

PD-APST-324
ISA 81008

**SWAZILAND
COMMERCIAL AGRICULTURAL PRODUCTION AND MARKETING
PROJECT**

CONTRACT NUMBER 645-0229-C-00-9019

**ACTION PLAN
for
UPGRADING AND REHABILITATING CERTAIN IRRIGATION SCHEMES
and
DEVELOPMENT OF IRRIGATION
on
SWAZI NATION LANDS**

Prepared in Association With :

**MINISTRY OF AGRICULTURE AND COOPERATIVES
MBABANE, SWAZILAND**

AND

**THE UNITED STATES AGENCY FOR
INTERNATIONAL DEVELOPMENT
SWAZILAND MISSION**

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March 1992

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LIST OF ACRONYMS

CAPM	Commercial Agricultural Production and Marketing Project
CIE	Consulting Irrigation Engineer
EEC	European Economic Community
GOS	Government of Swaziland
IFAD	International Fund For International Development
MOAC	Ministry of Agriculture and Cooperatives
SNL	Swazi Nation Land
TDL	Title Deed Land

**SECTION I
INTRODUCTION**

A. Stated Objectives of the Consultancy

The overall objective of the consultancy is to provide technical assistance for the Ministry of Agriculture and Cooperatives (MOAC) as well as the Commercial Agricultural Production and Marketing (CAPM) team as follows: provide plans and specific technical advice to individuals and groups with a commitment to commercial horticultural production; identify priority schemes and the costs associated with recommended rehabilitation under the Government of Swaziland (GOS) CAPM contribution to the project; develop an action plan to get repairs and upgrades completed through the GOS; and develop a set of overall recommendations for the future development of small scale commercial irrigation potential in Swaziland.

Expected Outputs

- Preparation of irrigation upgrading and renovation plans for selected individual and private schemes for commercial production of irrigated horticultural crops. (These plans be developed to the point where CAPM staff can take the proposals to donors or commercial financing institutions for funding, or the individuals or schemes can initiate the plans utilizing their own resources.)
- Develop a plan of action for utilizing the \$100,000.00 (approximately E280000.00) in GOS cash contributions to the CAPM project for upgrading and renovating selected schemes in Swaziland. This plan includes a priority listing of needed rehabilitation and estimated costing. A procedure will be identified for carrying out the rehabilitation process as quickly as possible. The plan is to include specific steps necessary to properly tender and make the

necessary improvements.

- Submit a report which recommends the alternatives available for the future development of commercial small-scale irrigation programs in Swaziland. The recommendations will include an overall assessment of the problems and prospects for the expansion of small-scale irrigation. The recommendations need to be practical and achievable in the near term.

B. Statement of Work

The consultant is to report to the CAPM Chief of Party or his designee, and appropriate CAPM staff and MOAC personnel. The work is to be performed throughout Swaziland but based at the CAPM field office in Matsapha. On a day-to-day basis, the consultant is to relate directly to the Horticultural Specialist and the Production Advisor.

Work Tasks

- Provide technical assistance directly to selected individuals and irrigation schemes as indicated by the CAPM team members.
- Prioritize a list of schemes requiring upgrading and renovation and the costs associated with such repairs.
- Identify the steps necessary for carrying out the above upgrading and renovations utilizing the GOS CAPM cash contribution under the terms and conditions of the CAPM Grant Agreement between the United States Agency for International Development (USAID) and the GOS.
- Assist the GOS and the MOAC with the development of a strategy for maximizing the future expansion of commercial horticultural production on small-scale farms in Swaziland.

C. Methodology

Upon arrival in Swaziland, the Consulting Irrigation Engineer (CIE) met with Robert Thwala, CAPM Project Coordinator and Doyle Grenoble, CAPM Horticultural Specialist and Acting Chief of Party, to review the consultancy as directed in the CAPM project Terms of Reference. During this meeting, the individuals and irrigation schemes CAPM is working with in the horticultural production program were identified. The discussion included alternate procedures that could be followed to best serve everyone involved in prioritizing the irrigation schemes. It was agreed that personnel from the MOAC be consulted early in the consultancy to participate in the prioritizing process.

A meeting was set up by Robert Thwala with personnel from MOAC to discuss the CIE assigned activities under the short term consultancy. Those attending the meeting representing MOAC included Magalela Ngwenya, Senior Agricultural Project Officer; Reuben Myeni, Irrigation Officer; Patrick Khumalo, Assistant Irrigation Officer; and Thandi Lupupa, Horticultural Specialist, National Extension Subject Matter Specialist. CAPM representatives included Robert Thwala, Doyle Grenoble and the CIE. Reference was made by the CIE to the report "Preliminary Irrigation Scheme Rehabilitation Survey - Swazi Nation Lands, May 1991" which identified schemes CAPM is currently working with on horticultural production. This report identifies the scheme upgrading and renovating necessary for efficient irrigation to maximize land and water resources for horticulture crop production. The MOAC representatives strongly suggested the following be considered in prioritizing irrigation schemes:

- Irrigation schemes currently under the International Fund for Agricultural Development (IFAD) rehabilitation program would not participate in the CAPM upgrade program.
- Irrigation schemes would be selected based on positive farmer interest, and farmers willing to participate as individuals and as a group in contributing to the upgrading and renovation costs of their respective schemes.

- Schemes would be selected from more than one region in the country.
- Give priority to upgrading and renovating group irrigation schemes rather than of individual farmer schemes.
- Develop an action plan such that the GOS cash contribution to the CAPM Project be expended by March 31, 1993.

At the MOAC meeting, the CIE was requested to focus the upgrading and renovating needs study on the following irrigation schemes known to have aggressive farmers and who were willing to provide some individual inputs:

- Luyengo (Manzini - Central Region)
- Kandwandwe (Hhohho - Northern Region)
- Phophonyane (Hhohho - Northern Region)
- Ndlalambi (Hhohho - Northern Region)

Figure I. , which follows, shows the location of the above irrigation schemes in Swaziland.

The CIE conducted extensive field studies of the above irrigation schemes, and involved the CAPM Field Representatives for their respective irrigation schemes, the appropriate field Extension Officers and representative farmers from the respective irrigation schemes.

The CIE obtained material and supply prices from 5 vendors located in Swaziland to estimate costs for upgrading and renovating the irrigation schemes under study.

[Figure 1 overleaf]

