past that it has the capacity to produce wide variety of vegetables and crops as highlighted in the section below.

3.2.3.2 Vegetable and Crop production

The Chime Primary Cooperative specializes mainly on production of a variety of vegetables and crops. These include: tomatoes, dry beans, cabbage and maize as there is a ready market for these products at the local villages. The farmers are organized into groups as shown in Table 3 below to produce these commodities.

The scheme is intending to produce high quality crops in order to:

- Supply the local market on a regular basis and extend their sale of products to Tshwane and Tzaneen markets
- To meet the required quality and standard of the products in demand
- Generate sustainable income and promote job creation
- Technology transfer and skills development

Table 2: Farmer commodity groups

Commodity group	Number of farmers	Gender		Youth	Number of hectares
		Male	Female		
Butternut	20	16	4	4	20.9
Tomato	19	15	4	16	23.3
Beans	23	18	5	6	26.4
Grain total	62	49	13	26	70.6

3.2.3.3 Availability of marketing and technical support

The farmers from Mphaila smallholder irrigation scheme sell their vegetables and crops to the following markets:

Vegetable Type	Market
Green pepper, butternut, jam squash and green beans	Johannesburg Fresh Produce Market (City Deep), Local Spar, Boxer and informal traders.
Chilies	Cape Town fresh produce market
Tomatoes	City Deep, Hawkers

The cooperative has a firm marketing team whereby the investigation of markets is an ongoing process and the farmers do make it their tasks to find the market for their produce. The effective marketing of all produce will be very important for the financial success of the project.

The LDARD has a permanent office on the irrigation scheme which provides continuous technical, market and financial information and advisory services to the farmers.

3.2.3.4 Availability of water

The irrigation water is sourced from the perennial Mutshedzi River. Water is pumped from the river to a balancing dam which is located on the mountain side and comes down by gravity to irrigate the fields. The location of the balancing dam gives enough pressure to operate the sprinklers and drippers. That results in low operational costs for the farm which makes the scheme viable.

3.2.3.5 Power availability

The scheme has a three phase, 50 kVA transformer which operates the pump station.

3.2.3.6 Machinery and equipment

The Mphaila irrigation farmers have no tractor nor any form of implements. They hire the tractors and hire the implements for their cropping needs.

3.2.4 The status of the irrigation infrastructure

3.2.4.1 The pump station

The pump station is in good operating status and pumps water from Mutshedzi river to the balancing dam.

3.2.4.2 Power availability

The scheme has 3-phase electricity and the size of the transformer is 50 kVa. This is adequate for the existing irrigation pumps.

3.2.4.3 The irrigation system

Currently, the scheme uses a combination of sprinkler and drip irrigation systems. During the study, the farmers indicated that they intend replacing all overhead sprinklers by drip lines. It was stated that a lot of water is wasted from the sprinklers since most of the farm areas experience high speed winds. This tends to result in poor application uniformity which is not good for the crops.

3.2.4.4 Availability of technical advice

Fortunately, Mphaila Agricultural Cooperative has an Agricultural Extension officer who stays on the farm. The extension officer has a very established track record in terms of offering advice and support to the local small-scale farmers.

3.2.4.5 Government Support to the Scheme

The government as part of food security and economic growth in the area supports farmers in the buying of the following:

- Free inputs: seeds, Chemicals and fertilizer
- Paid water levy

The cooperative has received R2.5 million from rural development recapitalization program. Funds will be used to enhance infrastructure development and to provide crop inputs (drilling and equipping of two boreholes, farm fence, production inputs [beans; butter nut; and tomato seedlings: fertilizers; chemicals, seeds], water pump, dam fixing and drips installation).

3.2.5 Project management

The project management structure comprises the following: Chairperson, Deputy Chairperson, Treasurer, Secretary and Marketing Manager. The management team has sound farming expertise in all products that are produced on the farm. Since this project is registered as a cooperative, the day to day operations of the enterprise are governed by the cooperative principles. The leadership is for a two (2) year period and they meet once every month.

Fines have been introduced (R200) for unlawful opening and irrigating the portion of the farm without following the order.

Whilst the management structure makes decisions in terms of markets, the 1 ha per household principle means that each household is solely responsible for its 1 ha block for matters of crop selection, when to irrigate and the markets.

3.2.6 Challenges faced by farmers of Mphaila irrigation scheme

During the study, farmers indicated the following key challenges they face:

- Expensive electricity: R550/ha/month
- Water leakage in the system and water loss through wind drift from the sprinkler irrigation
- High maintenance costs of the pump station due to oil leakages resulting in changing/servicing every three (3) months

3.2.7 Challenges observed by researchers

The current challenges faced by farmers include inadequate land for production. Farmers are now opting to get more land in the nearby villages after realising the benefits which come with irrigation farming. Financing of production inputs and water have also contributed to stimulate and improve production at the farm.

The following were observed as challenges the farmers face at the scheme:

- Lack of tractors and other farming implements
- Incomplete fencing.
- Shortage of drip lines to cover one (1) ha
- Poor access road
- Depleted sub and main line pipes
- Electricity bills too expensive (ranging from R15,000 -R35,000 a month)

3.2.8 Factors affecting scheme performance

Mphaila irrigation scheme can be considered a success story.

Famers are moving away from the usage of sprinklers into drip irrigation systems; a system that is known to save both water and labour costs related to weed removals.

A total of 140 people were trained as part of the project development at Mphaila Irrigation Scheme including both female and males and 26 youth. The trainings included but not limited to; agro-processing, soil/water conservation, bean production, nursery management and drip system installations and safe use of chemicals

Previously, the Mphaila irrigation scheme used to function quite well however their level of production was too low. There was un-sizable produce for market selling which was of low quality as they did not have sufficient production inputs to improve their ways of farming. Their yields were not enough for selling although the idea of producing for business was there. However, that changed with a great improvement when they acquired funding through the Chime Agricultural cooperative. A fund aimed at solely improving the livelihoods of farmers through a one hectare one household funding from the DRDLR recapitalization programme.

In the first tranche, most of the expenses were on infrastructural costs. Through developments in infrastructure, it had positive impacts on the increment of yields for farmers. The drip systems installed for most farmers showed effective water use as they have been using Sprinklers for irrigation. This allowed farmers to increase plant populations therefore leading to an increase in production.

The following are some of the factors which make Mphaila irrigation scheme a sustainable venture:

- Farmers have established study groups.
- The government through the LDARD is paying for water levy.
- They are self-reliant: pay electricity bill, continue buying crop inputs.
- They purchase Inputs in bulk (discount).
- The existence of an office on the scheme site for an Agricultural Advisor dedicated to the irrigation scheme.
- Succession plan through youth involvement.
- Extension of market from informal to formal markets.
- Boreholes drilled for water supplement during drought season.
- Farmers taught sustainable soil use (soil and water conservation)
- Skills development: the farming skills and knowledge through training and practical experience gained by the participants thus far are an added advantage in managing the farm. Participants have been exposed to both formal and informal agricultural training and are currently involved in farming.

3.3 Tours irrigation scheme

3.3.1 Summary information of the scheme

Name of scheme	Tours Agricultural Cooperative
Area situated	Tours
Current status	Not functional, vandalised
Project activity (previous)	Crop/Vegetable Production
District	Mopani
Municipality	Greater Tzaneen
Area size	120 hectares
Number of beneficiaries	53 farmers
Contact person	Mr MS Mametja

3.3.2 Background information for Tours irrigation scheme

The initial infrastructure of Tours irrigation scheme was established in 1958 as a flood irrigation system. Unlined canals were used to convey water to the scheme. At a later stage, an underground pipeline was established which supplied water to both the scheme and the local community. The scheme is located in the Greater Tzaneen municipality of the Mopani District in the Limpopo Province. It is approximately 45 km south of Tzaneen town. The source of water for the scheme is Tours dam which is located about 2 km upstream of the farm (LDARD, 2011).

The irrigation scheme was sub-divided into Tours 1 and Tours 2. Tours 1 was a coffee project with 17 beneficiaries. Later on a strategic partner was introduced to farm pepper dew. The scheme has a bore hole and was under drip irrigation system for a long time until 2008 when the coffee project stopped due to a strike which was led by the workers on the farms.

In 2011 a strategic partner was invited to start farming pepper dew. After 5 years the project was abandoned due to soil health problems. When the strategic partner left, the 140ha which had drip irrigation was vandalised since there was no security in place to guard the farm infrastructure.

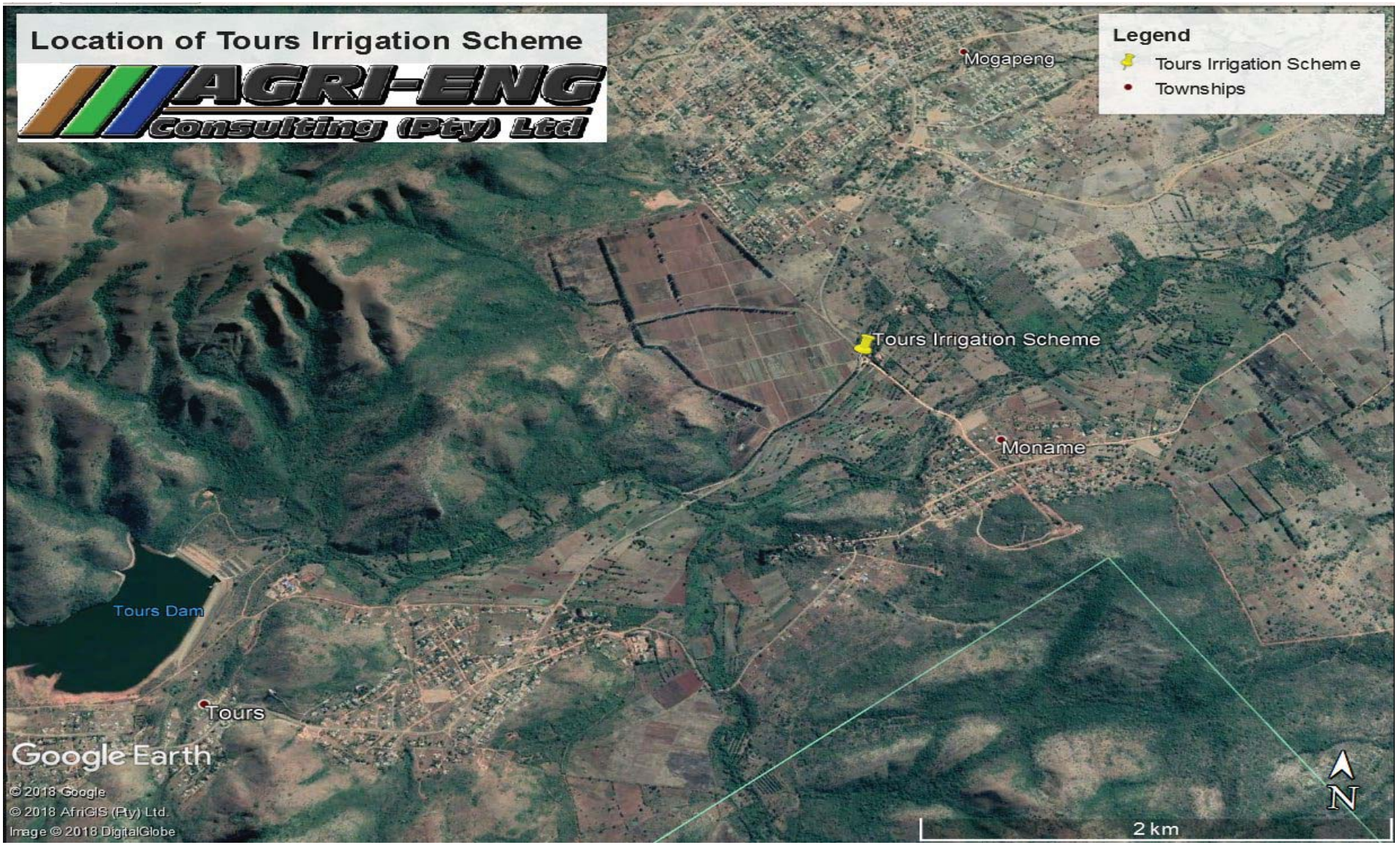

Figure 10: Location map of Tours Irrigation Scheme

3.3.3 Current status and available resources

Currently the coffee project (Tours 1) has been abandoned and completely vandalised. Farmers are now farming using rainfed agriculture. The following are the main crops cultivated: sugar cane; green beans; cabbage and maize.

The other scheme which is commonly known as Tours 2 has a total of 120ha. Currently there are a total 53 farmers, farming a total of 49 ha using canal/furrow irrigation system.

3.3.3.1 Water availability

Tours irrigation obtains its water from Tours dam which is located about 2 km upstream of the farm.

3.3.3.2 Soil type

The predominant soils are red loamy Hutton soils which are characteristically deep soils with good drainage. The Hutton soils are generally good for irrigation purposes.

3.3.3.3 Climate

Tours irrigation scheme experiences a semi-arid type of climate with summer thunderstorms typical for the area. The average annual rainfall is 850 mm per annum. The area is frost-free which allows all-year round crop production.

3.3.3.4 Topography

Tours irrigation scheme lies on the foothills of the Klein Drakensberg hills. The topography consists of portions that are even to gentle rolling slopes towards the river.

3.3.3.5 Market availability and technical advice

During the study, the scheme had been completely vandalised. There were a few portions of the scheme where farmers grew cabbages. The markets available for the scheme consist of neighbouring communities of Tours, Moname, Mogapeng, Rhulani, Julesburg, Pharare, Lunyenye, Tzaneen, Polokwane, Joburg City Deep, Pretoria Fresh Produce Markets.

The scheme had a resident agricultural advisor. However, the residence and offices have been vandalised.

3.3.4 Status of the existing irrigation infrastructure for Tours

The scheme was under drip irrigation for the entire 120 ha. All the irrigation infrastructure has been completely vandalised. The major challenge facing the scheme is lack of water for irrigation. There is no water to the scheme due to the broken pipe which was caused by the contractor (see the photo below) who is constructing pipes for domestic water along the same area.

Figure 11: A Sign board showing a contractor at the Tours Irrigation scheme

3.3.5 Factors affecting the performance of the scheme

During the study, Tours Irrigation scheme was not functioning, the scheme infrastructure and machinery had been completely vandalised. This is a failed irrigation scheme. During the period of the study, there were no original farmers on the project site. With the assistance of the Agricultural Advisor who was responsible for the scheme, the team managed to secure an interview with the Chairperson of the Committee which presided over the scheme affairs when the scheme collapsed.

The following were highlighted as the main reasons that caused the irrigation scheme to collapse:

a) **Interference from the Tribal Authority Office**: it was indicated that after the departure of the strategic partner there was significant interference from the Tribal Authority which included taking decisions for the scheme without the knowledge of the Scheme Committee. That resulted in the conflict between the two centres of power which divided the irrigation members.
b) **Lack of skills transfer from the strategic partner**: when Pepper Dew International left, the farmers were not ready to take over the scheme successfully.
c) **Lack of commitment from farmers**: the researchers are of the view that the challenges experienced at the scheme were not insurmountable. An amicable solution could be found that could have saved the scheme and its infrastructure. In 2016, all the scheme offices were vandalised including all seven (7) tractors were vandalised and implements stolen. The pack house for coffee project was also vandalised including coffee pulp house and two (2) houses for extension staff were vandalised. The scheme leaders could not stop and prevent vandalism and theft.

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Figure 12: Showing vandalised drip irrigation lines at the scheme

Figure 13: Showing the remains of the tractors which have been vandalised

Figure 14: Vandalised coffee pack house

Figure 15: Vandalised office and administration block

3.4 Thabina irrigation scheme

3.4.1 Summary information of the scheme

Name of Scheme	Thabina Agricultural Cooperative
Area Situated	Khopo
Project Activity	Crop/Vegetable Production
District	Mopani
Municipality	Greater Tzaneen
Hectares	229 hectares (only 45ha under production)
Number of Beneficiaries	155 farmers
Contact Person	Mr Frans Modiba (Chairperson)

3.4.2 Background information for Thabina irrigation scheme

The Thabina irrigation scheme was established in 1964 and is located by 23.959525 S; 30.291118 E. It lies at an altitude of about 560m along the Thabina river, which runs North East towards the Great Letaba. The scheme is located 24 km South East from Tzaneen (along the R36 road). It benefits from sub-tropical, frost-free conditions, and fairly good alluvial soils.

Annual rainfall averages around 790mm, yet with drastic inter-annual variations (20-30%), recurrent and severe droughts and a long dry season (about 90% of rain falls between October and February). The scheme started in 1964, to promote development and food security in impoverished rural areas of former Gazankulu and Lebowa homelands. Thabina lies at the southern edges of the Levhuvu-Letaba water management area.