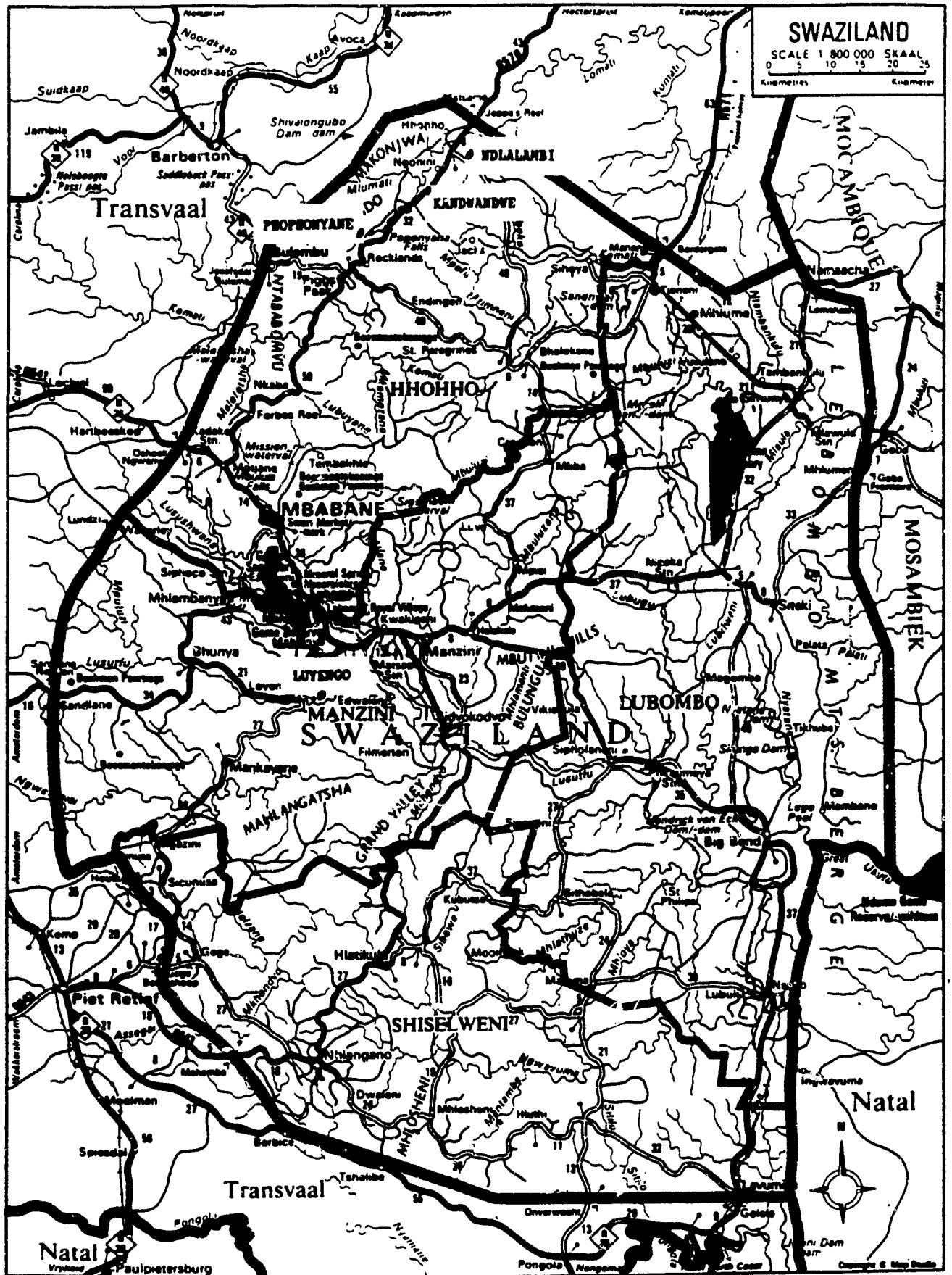


Figure 1: Location of Irrigation Schemes Studied

SECTION II
IRRIGATION SCHEME UPGRADING AND RENOVATING STUDIES

A. Luyengo Irrigation Scheme - Cost Estimates

The Luyengo irrigation scheme is a farmer-developed scheme, 30 hectares in size and includes 30 farmers. The water source is the Malkerns Irrigation Development Company canal. The Luyengo main delivery canal is an earthen canal, 4 kilometers in length. There is no storage reservoir as part of this scheme.

Sections of the earthen canal needs lining where seepage is very high. Farmers near the end of the delivery canal indicated that often the irrigation water does not reach their fields because of the canal's great length. Again, lining the canal sections should solve this problem.

1. Required Materials and Costs

- 1300 meters of precast concrete canal lining, 450 mm x 1 meter in size, costing E26.00 per meter. Total cost = $1300 \times 26.00 = E33800.00$.
- 30 concrete blocks for constructing take out structures to divert water unto the farmer fields requiring 4 blocks per structure (4"x 6"x 12"). Total of 120 blocks (30 x 4) required, costing E1,80 each. Total cost = $120 \times 1,80 = E216.00$
- 60 bags of 50 kg cement required to cement the precast canal lining joints and construct the diversion structures, costing E14.00 per bag. Total cost = $60 \times 14.00 = E840.00$
- Canal lining will follow existing earthen canal. Trenching for the canal lining is to be done by MOAC Land Development furnishing a back hoe and operator. Approximately 30 hours

of back hoe operation time will be required using 20 litres per hour, costing E2,75 per litre. Total cost = $30 \times 20 \times 2,75 = E1650.00$

- A concrete structure is required where the canal crosses the Bhunya road near the Luyengo campus. 50 (6"x 6"x 12") concrete blocks will be required, costing E1,90 each. Total cost = $50 \times 1,90 = E95.00$
- 15 bags of 50 kg cement required for the above structure plus a concrete bottom in the structure costing E14.00 per bag. Total cost = $15 \times 14.00 = E210.00$.
- Farmers donation of labor will include shaping of the trench for the precast concrete canal lining, placing the precast concrete lining, hand back filling, applying cement into the concrete lining joints, building the take out structures, and building the structure crossing the Bhunya road. Estimated labor time is 300 man days, wages at E7.00 per man day. Total contribution by the farmers of their labor = $300 \times 7.00 = E2100.00$.
- MOAC contribution - Lorry (large truck) and driver to haul precast concrete lining, cement and concrete blocks from vendor(s) and sand from a nearby source to the Luyengo irrigation scheme. Land Use Planning (LUP) personnel to provide the final construction plans and field layout (CAPM Field Assistant Andreas Simelane, Extension Officer John Hlatshwayo and farmers know location of all construction and can assist LUP) and Land Development to provide back hoe and operator, and supervision of construction.

2. Total Estimated Costs for Upgrading and Renovating

CAPM DESIGNATED FUNDS (GOS CASH CONTRIBUTION):

Precast concrete lining (E33800.00), cement (E1050.00), concrete blocks (E311.00), diesel fuel (E1650.00) plus 10% contingency (E3680.00). Total contribution = E40491.00.

FARMERS' CONTRIBUTION:

Labor (E2100.00) and sand (no cost) plus 10% contingency (E210.00). Total contribution = E2310.00.

MOAC CONTRIBUTION:

Transporting materials, final construction designs and field layout, back hoe and operator, and supervision of construction.

The areas where upgrading and renovation would take place on the Luyengo irrigation scheme are highlighted in Figure 2.