The scheme composes of 229 ha under furrow irrigation with 155 farmers (PTO beneficiaries with irrigable plots) who are living in the surrounding villages (Lifara, Burgersdorp, Khopo, Mhlaba Kraal and Head/Kraal, Mafarane, Shwapane, Sasekane,

Lenyenye, Zanghoma, etc.). An additional 65 ha is under centre pivot irrigation. However, the farmers are not using the centre pivots.

Initially each farmer was allocated one hectare, but re-allocation occurred afterwards. Some farmers now own more than 1ha. A striking fact is that about 40% of the land lies unused in Thabina, the plot holders not being interested in farming. Only 45ha of land is being cultivated.

Finally, it must be noted that some commercial farmers own private small pumps, extracting water from the river bed, especially in winter.

Currently the farmers are funded by Department of Rural Development and Land Reform. They have recently purchased inputs, a tractor and erected a fence. Their biggest challenge is irrigation water as they are using free-flow canal due to the absence of a proper irrigation system.

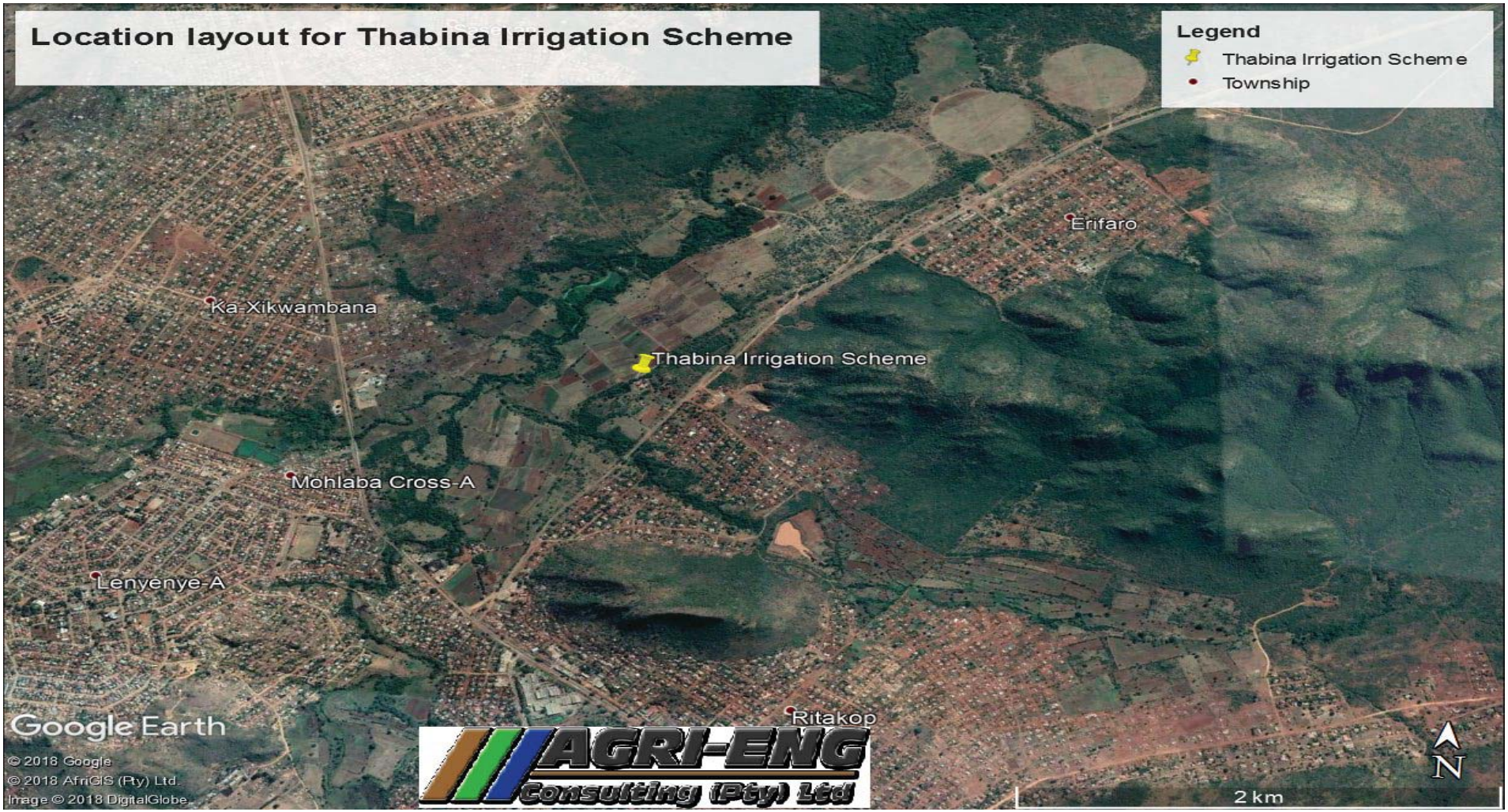

Figure 16: Layout map for Thabina Irrigation Scheme

3.4.3 Current status and available resources

Currently, Thabina irrigation scheme is operational. During the study visit, the farmers were growing maize using flood irrigation.

3.4.3.1 Soil types

The area is characterized by very fertile soil. The soil type is mostly alluvial soils with some exceptions here and there. The soils in the area have demonstrated over the past that they have the capacity to produce a wide variety of vegetables and crops as highlighted in the section below.

3.4.3.2 Availability of water

The irrigation water is sourced from the perennial Thabina River which originates from the Klein Drakensberg mountains. The Ramodike dam was built on the Thabina river upstream from the irrigation scheme and is used to regulate water flow into the main weir which is used to lift water into the main canal that feeds the Thabina irrigation scheme. The farm uses existing furrow irrigation to irrigate the entire farm. It has one main canal with 18 sub-canals.

Water from the Ramodike dam also supplies water for domestic uses to the local communities of Lenyenye, Manchaneni, Mphame and Mohlahlabeng. That is putting a lot of pressure on the available water for irrigation purposes. It is reported that the available water for Thabina scheme from Ramodike dam is about 500,000 m^3 per annum which is adequate for about 18 % of the total scheme water demand (LDARD, 2005).

Such water pressures are resulting in water failing to flow into the main canal into the scheme. Farmers have tried to resolve that problem by establishing a pump station next to the scheme and pumping water up the field into the canals.

This therefore means that Thabina irrigation scheme has serious water supply problems.

3.4.3.3 Availability of Markets and technical advice

Thabina Agricultural Cooperative is very fortunate indeed to be closer to markets in the form of local townships and villages such as Lenyenye, Manchaneni, Mphame and Mohlahlabeng and Tzaneen. Technical inputs are provided by the extension staff who have offices close to the scheme.

The main crops grown include: green mealies, green beans, chilies, okra, cabbages, beetroot and spinach.

3.4.3.4 The revitalization process: current status

The revitalization process is officially completed in Thabina. It first addressed infrastructure development. It consisted of:

- installing two (2) electric pumps
- repairing existing diesel pumps
- refurbishing / upgrading the weir, the main canal and one of the storage dams
- levelling irrigated plots

The farmers' perspective and evaluation over the work done is slightly different. They acknowledge the improvement in water supply through the pumps, but complain about the resulting costs. Besides, vandalism prevents the electric pumps from operating properly. Their main complaints touched on:

- the lack of levelling, which is direly needed to improve furrow irrigation at plot level, and subsequently water sharing at scheme level (according to the farmers, plots that are properly levelled are irrigated more easily and more quickly, hence a quicker rotation among irrigators);
- the need for canal upgrading and heightening, to increase its capacity;

- the need to upgrade the secondary canals, most being in poor conditions, and resulting in water and time lost during irrigation.

It must be noted that farmers mention water shortages and the unfair sharing of water among themselves as background reasons for those works to be carried out. All in all, it has been found that 52% of farmers are not satisfied with the revitalization process. Most of these 52% feel that it has not been carried out and completed as initially promised (44% acknowledge some improvement).

Farmers also mentioned issues around the access to mechanisation. They feel that the two (2) tractors have been left unrepaired or in poor condition for quite some time. Other equipment available on farm include: mouldboard plough, planter, disc harrow, ripper, cultivator and boom sprayer.

3.4.4 The status of existing irrigation infrastructure

3.4.4.1 The pump stations

The infrastructures for water supply include the initial gravity-fed system (weir, dams and a main canal), now combined with four (4) pumps (Pump No 1 and Pump No 2 are diesel pumps; Pump No 3 and Pump No 4 are electric pumps), which have been installed later to increase water supply to the main canal. The weir has been recently refurbished and upgraded, in the frame of the rehabilitation programme (see figure 3). The canal starts at a weir along the Thabina river downstream a dam. It must be emphasized that the dam was initially devoted to irrigation supply. Then, its purpose has switched totally to domestic supply. It currently does not store water for the scheme. This underpins a basic claim by the farmers, who want some water re-allocated to irrigation.

3.4.4.2 The main irrigation canal

The length of the main canal is 7000 m. About 5000 m of it lies outside the scheme, where it used to be almost entirely covered with concrete plates, although now broken from place to place. It passes through a built area (communities) and water extraction and used for different purposes seem to have been the usual practices along the canal (especially cloth washing, yard gardening, and even a plant nursery). Community members seem to find it easier to extract water from the canal that to resort to other sources at their disposal. Also, the Thabina dam was initially developed for irrigation purposes. It seems that it now mostly serves communities for domestic water, under municipal control, although it's purpose remains officially irrigation water supply.

The scheme is about 2000m long. The main canal supplies secondary canals within each irrigation ward. Water bailiffs control each ward's water supply. Irrigation is scheduled on a turn basis among wards. There are four wards, and within each ward some farmers are allowed to irrigate while the rest are to wait for the next turn according to the schedule. Farmers commonly admit that all wards experience water shortages, with Ward D being more exposed, as it lies at the ending part of the main canal.

3.4.4.3 Irrigation Scheme challenges

The electric pumps have recently been badly vandalised, to such an extent that it should take quite some time for the farmers to get them repaired, owing to the costs incurred (copper wires being taken away, probably molten and resold for metal value; plus, mere vandalism and destruction of the pumping stations). This has become a major source of concern in the scheme, to an extent that it has sometimes been difficult to address other issues with the farmers during the project's workshops.

During the study, most farmers indicated that they would prefer to change the current furrow irrigation to drip irrigation which can save labour and water.

3.4.4.4 Irrigation Scheme management

The management structure comprises a committee of seven (7) which consists of the: Chairperson, Deputy Chairperson, Treasurer, Secretary and Marketing Manager and two (2) Committee members. The committee consists of seven (7) members. The committee meets once per month and is elected after every five (5) years.

It was reported that the maintenance of the canals is done on a weekly basis.

3.4.5 Factors affecting Thabina irrigation scheme performance

Below are some of the key challenges affecting the performance of the Irrigation scheme:

- Challenges of availability of water. There is not enough water for the entire scheme.
- The furrow irrigation system wastes a lot of water which is in short supply for the scheme
- There is need to change from the furrow irrigation system to drip irrigation
- Strategic partner (mentor) who left the scheme
- Fence is not good – cattle tend to break into the fields.
- Squatting of villagers on the farm

3.5 Phetwane irrigation scheme

3.5.1 Summary information of the irrigation scheme

Name of Business	Phetwane Agricultural Cooperative
Area Location	Phetwane Village
Status of the irrigation scheme	Operational
Project Activity	Crop Production
Province	Limpopo
District	Sekhukhune
Municipality	Ephraim Mogale
Hectares	48 hectares
Number of Beneficiaries	48
Contact Person	Mr Terrance Togwane

3.5.2 Background information for Phetwane irrigation scheme

Phetwane irrigation scheme was established in 1970 and is situated at portion 680 KS of the Farm Hindustan in Ward nine (9) of Greater Ephraim Mogale municipality in Sekhukhune district. The scheme lies on 24.757661^{o} S and 29.431812^{o} E. This irrigation scheme occupies an area of about 48 hectares with 48 member beneficiaries. It is situated below Flag Boshielo dam on the right bank of perennial Olifant River. The history of the scheme dates back to the time of homelands under Lebowa government.

The cooperative is an agri-business entity which specializes on crop and horticultural production. The management of the business has recognized the rapid growth potential made possible by the quick success and fast return on investment from the proposed business activities. The farm is approximately 34 km away from Marble Hall Town under the jurisdiction Greater Ephraim Mogale Local Municipality (formerly Marble Hall) in the Sekhukhune District Municipality, Limpopo Province.

The cooperative occupies an area of approximately 80 ha of which 48 ha is arable land which has been installed with floppy irrigation system, hence previous production was taking place at the fields.

The farmers have land rights (P.T.O) for the farm and currently they planted maize, cotton (in 2016), wheat and potatoes (rotating each year) on 48 hectares of land under floppy irrigation system with the assistance of strategic partner. The profit shared is on 50/50 basis wherein the partner has to deduct his costs before declaring the dividend. The farmers are experienced as they have been farming for a justifiable period of time. Currently the farm is being managed by a youth team.

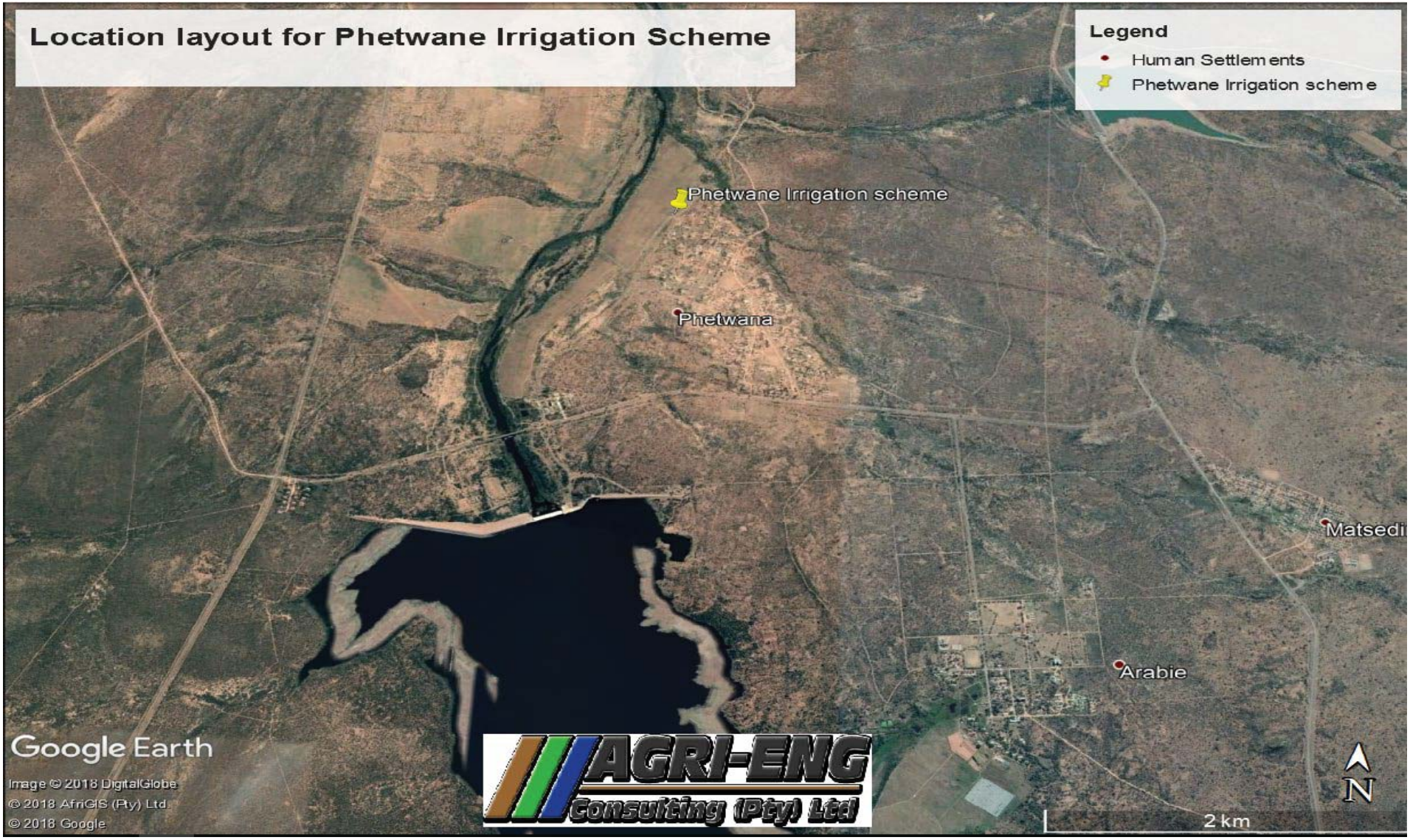

Figure 17: Location map for Phetwane Irrigation scheme

3.5.3 Current status and available resources

During the study visit, the irrigation scheme was not operational. There is need for the repair of the pump station and the floppy irrigation system for the farmers to be able to grow crops and vegetables using irrigation. During the study, there were no crops in the field.