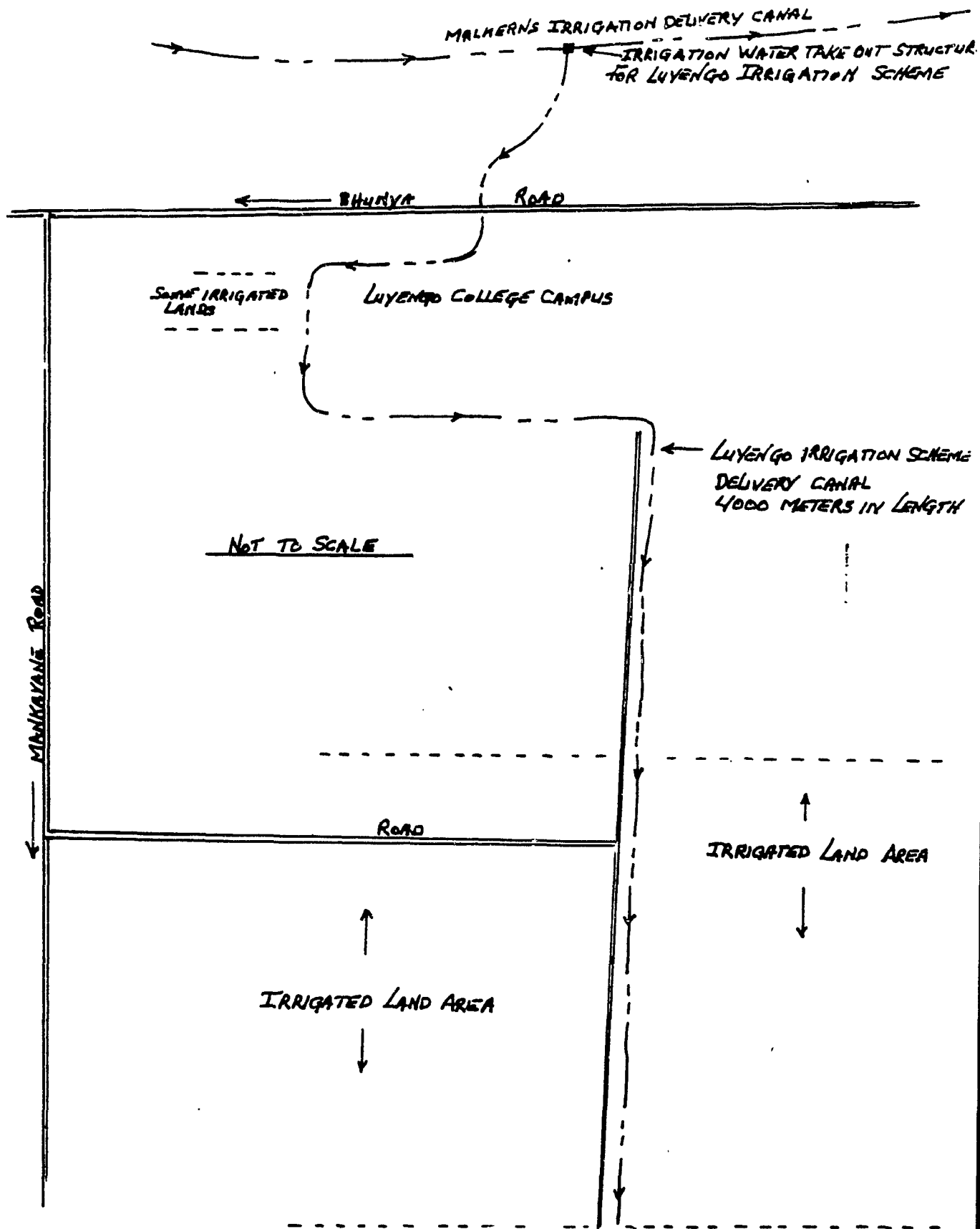


Figure 2. Luyengo Irrigation Scheme

3. Alternate Plan for the Luyengo Irrigation Scheme -Cost Estimates

As indicated above, the Luyengo main delivery canal is 4 kilometers in length, with the water drawn from the Malkerns Irrigation Development Company delivery canal. Due to the great distance from the irrigated lands on the scheme to the Luyengo take out structure, water is turned into the canal and very seldom does someone take the time to go to the take out structure to turn the water off. Thus, water flows almost continually in the canal whether anyone is drawing water for irrigation purposes on the scheme or not. This is an excessive waste of water. If the delivery canal were put into an enclosed pipeline, water would be drawn from the Malkerns canal source only when the farmers opened their respective water take out valves. The CIE highly recommends the following pipeline plan for upgrading and renovating the Luyengo irrigation scheme. Also, there will be sufficient pressure in the pipeline due to elevation difference from the Malkerns canal source to the scheme fields to use drip irrigation.

a. Required Materials and Costs

- 1000 meters of 160 mm (6 inch +) PVC class 4 pipe costing E26.00 per meter. Total cost = $1000 \times 26.00 = E26000.00$. 3000 meters of 125 mm (5 inch) PVC class 6 pipe costing E24.00 per meter. Total cost = $3000 \times 24.00 = E72000.00$ (includes enough pipe for several road crossings which are required). Trenching for the pipeline is to be done by MOAC Land Development furnishing a back hoe and operator. Estimated time to do the trenching (pipeline to follow the existing earthen canal) is 200 hours, requiring 20 litres per hour, costing E2,75 per litre. Total cost = $200 \times 20 \times 2,75 = E11000.00$.
- 30 stand pipes, 50 mm (2 inch) galvanized pipe x 1.5 meter in length (male threaded at both ends), each with 125 mm x 125 mm x 50 mm (female thread) PVC "T"

coupling, 50 mm 90 degree elbow (female threaded on both ends), 50 mm globe brass valve, 50 mm galvanized nipple (male threaded on both ends) and 50 mm galvanized nipple (male threaded on one end), costing E200.00 each. Total cost = $30 \times 200 = E6000.00$.

- 30 concrete pipes, 110 mm x 1.25 meters for use to cover the stand pipes for protection, costing E18.00 each. Total cost = $30 \times 18.00 = E540.00$.
- 600 meters of lay flat flexible hose with clamps for taking water to the farmers fields from the stand pipes, costing E17.00 per meter. Total cost = $600 \times 17.00 = E10200.00$.
- 1 butterfly valve, 160 mm (6 inch +), and air intake valve with fittings at take out structure at Malkerns delivery canal, costing 750.00 each. Total cost = $1 \times 750.00 = E750.00$.
- Farmers contribution will include labor for installation of the pipeline, stand pipes, road crossings and hand back filling the trench. Estimated labor time is 700 man days, wages at E7.00 per man day. Total contribution by the farmers of their labor = $700 \times 7.00 = E4900.00$.
- MOAC contribution - Lorry (large truck) and driver to haul pipe and other supplies from vendor(s) to Luyengo irrigation scheme, Land Use Planning to provide final construction plans and field layout, and Land Development provide back hoe and operator and supervision of construction.

b. Total Estimated Costs for Upgrading and Renovating

CAPM DESIGNATED FUNDS (GOS CASH CONTRIBUTION):

Pipeline (E98000.00), stand pipes (E6000.00), concrete pipe (E540.00), lay flat flexible hose (E10200.00), butterfly valve with fittings (E750.00), diesel fuel (11000.00) plus 10% contingency (E12650.00). Total contribution = E139140.00.

FARMERS' CONTRIBUTION:

Labor (E4900.00), sand (no cost) plus 10% contingency (E490.00). Total contribution = E5390.00.

MOAC CONTRIBUTION:

Transport, final construction plans and field layout, back hoe and operator, and supervision of construction.

Referring to Figure 2., the entire Luyengo delivery canal would be replaced from the Malkerns canal to the end of the Luyengo irrigation scheme with a pipeline.

B. Kandwandwe Irrigation Scheme - Cost Estimates

The Kandwandwe irrigation scheme is a government constructed scheme. The GOS many years ago financed the lining of the delivery canal, one kilometer in length. The water source comes from rainfall runoff from the area with the runoff stored in a reservoir. The scheme is 6 hectares in size with 8 active farmers. A flood control terrace runs through the center of the scheme. To deliver irrigation water to parts of the fields, field irrigation ditches cross the terrace essentially making the terrace ineffective as a flood control structure. Also, delivering water to the fields below the terrace is very inefficient. A section of field delivery canal needs precast concrete lining to better serve the fields below the terrace with irrigation water.