3.5.3.1 Soil types

The soil close to the village is of Nebo Granite origin. This leads to the development of very shallow coarse sandy soils with a low water holding capacity and good drainage. The soils formed on the flood plain are of alluvial material. The soils formed on this material are also very sandy but they are deeper and have a higher water holding capacity with good drainage.

The gradual slope and two parent materials have a huge influence on the uniformity of the soils formed on these parent materials. Hutton soils are the dominant soil-forms that occur on the Granite parent material (50-60 % of total area). It has an Orthic A-horizon approximately 20-30cm deep and has a red appadale B-horizon approximately 30-40cm deep. Near the crest it is shallower and Glenrosa soils are dominant (10-15 % of total area). It has an Orthic A-horizon on a Lithocutanic B-horizon and varies from 20-35cm in depth. The water holding capacity on all these soils are very low (30-40mm) and is further influenced by a high percentage (50-60 %) of very course gravel causing water to percolate quickly down out of the profile. Oakleaf soils are the dominant soil form on the alluvial material (40-50 % of total area). It has a bleached orthic A-Horizon 30cm deep and a neo-cutanic B-horizon (LDARD, 2007).

3.5.3.2 Availability of water

The water source for this project is from the Flag Boshielo Dam. The irrigation water will be sourced from perennial Olifant River which is located less than a kilometre from the farm. The farm will use existing floppy irrigation to irrigate the entire farm. No formal

water permits or allocations are available from the Department of Water Affairs and Forestry.

Water is pumped into several balancing dams and then to the floppy irrigation system through a booster pump station.

Figure 18: Flag Bushelo dam which supplies water to Phetwane irrigation

3.5.3.3 Topography

The terrain of the Phetwane irrigation is generally flat, sloping gentle for adequate drainage. It is highly suitable for any type of irrigation system without causing ponding. Before the floppy irrigation, the scheme had flood irrigation. The topography has a convex shape with slope of 1-2% sloping towards the Olifants river.

3.5.3.4 Climate

Phethwane, just like the entire Sekhukhune District is known for its dry winters and summer rainfall with the average between 400-600 mm per annum. Very little frost occurs and the mean daily temperatures range between 37.3°C and -0.9°C.

Such climate is suitable for several crops and all year round crop production.

3.5.3.5 Market availability

The Phetwane irrigation scheme is surrounded by several rural communities such as Phetwana, Mogalatsana, Matseding, Masanteng which offer immense local markets for its agricultural produce. Furthermore, it is very close to Marble Hall and Polokwane, Joburg and Pretoria Fresh Produce Markets. This means markets are readily available.

3.5.3.6 Availability of machinery and equipment

The irrigation scheme has a tractor, boom sprayer, planter, disc plough and mouldboard plough which must make it easier for crop production. However, it was noted that the size of these implements were unnecessarily too big for the tractor power available and intended tasks.

3.5.3.7 Availability of technical advice

Phetwane Agricultural Cooperative is very fortunate indeed to be closer to Tompi Seleka Agricultural Training Centre. This college has a very established track record in terms of offering advice and support to the local small scale farmers.

The Phetwane Agricultural Cooperative, is an agricultural business owned by dedicated emerging farmers, established due to the farming business opportunities

existing in the district and outside. The project members own 100% of the land and business.

The LDARD through its district offices in Marble Hall will have to proactively act by provision of extension services and also assist participants on a continuous basis during the production season, since this is an agricultural enterprise and is one of the department's competencies.

After commissioning of the floppy irrigation system, the farmers entered into a three (3) year contract with a commercial farmer, producing commodities such as potatoes, seed maize and popcorn. Production of potatoes was severely damaged by winter frost and led to lesser profit which prompted disputes between farmers and commercial farmer. The contract was then terminated and production stalled.

With endeavours to stimulate production, Phetwane farmers through consultation with Department of Agriculture in Ephraim Mogale agreed in principle to resuscitate production by targeting planting grains crops during the current production season, which will be marketed at AFGRI. The conditions are supremely ideal for grain growing and in addition, grains are a far easier crop to grow than either potatoes or vegetables.

The current prevailing challenges which farmers face are lack of production capital and mechanization to work the land, hence request for funding of production inputs and soil preparations. The farmers agree to provide labour starting with soil preparation until harvesting. Financing of production inputs and soil preparation will stimulate and improve production at the farm. The budget required will assist in ensuring that the project is operating effectively and efficiently.

The predominant activity on the farm is crop production, in particular maize which will be rotated with wheat. This has been chosen primarily because maize is by far an easier crop to produce and the market is readily available.

3.5.3.8 Project participants

There are 48 active members who are the direct beneficiaries of the project. The members will be solely responsible for the entire farm operations on a daily basis.

3.5.4 The status of the existing irrigation infrastructure

3.5.4.1 The pump station

The pump station consists of two (2) 37 kW centrifugal pumps. The pump station requires repairs to the control box and the pumps. The pump house building needs renovation to cover the pumps which are currently exposed to the weather vagaries particularly driving rainfall which can damage the motors.

Figure 19: Poor condition of pump station at Phetwane irrigation scheme

3.5.4.2 The floppy irrigation system

The system needs significant repairs to the overhead pipes which have been damaged due to non-use.

3.5.4.3 Balancing dams

The balancing dams are in good condition at the moment. It may be required that the water in the dams be pumped out before pumping in any fresh water. Water has been stagnant in the balancing dams for a long time and this might have affected its quality.

3.5.4.4 Irrigation Performance

The scheme has the following strengths

- Availability of infrastructure: Floppy irrigation systems need repairs to the pipelines, land, pump house, store room, water and electricity.
- Technical support from the extension services through Provincial Department of Agriculture
- Good Road infrastructure
- Favourable climatic conditions

3.5.4.5 Project management

The project management structure comprises eleven (11) members which are the following: Chairperson, Deputy Chairperson, Treasurer, Secretary and seven (7) committee members. The management team for Phetwane had just been elected when the Team visited the scheme and consists predominantly of young members.

3.5.4.6 LDARD, Municipality and other government structure

The government structures are responsible for coordinating and assisting with finance where possible. The Department of Agriculture for instance, will be responsible for assisting project participants with outcome-based training, extension services as well as monitoring and evaluation of the project.

3.5.5 Factors affecting scheme performance

The following were reported as some of the factors affecting the scheme:

- The floppy irrigation system does not allow for demarcation of blocks into individual blocks. Some farmers indicated that they would require the demarcation of the scheme into one block per household which will enable each household to take full responsibility of their blocks.
- Pump station not functional since 2017 due to lighting problem. This has rendered the entire irrigation dysfunctional.
- The operational and maintenance costs of the floppy irrigation system is too high by farmers.
- Farmers are not keeping records of their income and expenditure, amount of water and electricity used per season. This is recipe for failure for any business enterprise.
- Theft
- The scheme has no toilets
- Lack of proper fencing
- Skills training for youth farmers who have taken over the farm as from 2018.

3.6 Kolokotela irrigation scheme

3.6.1 Summary information of Kolokotela irrigation scheme

Name of Scheme	Kolokotela Agricultural Cooperative
Area Situated	Kolokotela
Project Activity	Crop/Vegetable Production
Current activity	Dysfunctional, vandalised
District	Sekhukhune
Municipality	Makhuduthamaga
Hectares	243 hectares
Number of Beneficiaries	N/A
Contact Person	N/A
Cell Number	N/A

3.6.2 Background information for Kolokotela Irrigation scheme

Kolokotela irrigation scheme comprised of 243 ha irrigated land that was under the floppy sprinkler system. The scheme had 188 beneficiaries. All the irrigation infrastructure (the floppy irrigation system, pump station) was funded by the South Africa government through the Limpopo Department of Agriculture.

The scheme was operated through Kolokotela Primary Agricultural co-operative which was later renamed Moleke primary agricultural cooperative. The cooperative committee had ten (10) management members headed by the chairperson. The farm management was designed to be constituted by ten (10) members in which the co-operative was represented by four (4) members including a representative of the traditional council, two (2) people representing the strategic partner and two (2) government officials to monitor and provide advisory services. However, the management team was just constituted but dysfunctional.

The Kolokotela Irrigation Scheme is located on the farm Kolokotela 640 in the Makhudutamaga Municipality in the Sekhukhune District of Limpopo Province on coordinates 24.693380° S and 29.445598° E. Irrigation water is sourced from the Upper Lepelle Canal. The canal supplies water to four balancing dams on the scheme from where the water is pumped onto the fields.

The irrigation scheme consisted of 243 ha of overhead floppy irrigation that was designed and installed by Floppy Sprinkler Irrigation. For a period, the scheme was operated by a strategic partner, in conjunction with the beneficiaries. The strategic partner left the farm sometime in the 2009/2010 and since then the irrigation scheme has been in disuse.

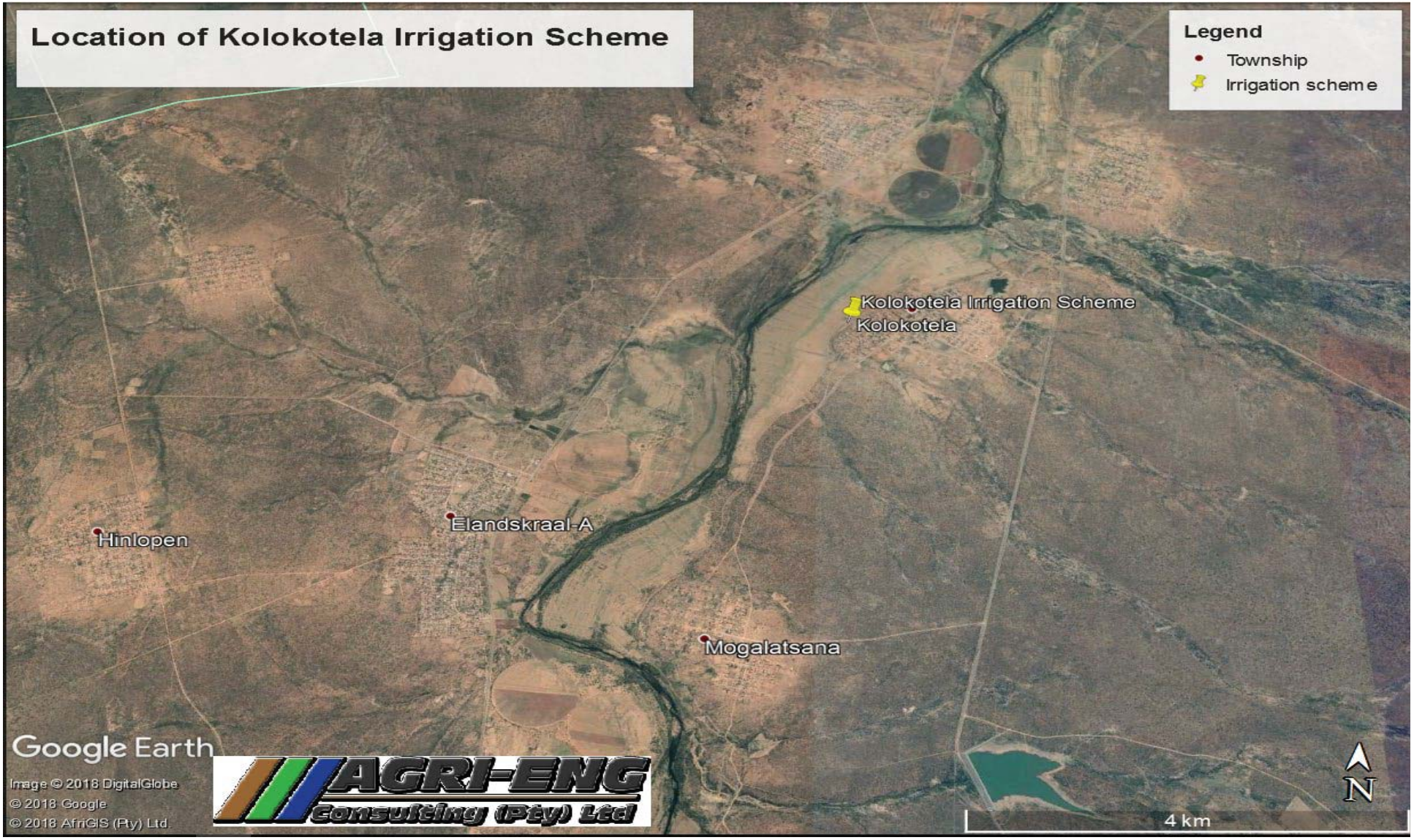

Figure 20: Location map for Kolokotela Irrigation Scheme

SCHEME LAYOUT

The floppy irrigation scheme is split into five (5) zones as follows:

Zone	Area
A (North)	54 ha
B (Central)	54 ha
C (Central)	27 ha
D (Central)	54 ha
E (South)	54 ha
Total	243 ha

All five zones are bordered in west by the Olifants river and in the east by the Upper Lepelle Canal. All five Zones get their irrigation water from the Upper Lepelle Canal and have independent pump stations.

3.6.3 Current status and available resources

3.6.3.1 State of irrigation scheme

As stated previously, the scheme has been in disuse for a number of years and as a result has been completely vandalized. Few signs of an irrigation scheme exist now. There is only one pump station that has not been damaged to date (Pump Station No 3 for Block C). The only work required for this pump station will be to re-commission the pump station.

The Table below shows the summary of the theft / damage to the overhead structure at the Kolokotela Floppy Irrigation Scheme as per assessment done in 2012

Table 3: Summary of theft/damages to the overhead structures at the Kolokotela Floppy Irrigation Scheme as per assessment done in 2012

Item	**Assessment done in August 2012***	**Current status**
No of Anchor Cables / Support Bracing Cables that need replacing / repairing	**5**	**No anchor cables found**
No of Support Poles that need replacing	**10**	
Meters of Poly pipe that need to be replaced (assuming 50m per span)	**950**	
No of Floppy Sprinklers required (assuming 1 per 12.5m of poly pipe that needs to be replaced)	**76**	
No of Spans that need extra hangers (assuming 50m span)	**10**	
No of connecting pipes that have been cut	**A large number >1000**	

**Assessment done by Mr B Marx, who was accompanied by Mr Hendrick Moshidi, chairman of the Co-op, and representatives of the LDARD. August 2012*

3.6.4 The status of the irrigation infrastructure

During the study, it was found that there has been a total damage to the overhead infrastructure of the scheme. This is mainly due to theft / vandalism and a little fire damage. The following has occurred in both blocks:

- A number anchor poles, anchor cables and anchor rods for the overhead infrastructure have been removed and stolen
- Support poles have been cut and stolen
- Sections of poly pipe and floppy sprinklers have been removed and stolen
- The pipe hangers have broken due to sun exposure
- The pump station has been vandalised

Figure 21: The original pump station which is now vandalized

Figure 22: Showing floppy poles which have been cut

Figure 23: Showing the position of the balancing dam which is now non-functional

Figure 24: The manhole around this cluster valve in 2012, which now has been completely vandalized.

3.6.5 The factors that caused the collapse of the irrigation scheme

The main factor that caused the scheme collapse was the misunderstanding between the strategic partner and the beneficiaries. In 2008, a memorandum of understanding was signed between the beneficiaries and a strategic partner for a 3-year period on the 243ha floppy sprinkler irrigation system for the 188 farmers. The partnership arrangement produced three crops during the three-year period. In the first year, there was profit, and for the two subsequent years the strategic partner reported scheme losses. That was unacceptable to the beneficiaries which resulted in conflicts which caused the strategic partner to abandon the scheme. Eventually, vandalism and theft resulted in everything being totally destroyed requiring a new start if the scheme will be revived.

It is the view of the Researchers that if the Strategic Partner had been open with the financial information, expenditures and incomes the farmers would have believed the given data. This could have saved the scheme.

3.6.6 Strategic partner concept

A number of irrigation schemes have benefitted from the programme through installation of modern irrigation infrastructure. In Sekhukhune District, seven (7) irrigation schemes were identified for revitalization and floppy irrigation systems were installed. The strategic partnership (SP) model was introduced to capacitate, train and mentor farmers towards commercialization of the schemes. The strategic partnership model had a clause indicating that irrigation scheme farmers and a commercial farmer should make an agreement on the following (Mothapo et al., 2012):

- skills transfer/ empowerment,
- mentorship,
- full participation from both parties, and
- how both parties will benefit.