1. Required Materials and Costs

- 500 meters of precast concrete canal lining, 300 mm x 1 meter in size costing E16,80 per meter. Total cost = $500 \times 16,80 = \text{E}8400.00$.
- 10 take out structures for diverting water onto the farmer fields, 4 concrete blocks (4"x 6"x 12") required per take out, costing E1,80 per block. Total cost = $10 \times 4 \times 1,80 = \text{E}72.00$. Plus 30 concrete blocks are required for an corner structure in the canal, costing E1,80 per block. Total cost = $30 \times 1,80 = \text{E}54.00$.
- 20 bags of 50 kg cement required to construct the structures and to repair cracks and breaks in the existing concrete canal, costing E14.00 per bag. Total cost = $20 \times 14.00 = \text{E}280.00$.
- 100 meters of 300 mm (12 inch) concrete pipe for repairing a section of the main delivery canal costing E35.00 per meter. Total cost = $100 \times 35.00 = \text{E}3500.00$.
- Farmers contribution will require labor for hand digging the trench for the precast concrete canal, placing the precast concrete canal lining, apply cement into the concrete lining joints, building the take out structures and canal structures, digging the trench and laying the concrete pipe and repairing existing concrete ditch. Estimated labor time is 200 man days, wages at E7.00 per man day. Total contribution by the farmers of their labor = $200 \times 7 = \text{E}1400.00$.
- MOAC contribution - Lorry (large truck) and driver to haul precast concrete lining, concrete pipe, concrete block, sand, and cement from vendor(s) to the irrigation scheme. Land Use Planning personnel to provide the final construction plans and field layout (CAPM Field Assistant Themba Magagula, Extension Officer Maquawe Shongwe and farmers know where construction is to be located and can assist LUP), and Land Development supervision of the construction.

2. Total Estimated Cost for Upgrading and Renovating

CAPM DESIGNATED FUND (GOS CASH CONTRIBUTION):

Precast concrete lining (E8400.00), concrete pipe (E3500.00), concrete blocks (E126.00), cement (E280.00), plus 10% contingency (E1230.00).
Total cost = E13536.00.

FARMERS' CONTRIBUTION:

Labor (E1400.00), sand (no cost) plus 10% contingency (E140.00).
Total contribution = E1540.00.

MOAC CONTRIBUTION:

Transportation, final construction plans, field layout and supervision of construction.

The areas where upgrading and renovation would take place on the Kandwandwe irrigation scheme are highlighted in Figure 3.

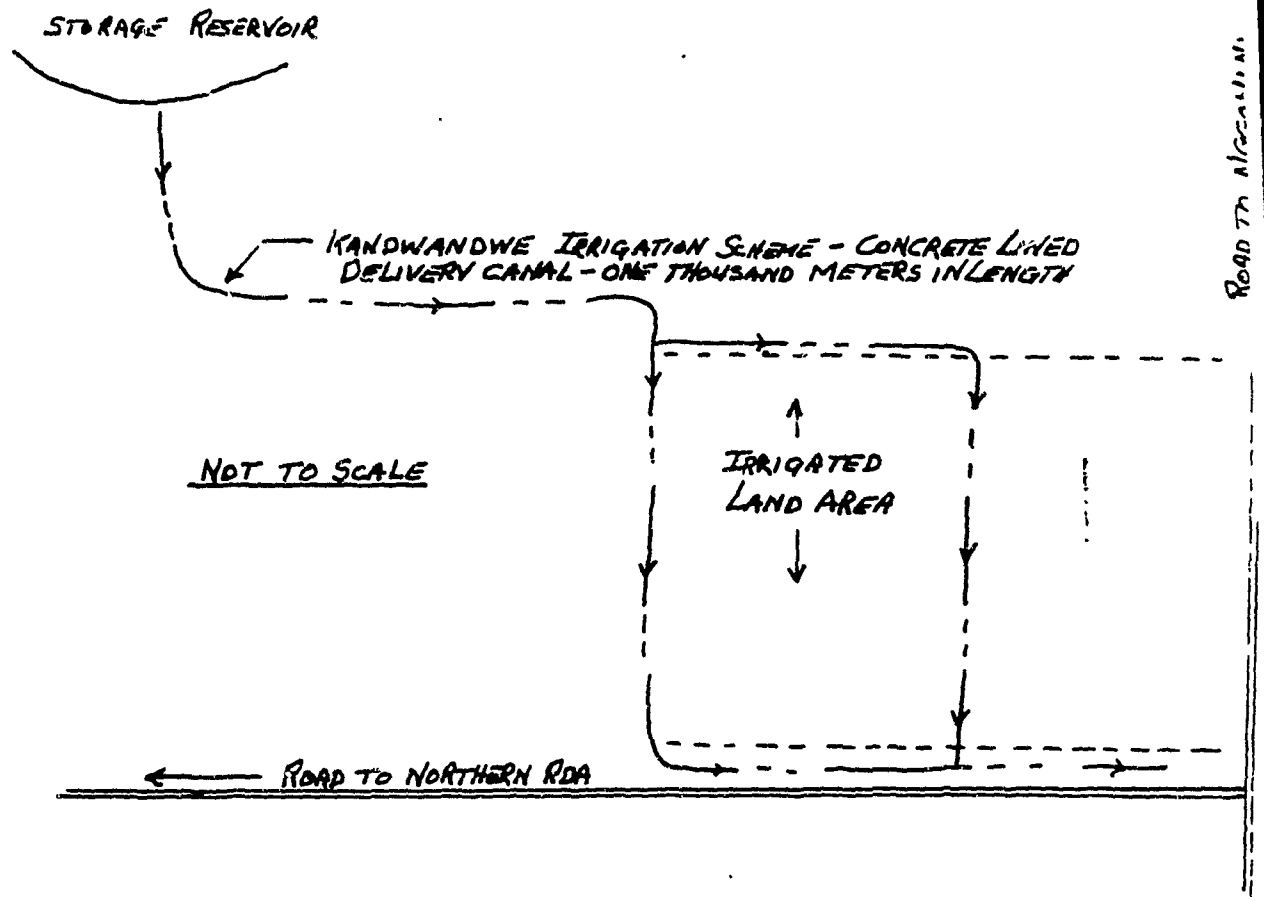


Figure 3. Kandwandwe Irrigation Scheme

C. Phophonyane Irrigation Scheme - Cost Estimate

The Phophonyane irrigation scheme is a private farmer operated scheme. The scheme is 28 hectares in size with 14 farmers. The original irrigation water supply was pumped from a stream source into a storage reservoir. Some 4 or 5 years ago the farmers decided to stop pumping water due to the high electric power costs, thus shutting down the irrigation scheme. In the meantime another water source has been located from another stream from which the water can be supplied to the storage reservoir by gravity. In most years, indications are that this new water source will be sufficient to meet irrigation requirements for the scheme without having to supplement by pumping from the original water source. However, this new water source will require a 3500 meter pipeline. The farmers have begun digging a trench by hand while working on finding financing for the project. These farmers are determined to get their irrigation scheme underway again.

1. Required Materials and Costs

- 3500 meters of 110 mm (4 inch +) PVC class 4 pipe, costing 11.50 per meter. Total cost = $3500 \times 11.50 = \text{E}40250.00$. Trenching for the pipeline is to be done by the MOAC Land Development furnishing a back hoe and operator. The estimated time to do the trenching is 200 hours requiring 20 litres per hour, costing E2,75 per litre. Total cost = $200 \times 20 \times 2,75 = \text{E}11000.00$.
- Concrete diversion weir requiring 25 bags of 50 kg cement to construct, costing E14.00 per bag. Total cost = $25 \times 14.00 = \text{E}350.00$. Reinforcing steel costing a total of E60.00. 100 meters of 100 mm (4 inch) galvanized pipe costing E50.00 per meter. Total cost = $100 \times 50 = \text{E}5000.00$. Overall total cost of diversion weir = $\text{E}350.00 + \text{E}60.00 + \text{E}5000.00 = \text{E}5410.00$.
- 100 mm (4 inch) butterfly valve, air intake valve and all other fittings costing a total of E500.00.
- Farmers contribution of labor will include constructing the diversion weir. Estimated time to construct the weir is 60

man days and hand back filling the pipeline trench with an estimated time of 600 man days, wages at E7.00 per man day. Total contribution by the farmers of their labor = $660 \times 7.00 = E4620.00$.