The strategic partnership model further indicates that the incentives for the appointed strategic partner would be the profits sharing while for the emerging farmers it was a combination of factors. These factors included the strategic partner financing the inputs and machinery, providing farming skills, management and expertise, transfer of skills and mentoring, providing access to markets and bearing all the risks.

However, for this particular scheme like many others in Sekhukhune, the SP model has not delivered and has not produced the desired outcome. The model produced lack of trust from both parties (especially from the beneficiaries) due to non-disclosure of the profits from the SP. This is the main cause of the total failure at the Kolokotela scheme.

4 SUMMARY OF THE FINDINGS OF THIS STUDY

In the study carried out under this research study, several underlining causes of the under-utilisation of these irrigation schemes were identified. The main causes of underperformance of the smallholder irrigation schemes in Limpopo Province were identified as follows:

a) **Lack of skills related to irrigation scheduling**: all irrigation schemes rely on the crude and inaccurate methods for determining when to irrigate and how much water to apply. This has a direct implication on the quality of the crop and yields.
b) **The underperforming of the strategic partner approach**: The Strategic Partner approach in its current form may require further investigation to verify these preliminary findings. The same outcome was observed in the study carried out by Jiyane (2011) in the Limpopo Province.
c) **Cooperative farming and organization approach**: the study showed that the cooperative concept in smallholder irrigation farming does not work. This was contrary to the government approach as outlined in the DTI Integrated Strategy on the Development and Promotion of Co-operatives (2012). This aimed at promoting co-operatives in order to unleash their potential to create and develop income-generating activities and decent, sustainable employment; reduce poverty, develop human resource capacities and knowledge; strengthen competitiveness and sustainability; increase savings and investment; improve social and economic well-being. However, this study revealed that the allocation of farms or plots to several people (the cooperative approach) resulted in several conflicts and infighting resulting either in the collapse of the smallholder farming or reduced production levels. The outcome of this study is corroborated by several other studies carried out in South Africa, Africa and other places. Nkhoma (2011) found out that the members of agricultural cooperatives in the rural communities of Malawi indicated that their cooperatives in their current state were not sustainable. Mabunda (2017) and Dube (2016) found out that agricultural cooperatives continue to experience significant problems, which have hindered their development. The main

identified reason for the failure of cooperatives has been the lack of interest from members; internal challenges include conflict among members and poor management.

It may be concluded therefore that such irrigation methods as floppy irrigation system which does not allow for demarcation into individual blocks is not suitable for smallholder irrigation schemes owned by several beneficiaries.

d) **Lack of business attitude towards irrigated farming**: it was observed that the farmers have no proper and detailed records of the production costs. The farmers were not aware if they had made profit at some point in time. As long as farmers do not have the income/expenditure attitude towards irrigated agricultural production, the level of production at these smallholder schemes will be low.

e) **No record keeping as part of farm management**: it was observed that the farmers do not keep records of the following: seasonal water use, quantities of production inputs purchased and used at any given season.

f) **No prior arrangement of markets for the crops/vegetables grown**: the farmers produce the crops/vegetables and look for markets when the crops/vegetables are ready. This leads to produces fetching low prices.

g) **Vandalism and theft problems:** the study revealed that several smallholder irrigation schemes had experienced serious problems related to vandalism and theft of irrigation assets bought for the schemes. This can be attributed to overall management problems and lack of accountability of leadership in the schemes.

5 POSSIBLE INTERVENTIONS FOR THE EXISTING SMALLHOLDER IRRIGATION SCHEMES THAT WILL RESULT IN IMPROVED PERFORMANCE

This study hereby makes the following possible interventions towards the improved performance of smallholder irrigation schemes in Limpopo Province and South Africa in general.

5.1 Training and on-farm demonstrations in the basics of irrigation scheduling

There are several irrigation scheduling methods available which can be used by smallholder farmers. The most suitable method will be selected and training and demonstration in irrigation scheduling will be carried out on selected pilot irrigation schemes before the method is out-scaled to several other smallholder farmers in Limpopo Province and South Africa at large.

5.2 Training in basic business management with a view towards transforming the mindset of smallholder farmers into entrepreneurs and business people.

It is proposed that a basic business management course at the suitable National Qualifications Framework level (NQF level) be developed for the farmers in Limpopo Province. There could be need for translating the course to the most prominent and common language in Limpopo Province which can either be Sepedi, Tshivenda or Xitsonga.

5.3 Comprehensive review of the strategic partner concept

A number of irrigation schemes have benefitted from the programme through installation of modern irrigation infrastructure. In Sekhukhune District, seven (7) irrigation schemes were identified for revitalization and floppy irrigation systems were

installed. The strategic partnership (SP) model was introduced to capacitate, train and mentor farmers towards commercialization of the schemes. The strategic partnership model had a clause indicating that irrigation scheme farmers and a commercial farmer should make an agreement on the following (Mothapo et al., 2012):

- skills transfer/ empowerment,
- mentorship,
- full participation from both parties, and
- how both parties will benefit.

The strategic partnership model further indicates that the incentives for the appointed strategic partner would be the profits sharing while for the emerging farmers it was a combination of factors. These factors included the strategic partner financing the inputs and machinery, providing farming skills, management and expertise, transfer of skills and mentoring, providing access to markets and bearing all the risks.

However, from the study carried out it was found out that the SP model as it stands now has not delivered and has not produced the desired outcome. The model produced lack of trust from both parties (especially from the beneficiaries) due to non-disclosure of the profits from the SP.

It is proposed that further studies be carried out to review the current SP model. This way, key problems can be identified and proposals to formulate a new model be made. Alternatively, the current model can be remodelled accordingly to enhance farm productivity and profitability.

5.4 Gradual conversion of existing large scale sprinkler irrigation schemes to drip irrigation.

It is proposed that a gradual conversion of the existing large scale sprinkler irrigation systems (centre pivots, floppy) into drip irrigation systems be carried out which will allow demarcation of the farms into blocks of 2 – 5 ha which must be parcelled to

individual families. All new irrigation schemes for smallholder farmers must ensure that individual farmers own individual blocks.

5.5 Introduction of mechanisation centers as medium term solutions for the problems of agricultural machinery and equipment at the farms

It is proposed that mechanisation centres be established at selected central locations which will consist of tractors of different sizes, agricultural implements relevant for the most common activities in the neighbouring farmers, see Appendix 1. It is considered that this will be cheaper as government intervention than purchasing individual farmers' tractors and implements.

5.6 The Promotion of Agri-Park Concept

The Agri Park concept as presented in Section 3.2 of this report is considered the complete long term answer to the majority of problems identified during this study.

5.7 Strengthening the participation of youth and the use of digital agriculture technologies in irrigation farming

Youth are the future of any nation. Current trend all over the world show that youth shun agriculture as they perceive it to be an unattractive industry which is not profitable within a short space of time. This can be averted by introducing programmes targeting the youth. The use of mechanization and digital technologies is one of the ways which can make agriculture to be "a cool" industry and attract youth to participate in farming and irrigation ventures.

6 RECOMMENDATIONS

The following are the recommendations of this study:

h. The new smallholder irrigation schemes must adopt the “One block one household” approach.
i. The current Strategic Partnership model requires further investigation.
j. Smallholder farmers must be trained in basic business management and record keeping
k. There is need for the introduction of easy, affordable but fairly accurate irrigation scheduling methods to smallholder irrigation farmers
l. Marketing and cooperative issues
m. There might be a need to investigate the “floppy” irrigation scheme on its sustainability related to operational costs, operational design and profitability
n. Vandalism noticed in some of the irrigation assets needs to be addressed by the owners for sustainability of irrigation schemes
o. The youth should be encouraged to take over from the ageing farmers as demonstrated by Phetwane and Mphaila irrigation scheme approach.

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8 APPENDICES

APPENDIX 1: DATA COLLECTION INSTRUMENT

1. FARM DETAILS & BENEFICIARIES REPRESENTATIVE

NO	ITEM	RESPONSES				
1.1	Farm Name					
1.2	Ward					
1.3	District					
1.4	GPS Coordinates					
1.5	Farm Size (Ha)					
1.6	No of Beneficiaries	**Total**	**Male**	**Female**	**Youth**	**Disabled**
1.7	No of Labourers	**Total**	**Male**	**Female**	**Youth**	**Disabled**
	Comments:					
1.8	Name of Representative					
1.9	Cell phone No					
1.10	Land ownership	**Owned:**		**Leased:**	**Communal:**	
1.11	When was the irrigation scheme established?					