- MOAC contribution - Lorry (large truck) with driver to haul pipe and supplies from vendor(s) to irrigation scheme, haul sand from source nearby to diversion weir site, Land Use Planning personnel to provide final construction plans and field layout (CAPM Field Assistant Themba Magagula, Extension Officer Maquawe Shongwe and farmers know where the construction is located on the scheme and can assist LUP) and Land Development to provide back hoe and operator and supervision of construction.

2. Total Estimated Cost for Upgrading and Renovating

CAPM DESIGNATED FUNDS (GOS CASH CONTRIBUTION):

Pipeline (E40250.00), materials for diversion weir (E5410.00), fittings (E500.00), diesel fuel (E11000.00) plus 10% contingency (E5720.00).
Total contribution = E62880.00.

FARMERS' CONTRIBUTION:

Labor to construct diversion weir and back filling the pipeline trench (E4620.00), sand (no cost) plus 10 % contingency (E460.00).
Total contribution = E5080.00.

MOAC CONTRIBUTION:

Transportation, final construction plans and field layout, back hoe and operator, and supervision of construction.

The areas where upgrading and renovation would take place on the Phophonyane irrigation scheme are highlighted in Figure 4.

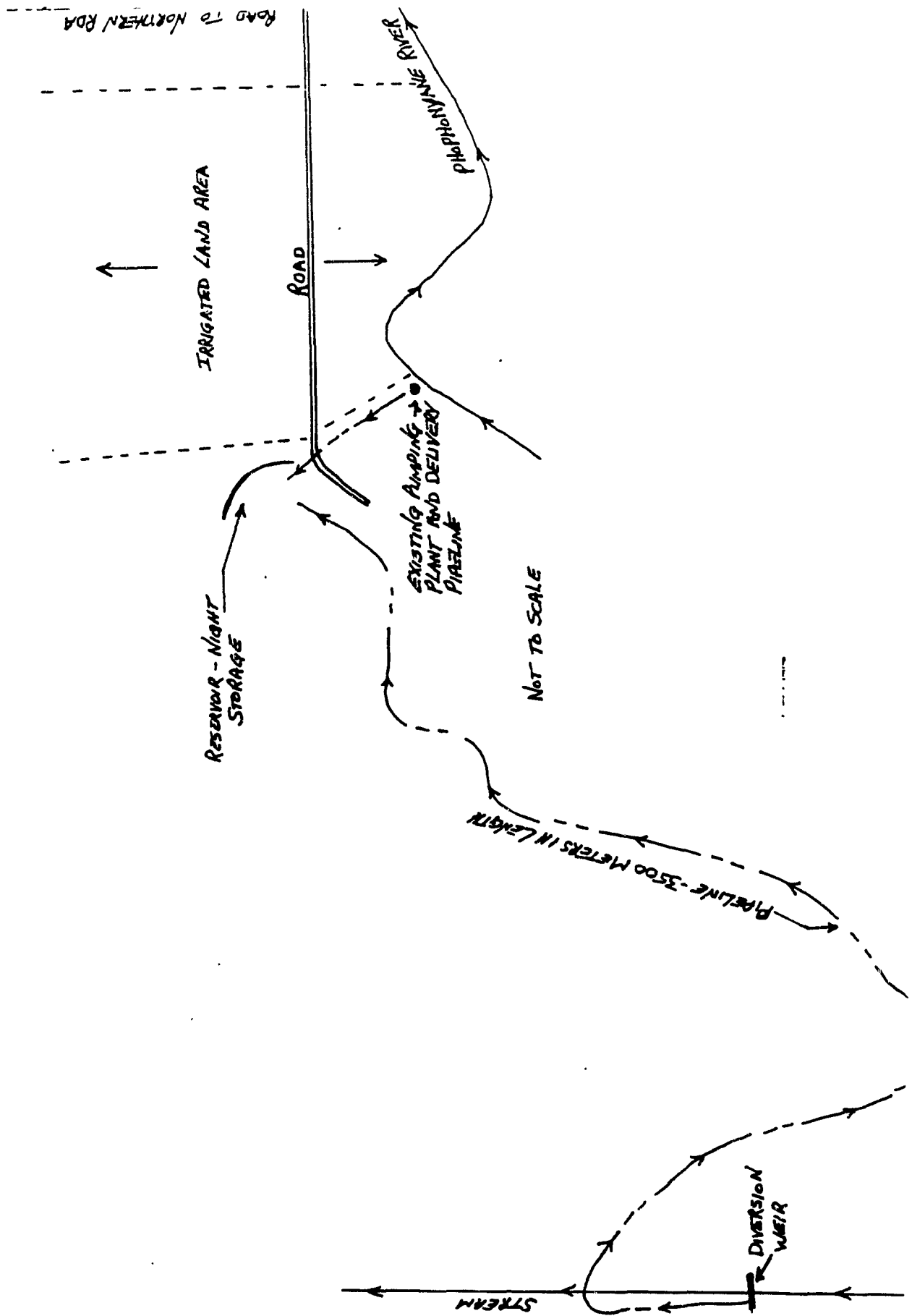


Figure 4. Phophonyane Irrigation Scheme

D. Ndlalambi Irrigation Scheme - Cost Estimates

The Ndlalambi irrigation scheme is a farmer developed scheme. The farmers have hand dug a four kilometer delivery canal from a stream source and constructed two storage reservoirs. The irrigation scheme is 16 hectares in size with 32 farmers. To increase the water efficiency, pipelines and precast canal lining are required to adequately serve the irrigation scheme. Many areas are too steep for using concrete lined canals, thus pipelines are recommended.

1. Required Materials and Costs

- 200 meters, 125 mm (5 inch) PVC class 4 pipe, costing E18.60 per meter. Total cost = $200 \times 18,60 = E3720.00$. 1900 meters, 90 mm (3.5 inch) PVC class 4 pipe, costing E7.20 per meter. Total cost = $1900 \times 7,20 = E13680.00$. 1400 meters of 110 mm (4 inch +) PVC class 4 pipe, costing E11.50 per meter. Total cost = $1400 \times 11.50 = E16100$.
- 30 stand pipes, 50 mm (2 inch) galvanized pipe x 1.5 meter in length (male threaded at both ends), 20 stand pipes with 90 mm x 90 mm x 50 mm (female thread) PVC "T" coupling and 10 stand pipes with 110 mm x 110 mm x 50 mm (male threaded at both ends), with stand pipe with 50 mm 90 degree elbow (female threaded on both ends), 50 mm globe brass valve, 50 mm galvanized nipple (male threaded on end), average costs of each stand pipe assembly of E200.00. Total cost = $30 \times 200 = E6000.00$.
- 30 concrete pipes, 110 mm x 1.25 meter length for use to set over the stand pipes for protection, costing E18.00 each. Total cost = $30 \times 18.00 = E540.00$.
- 600 meters of lay flat flexible hose with clamps for taking water to the farmers fields from the stand pipes, costing E17.00 per meter. Total cost = $600 \times 17.00 = E10200.00$.

- 450 meters, 300 mm x 1 meter precast concrete canal lining (lining of canal between upper and lower storage reservoirs), costing E16,80 per meter.
Total cost = $450 \times 16,80 = E7560.00$.
- Trenching for the pipeline and precast concrete canal is to be done by MOAC Land Development furnishing a back hoe and operator. Estimated time to do the trenching is 150 hours, requiring 20 litres per hour, costing E2.75 per litre.
Total cost = $150 \times 20 \times 2,75 = E8250.00$.
- 3 concrete block structures, one at the end of each pipeline to flush the silts from the lines with necessary valves and fittings. 45 concrete blocks (6"x 6" x 12"), costing E1.90 per block.
Total cost = $45 \times 1,90 = E85.50$.
- 75 bags of 50 kg cement is needed to repair existing diversion weir and for cementing the precast concrete canal joints and building flushing structures, costing E14.00 per bag. Total cost = $75 \times 14.00 = E1050$.
- 2 butterfly valves, one 125 mm (5 inch) and one 110 mm (4 inch +), air intake valves, pressure relief valves and necessary fittings costing a total amount of E1000.00.
- 100 meters of 110 mm (4 inch +) galvanized pipe to cross a drainage, costing E50.00 per meter.
Total cost = $100 \times 50 = E5000.00$.
- Farmer contributions will include labor for installation of the pipeline and precast concrete canal, assembling and placing all pipe fittings, cementing canal joints, repairing the diversion weir, and hand back filling the pipe trench. The estimated labor time is 1000 man days, wages at E7.00 per man day. Total contribution by the farmers of their labor = $1000 \times 7 = E7000.00$.

- MOAC contribution - Lorry (large truck) and driver to haul precast canal lining, pipes and materials from vendor(s) to the irrigation scheme, Land Use Planning to provide final construction plans and field layouts (CAPM Field Assistant Themba Magagula, Extension Officer Maquawe Shongwe and farmers know where the construction is located on the scheme and can assist LUP) and Land Development to provide back hoe and operator, and supervision of construction.

2. Total Estimated Costs for Upgrading and Renovating

CAPM DESIGNATED FUNDS (GOS CASH CONTRIBUTION):

Pipeline (E33500.00), stand pipes and fittings (E6000.00), concrete pipe (E540.00), lay flat flexible hose (E10200.00), precast concrete canal lining (E7560.00), concrete blocks (E85.50), cement (E1050.00), valves and fittings (E1000.00), galvanized pipe (E5000.00), diesel fuel (E8250.00) plus 10% contingency (E7320.00).
Total contribution = E80505.50.

FARMERS' CONTRIBUTION:

Labor (E7000.00), sand (no cost) plus 10% contingency (E700.00).
Total contribution = E7700.00.

MOAC CONTRIBUTION:

Transportation, final construction plans and field layouts, back hoe and operator, and supervision of the construction.

The areas where upgrading and renovation would take place on the Ndlalambi irrigation scheme are highlighted in Figure 5.

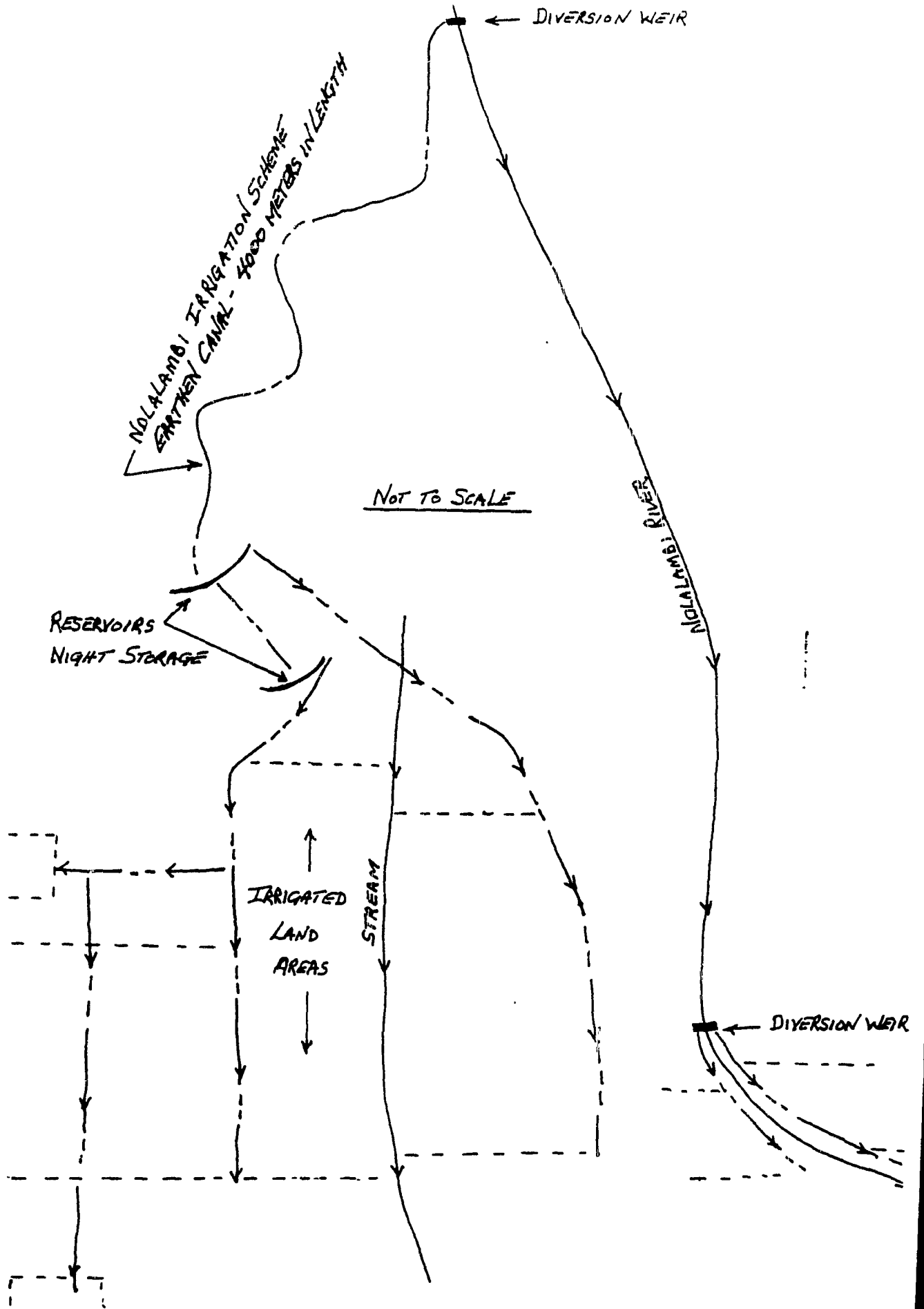


Figure 5. Ndlalambi Irrigation Scheme

E. Total Estimated CAPM Designated Funds (GOS cash contribution) for Irrigation Scheme Upgrading and Renovation

1. Luyengo Irrigation Scheme

For the precast concrete lining alternative for the Luyengo irrigation scheme:

LUYENGO	= E 40491.00
KANDWANDWE	= E 13536.00
PHOPHONYANE	= E 62880.00
NDLALAMBI	= E 80505.50
TOTAL	= E197412.50

2. Alternative Luyengo Irrigation Scheme

For the pipeline alternative for the Luyengo irrigation scheme:

LUYENGO	= E139140.00
KANDWANDWE	= E 13536.00
PHOPHONYANE	= E 62880.00
NDLALAMBI	= E 82505.50
TOTAL	= E298061 .50

The CIE favors alternative 2. above and recommends its selection for the upgrading and renovation plan (pipeline for the Luyengo irrigation scheme). Selecting this alternative, the GOS cash contribution to the CAPM Project would essentially be expended.

If alternative 1. is to be selected (sections of Luyengo canal to be lined), then the remaining funds would amount to approximately E83000.00 (E280000 - E197412.50).

If there are unexpended available monies after completing either of the above alternative upgrading and renovation programs, it is recommended that consideration be given to use such funds to purchase drip irrigation

materials and supplies for demonstration of this method of irrigation on several schemes, and/or add additional canal lining for some irrigated lands on the Ndlalambi irrigation scheme (irrigated lands shown in Figure 5. in the lower right hand corner - approximately 800 meters of lining) and lining sections of the 4 kilometer delivery canal where high seepage is occurring (approximately 500 meters).