2. CROP TYPES AND MANAGEMENT

NO	ITEM	RESPONSES		
2.1	Main Crops Grown			
2.2	Area under each crop (Ha)			
2.2.1	Crop 1			
2.2.2	Crop 2			
2.2.3	Crop 3			
2.2.4	Crop 4			
2.3	General Crop Status	**Very Good:**	**Good:**	**Poor:**
	Comments:			

2.3	Other Enterprises		
2.3.1			
2.3.2			
2.3.3			
2.4	How much is harvested per season? (Ton)		
2.4.1	Crop 1		
2.4.2	Crop 2		
2.4.3	Crop 3		
2.4.4	Crop 4		
2.5	**Comments**		
2.4	Do you use fertiliser?	**Yes:**	**No:**
2.5	How do you determine fertiliser requirements? (Is it based on soil needs?)		
2.6	Do you apply herbicides	**Yes:**	**No:**
2.7	Do you keep records of inputs used	**Yes:**	**No:**
2.8	Comments:		
2.9	Do you use treated seeds?	**Yes:**	**No:**
	Comments:		

3. SOIL TYPES

NO	**ITEM**	**RESPONSES**		
3.1	Predominant Soil Types			
3.2	Irrigation Suitability			
3.3	General Soil Conditions	**Very Good:**	**Good:**	**Poor:**
3.4	**Comments**:			

3.5	Any soil erosion?	**None:**	**Mild:**	**Severe:**
3.6	Any problem of poor drainage or waterlogging?			

4. IRRIGATION INFRASTRUCTURE AND MANAGEMENT

NO	ITEM	RESPONSES	
4.1	Type of Irrigation Used		
4.2	Area under Irrigation (Ha)		
4.2.1	Crop 1		
4.2.2	Crop 2		
4.2.3	Crop 3		
4.3	Who installed the system?		
4.4	Is it the system you wanted?	**Yes:**	**No:**
	Comments:		
4.5	Irrigation frequency used? *(How does it compare with the required for the crop, soils, location?)*		
4.6	Irrigation period used		
4.7	Do farmers practice Irrigation Scheduling?	**Yes:**	**No:**
4.8	Which tools, equipment or method are used for scheduling *(Water saving technologies)*		
4.8.1	**Comments on Irrigation scheduling or Water saving technologies**		
4.9	How frequent is maintenance/service carried out?		

NO	ITEM	RESPONSES	
4.10	Components that require maintenance/service?	1. 2. 3.	
4.11	Who does the service/maintenance?		
4.12	How much is monthly electricity?		
4.13	Do you have a water use license?	**Yes:**	**No:**
4.14	Do you pay for water use	**Yes:**	**No:**
	If yes, how much do you pay for water (per year)?		

4. RESOURCES AVAILAVBILITY

NO	ITEM	RESPONSES		
5.1	What is power source?	**Electricity:**	**Solar:**	**Diesel**
5.2	How much power (transformer size)?			
5.3	What is the water source?	**Dam:**	**Boreholes:**	**River**
5.4	**Comments**:			
5.5	Which farm machinery exist on the farm?			
5.6	Do you own or hire the machinery?	**Own:**	**Hire:**	
5.7	Which farm tools exist on the farm?			
5.8	Any problem of theft on the farm?			

5.9	What are the other facilities available? (storage, fence, tunnels, offices,	
	Comments:	

5. MARKETS AND FINANCE

NO	ITEM	RESPONSES	
6.1	Do you sell all your produces	**Yes:**	**No:**
6.2	Where do you sell your produces?		
6.3	How far is it from the farm?		
6.4	Where do you get your production inputs? *Fertilisers, seeds, chemicals*		
6.5	**Comments**:		
6.6	Are you getting support from government?	**Yes:**	**No:**
	What kind of support?		
6.7	Is the farm accessible by road?	**Yes:**	**No:**

6.7	How is the road infrastructure to the farm?		
6.8	How do transport your production inputs and produces?		
6.9	Do you own or rent transport?	**Own:**	**Rent:**
	Comments:		
6.10	Do you keep records of activities *(inputs, outputs, expenditure)*		

6. SOCIO-ECONOMIC FACTORS OF THE BENEFICIARIES

NO	ITEM	RESPONSES			
7.1	Ages of Classifications for Beneficiaries	**Youth:15-35**		**Middle Aged: 35-65**	
		Old Age: 65+		**Very Old: 75+**	
7.2.1	Sex	**Male**		**Female**	
7.2.2	Level of Education	**Matric**		**Diploma**	
		Degree			
7.2.3	Occupation of Members	No of Members full time **on** the project			
		No of Members with full time jobs **outside** the project			
7.3	Type of skills amongst project members	1. 2.			

7.4	Are the members fully dependent on the scheme?	**Yes:**	**No:**
	What are off-farm activities members are engaged?		
7.5	For how long have members been on the scheme? *(Experience)*		
7.6	Do members have constitution or rules?	**Yes:**	**No:**
7.7	What happens when members disobey rules? *(Conflict resolution methods)*		
7.8	How long is leadership terms?		
7.8	How often do members share dividends?		

APPENDIX 1: THE MECHANISATION CENTRE CONCEPT

Agricultural mechanization has been defined in a number of ways by different people, but perhaps, the most appropriate definition is “the process of improving farm labour productivity through the use of agricultural machinery, implements and tools”. mechanization is a key input in modernization of any farming system. It involves the provision and use of all form of power sources and mechanical assistance to agriculture. As a major agricultural production input, mechanization aims to achieve the following:

- Reduction of drudgery in farming activities and making farm work more attractive to end users and more specially to youth,
- Increased productivity per unit area due to improved timeliness of farm operations,
- Accomplishment of tasks that are difficult to perform without mechanical aids and,
- Improvement of the quality of work and products.

The proposed mechanization centres will consist of the following services:

1. **Tractors and implements**

- Tractors of different sizes: these will be kept at the centre, maintained and serviced by the service providers on behalf of the government. The tractors will be available to the farmers at subsidised rates. Highly skilled tractor or machinery operators paid for by the government will be available to operate the tractors and other farm machinery.
- Agricultural implements: the centres will consist of full complement of the implements required by the farmers within the 100 km radius. Such implements will include tillage implements (ploughs, harrows, cultivators, rotavators, rippers), planters, sprayers, hay making implements (slashers, hayracks,

balers, bale loaders), tractor operated feed mills, hammer mills for feed processing, combine harvesters

2. **Extensions services**

Government officers well skilled in the following areas must be available to the farmers at all times:

- Agronomy
- Agricultural economics
- Animal production
- Technical: irrigation, pumps,
- Mechanisation
- Market information
- Animal health

3. **Transport and logistics services**

Trucks and trailers of different capacities must be available at subsidised rates for the smallholder farmers. These must be serviced and maintained by the government. Drivers will be paid for by the state. The transport service will ensure that farmers are able to procure inputs and deliver at the farm timeously, transport produces to markets, auctions floors without delay.

Several studies have revealed that an improved transportation will encourage farmers to work harder in the rural areas for increased production, add value to their products, reduce spoilage and wastage, empower the farmers as well as having positive impact on their productivity, income, employment and reduce poverty level in the rural areas since it will be easier to move inputs and workers to farm as well as products to markets and agro-allied industry.

4. Credit services for production inputs

Farmers must be able to obtain production inputs at subsidised rates from the centre and pay after harvest. The centres must provide access to inputs, make inputs affordable and disseminate information about solutions to enhance agricultural productivity. Such inputs will include:

- Fertilisers
- Seeds
- Feeds
- Herbicides

5. Concluding Remarks

It can be argued that the promotion of these mechanization centres and inputs along the agricultural value chain can enhance job creation in rural areas, self-employment of machinery operators and maintenance services, improve farm production levels and encourage small scale industries in rural areas.

Consistent with National Development Plan, mechanization as a major input and driver for industrialization will contribute in meeting the following targets:

- High production and labour productivity,
- A well-educated and learning society,
- A competitive economy capable of producing sustainable growth and shared benefits,
- Food self-sufficiency and food security.