It is suggested that a visit be made to the European Economic Community (EEC) office to discuss the possibility of obtaining matching funds for this CAPM proposed upgrading and renovation program. The EEC has grant funds available for water resources projects through their macroproject program. It would be well to see if such funds are available for irrigation scheme rehabilitation. This would stretch the CAPM (GOS cash contribution) funds if EEC funds were available. The EEC office is located in Mbabane.

F. Prices Used In This Study

As indicated in the methodology, the CIE collected material and supply costs from 5 vendors. The vendors included Swazi Agri - Plan (Pty.) Ltd., Matsapha; Swazi Warehouse, Manzini; Sizeze Pipe Ltd, Matsapha; Swaziland Spares + Equipment (Aqua), Mbabane; and The Falls Building Center, Piggs Peak area. It was found that prices vary substantially between vendors. As an example, 90 mm PVC class 6 pipe price quotations varied from a high of E16,69 to a low of E10,63 per meter, a 36 % difference. Or, lay flat flexible hose price quotations varied from a high of E17,56 to a low of E16,31, a 7 % difference. Most price quotations varied between 30 to 50 % ! From the price quotations obtained, it appears that substantial savings in material and supplies can be realized if one seeks out the different vendors available in Swaziland. The CIE used the lower price quotations for the cost estimating in this study.

G. Drip Irrigation Demonstrations

Plans are for CAPM to demonstrate drip irrigation on one or two irrigation schemes as part of the GOS cash contribution program. Putting Ndlalambi and Luyengo irrigation schemes into pipelines would make these excellent schemes for demonstrating drip irrigation. In addition, there are other irrigation schemes CAPM is working with that would make good drip irrigation demonstration areas. Drip irrigation material and supply costs will be approximately E20000.00 to E22000.00 per hectare. Such a drip irrigation system would include a sand filter large enough to serve several farmers on the scheme. Depending upon the shape of the field, materials and supplies for a hectare of land would require approximately 18000 meters of 15 mm class 6 polythene pipe for laterals spaced 60 cm apart, 300 meters of 25 mm class 6 polythene pipe for mainlines, 200 to 300 meters of 50 mm class 6 polythene pipe for delivery line, 45000 drippers spaced 40 cm on the lateral lines, a sand filter, and including the necessary fittings. It is the CIE's understanding that used drip irrigation materials and supplies are available from the Simunye Estates at a relatively low cost. This may be an alternative for the CAPM project to establish drip demonstrations at a very low cost.

H. Upgrading and Renovation Construction Alternatives

In estimating the costs for upgrading and renovating the identified irrigation schemes in this study, MOAC government (Land Use Planning and Land Development) were considered to be used for completing final construction plans, providing the field layouts, transport, construction equipment and operators and supervising of the construction. Main reason for using the MOAC services is that the International Fund for Agricultural Development (IFAD) is soon to be completed. It is the assumption that the MOAC is interested in keeping the IFAD program staff and laborers employed rehabilitating irrigation schemes such as proposed in this study.

Also, farmers' contribution of their labor to install the upgrading and renovation materials is used.

However, there are other alternatives which may be considered. One alternative may be to hire a private contractor to do all the trenching for

the proposed concrete lining and pipelines. All other services required to be provided by the MOAC and farmers contribute their labor.

Another alternative is to hire a private contractor to do everything that is designated as the MOAC services in this study, such as complete the final construction plans, do the field layouts, do all the trenching and supervise all the construction. Again, the farmers would contribute their labor to install the materials and supplies.

It is strongly recommended by the CIE that the farmers be involved as much as possible in any alternative upgrading and renovation programs selected. Their involvement can create an interest and a feeling of ownership in the irrigation scheme.

Under all alternatives, the CAPM designated funds (GOS cash contribution) pays for the cost of the materials and supplies and costs of contracted work.

If private contractors are to be hired, construction costs are expected to be higher than the above estimates. For example, if a private contractor were to supervise the construction of the diversion weir and the installation of the pipeline, and excavate the pipeline trench on the Phophonyane irrigation scheme, costs would be approximately as follows:

- Developing a final field construction plan and field layout by the private contractor, it is estimated to take 5 man days at a cost of E600.00 per day.
Total cost = 5 x 600.00 = E3000.00
- Material costs would be the same as shown under the Phophonyane irrigation scheme above: pipeline (E40250.00), materials for diversion weir (E5410.00), and fittings (E500.00).
- Trenching for the pipeline to be done by the private contractor, requiring an estimated 200 hours (30 days), costing E400.00 per day for a excavation equipment and operator. Total cost = 30 x 400.00 = E12000.00. Farmers still would do the laying of the pipe and back filling.

- Farmers to construct the diversion weir.
- Contractor to supervise the construction of the diversion weir and the laying and back filling of the pipeline, requiring an estimated 30 days, costing E400.00 per day. Total cost = $30 \times 400.00 = E12000.00$.
- Overall construction cost estimate using a private contractor = final construction plans and field layout (E3000.00), Pipeline (40250.00), diversion weir (E5410.00), fittings (E500.00), trenching (E12000.00), supervision of construction (E12000.00) plus 10% contingency (E7320). Total cost = E80480.00. This cost compares to E62880.00 as estimated in this study using the MOAC services. The increased estimated cost using a private contractor on the Phophonyane irrigation scheme would amount to approximately E18000.00.

Estimated cost - private contractor	=	E80480.00
Estimated cost - MOAC services	=	E62880.00
Difference	=	E17600.00

I. Recommended Procedure for Carrying Out the Upgrading and Renovation Program

Upon receiving and approval of this report by all concerned, CAPM and MOAC can proceed utilizing the MOAC procedures in place for carrying out irrigation scheme rehabilitation under the IFAD program. Adaptations to the present procedures can be made accordingly to fit the upgrading and renovation plans selected from those outlined in this study. The MOAC can take the leadership through the Ministry's Land Use Planning and Land Development Sections.

It is recommended however; that the MOAC and/or CAPM designate a 5 or so member team to direct and coordinate this upgrading and renovation program. One team member should be designated to be in charge. This team will be essential for identifying

and recommending alternatives where needed, develop and coordinate the construction schedule for each irrigation scheme, purchase and schedule delivery of the materials and supplies in a timely manner, keep the farmers involved as appropriate and supervise and coordinate all involved people and activities.

J. Summary

The GOS has made a cash contribution of \$100,000.00 (approximately E280000.00) to the CAPM project for upgrading and renovating selected irrigation schemes in Swaziland. The CIE was employed on a short term consultancy to conduct a study and develop an action plan for upgrading and renovating selected irrigation schemes. The irrigation schemes to be studied were selected in consultation with CAPM and MOAC.

The irrigation schemes designated for study and the estimated upgrading and renovation costs for the CAPM designated funds (utilizing MOAC services and farmers contribution of their labor) are as follows:

1. Alternative where sections of the Luyengo irrigation scheme canal would be lined:

LUYENGO	= E 40491.00
KANDWANDWE	= E 13536.00
PHOPHONYANE	= E 62880.00
NDLALAMBI	= E 80505.50
TOTAL	= E197412.50

2. Alternative where the total Luyengo irrigation scheme canal where to be put into a pipeline:

LUYENGO	= E139140.00
KANDWANDWE	= E 13536.00
PHOPONYANE	= E 62880.00
NDLALAMBI	= E 80505.50
TOTAL	= E296061.50

The cost estimates for this study were made using price quotations for materials and supplies obtained by the CIE from 5 vendors in Swaziland. GOS contributions to the upgrading and renovation program includes utilizing MOAC Land Use Planning and Land Development services for developing the construction plans, field layouts, construction equipment and operators, transport and supervision of the construction. The farmers contribution include using their labor resources for the installation of the material and supplies.

An alternative to carrying out the upgrading and renovation program is to employ a private contractor to provide some or all of the above identified MOAC services. However, cost of upgrading and renovating the irrigation schemes would be more expensive.

To implement this irrigation scheme upgrading and renovation program, it is recommended that the existing MOAC Land Use Planning and Land Development (rehabilitation and construction services) be utilized as available. Also, the irrigation scheme farmers need to be part of this program, contributing their labour resources, giving them a feeling of ownership in their respective irrigation scheme.

It is recommended that a 5 member or so team be designated by MOAC and/or CAPM to direct and coordinate the upgrading and renovation program.

SECTION III
IRRIGATION DEVELOPMENT IN SWAZILAND

A. Background

The statement of work for the short term consultancy included the task that the Consulting Irrigation Engineer (CIE) assist the Government of Swaziland (GOS) and the Ministry of Agriculture and Cooperatives (MOAC) with the development of a strategy for maximizing the future expansion of commercial horticultural production on small-scale farms in Swaziland.

The CIE had the pleasure of having an audience with the Minister of Agriculture and Cooperatives, the Honorable Themba Masuku (Minister). The Minister indicated during our visit that small-scale irrigation scheme development and construction of small water storage dams for Swazi Nation Lands (SNL) in all Regions of the country, was one of his highest agricultural program priorities for the country. The Minister is very much interested in developing an irrigation and water storage plan and policy for Swaziland.

B. Present Irrigation in Swaziland

It is not exactly known when irrigation development started in Swaziland. It is known that use of irrigation for crop production in the country began around the early 1950's on Title Deed Lands (TDL), more specifically on the Sugar Estates in Mhlume and Big Bend and for a variety of crops in the Malkerns valley. Simunye Estate development began some time later, beginning in the early 1980's. Prior to this there may have been some individual SNL farmers along the many streams in the country that used irrigation to produce small acreage of vegetable mainly for their family use. It was not until the 1960's that full scale SNL irrigation development actually got started, most irrigation schemes having been developed between the late 1960's and through the early 1980's.

Studies by the U.S. Corps of Engineers (1980 Report) indicates approximately 42,000 hectares (104,000 acres) were being irrigated in Swaziland. Of this acreage, it was estimated that 1100 hectares (2700

acres) were being irrigated on SNL. The remainder 41,000 hectares (101,000 acres) were irrigated TDL. During the CIE's two year assignment with the Cropping Systems Project (1989 - 1991), a survey of irrigation on SNL was made with the field Extension Officers finding that the irrigated acres on SNL farms is still about 2700 acres just as indicated in the 1980 Corps of Engineers report. One of the reasons small-scale irrigation had slowed in the 1980's was because of the extensive damage that resulted on the existing irrigation schemes and the country due to the 1984 cyclone, Demoine. Available resources, particularly human and financial, are being expended to rehabilitate the damaged irrigation schemes.

The 1980 Corps of Engineers report also indicates that there are approximately 244,000 hectares (601,000 acres) of land that potentially can be irrigated in the country. However, the Corps report also indicates that there is sufficient stream (surface) waters available for only about 93,000 hectares (230,000 acres) of land. This, too, depends upon the types of crops irrigated and number of water storage dams that are to be built. As indicated above, some 42,000 hectares (104,000 acres) are now irrigated in the country leaving a potential development of about 51,000 hectares (91,000 - 42,000) or 126,000 acres. The Minister indicated he would like to see the country develop much of the potentially irrigable lands for small-scale farms.

Essentially all lands, SNL and TDL, are irrigated using surface water sources. A Canadian study team completed a detailed groundwater drilling study in 1991, identifying available groundwater supplies in Swaziland. Their reported information includes depth to water and quantity of water that can be expected from bore holes throughout the country. No one has studied the report sufficiently at this time to determine if there is available groundwater for irrigation purposes.

C. Planning for Future Irrigation Development and Rehabilitation in Swaziland

Swaziland has a very good potential for developing new lands for irrigation purposes and for increasing production on existing irrigated SNL. Soils suitable for irrigation, substantial water supplies remaining to be developed, excellent climate for crop production and people interested in irrigated agriculture from the MOAC and farmers, are all indicators that small-scale irrigation schemes can be a success in Swaziland. To carry out an efficient and feasible small-scale irrigation scheme development, a small water storage construction and a rehabilitation program, the country needs to adopt a national irrigated agriculture policy and plan. To adopt such a policy and plan, some basic and essential information is required to supplement the existing water data in the country. The 1980 Corps of Engineers report identifies primarily large-scale water storage and irrigation scheme potentials.

D. Problems Associated with Developing Irrigation and Rehabilitation of Schemes in Swaziland

- The available hydrologic and meteorological data are not in a usable form. The data, such as daily, monthly and yearly rainfall and runoff records, need to be assembled in usable publication form.
- No existing studies are available identifying potential small dam sites for storing stream runoff during rainfall times (generally during the summer months) for use during water shortage times (winter months). Nor is there information available on quantity of flows in tributary streams by water basins.
- There is a serious shortage of educated and experienced Swazis in the technical areas of irrigation engineering, irrigated agronomy, irrigation scheme management, agricultural economics, etc. to carry out an aggressive irrigation development and rehabilitation program.

- Irrigation training opportunities at the University of Swaziland are very limited.
- Irrigation training for farmers on irrigation schemes is not sufficient to carry out a successful irrigated agriculture program in the country.

E. Recommendation for a Plan of Action for Irrigation Development and Rehabilitation Program in Swaziland

- Continue the existing irrigation scheme rehabilitation program even after the IFAD program comes to a close (presently to end July 31, 1992). Identify funding sources for the rehabilitation program because there are very good existing schemes that should not be neglected in the country's planned irrigated agriculture program.
- Involve the irrigation scheme farmers during all the planning and construction phases of rehabilitation and/or new development. Where farmers have an opportunity to contribute their ideas and thoughts, their labor and financial resources, it will make them feel more like it is their irrigation scheme than a government scheme.
- A high priority should be given to developing SNL that can be irrigated from the Malkerns Irrigation Development Company canal. The GOS has sufficient water reserved for SNL to irrigate approximately 800 hectares (2000 acres) from the canal under an agreement between the GOS and Malkerns Irrigation Development Company. Twenty percent (20%) of the Malkerns canal flow is available for SNL irrigation. This amounts to 20 Q - secs. of water during unrestricted flows. In dry seasons when restriction may be imposed, the SNL shares in the reduction of flows with the Malkerns canal irrigators. Except for irrigation water being used by the Malkerns Research Station, Luyengo irrigation scheme and a few SNL individual farmers, a large quantity of water still remains for SNL irrigation development. This area is ideal for vegetable production, not only because of climate, soil and water

resources, but is located in the heart of the vegetable market area.

- Increase Swazi human resources in the technical areas of irrigated agriculture (B.Sc. and M.Sc. levels) by strengthening the irrigation curriculum at the University of Swaziland and/or training students at selected Universities throughout the world having good irrigation programs. Also, for some students, sufficient training may be obtained by attending irrigation short courses developed in country and/or again attending such courses at selected Universities throughout the world.
- MOAC Extension Section develop extensive farmer training programs in all phases of irrigation scheme management and irrigated agriculture production.
- Conduct small dam site potential studies including feasibility of such sites.
- Compile and assemble all existing water quantity and quality data into usable forms. This includes taking a look at the Canadian groundwater study to determine if there is sufficient groundwater available in certain areas in the country for irrigation development purposes.
- Adopt a national irrigation agriculture development and rehabilitation policy and plan as soon as possible. As the above studies are carried out, the policy and plan can and need to be updated accordingly.

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SWAZILAND COMMERCIAL AGRICULTURAL
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