

Business Plan for Leboeng

Community

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1 Background

On 27.02.2002 a meeting was convened at Leboeng, Northern Province, attended by:

- 30 representatives of the community
- chief F W Molapo, the chief
- the representative from chief M S Nkwana, Mr M Mashilwane
- municipal councillor Mr D J Moagi
- Mr L Moroasui, the executive director of Peoples Agricultural Development (PAD)
- Mr N J Papenfus from Dams for Africa.

The community expressed the desire to have a dam constructed in the adjacent stream, a tributary of the Ohrigstad river, so that they could use the water for crop irrigation. A scheme of this nature would be a huge boost to the local community, which is very under-developed. It would provide a significant level of employment and foster entrepreneurship.

2 Hydrological Considerations

Figure 1, taken from a 1:50000 topographical map (2430BC STRIJDOMTONNEL), shows the position of the proposed dam. It may be seen to collect water from a small catchment area of 15km² in the upper reaches of the Drakensburg. The stream is a tributary of the Ohrigstad river.

The lands to be irrigated and a 4km long 200mm diameter pipeline connecting them are also shown in figure 1.

The maximum height of the wall will not exceed 12m, impounding less than 50000m³. The downward gradient of the pipeline averages 1%, and generally runs with the slope of the ground.

72 hectares will be developed for growing bananas. This will require an annual off-take of 184500m³, equivalent to 20,8% of the catchment area's yield. (See table 2 for calculations). It is reported by the locals that the downstream 'California dam' (see figure 1) overflows throughout the year, and thus the relatively small off-take is not expected to be problematic.

1250mm is the assumed average annual rainfall (see table 2), corresponding to its geographic location on the rainfall map of South Africa. The average flow in the stream, which according to the locals runs throughout the year, has been estimated at 20 litres per minute. The flow shown in figure 2 represents the flow as it was on 27/02/2002, at a site just downstream of the proposed dam, and clearly this is much more than 20 litre/s.

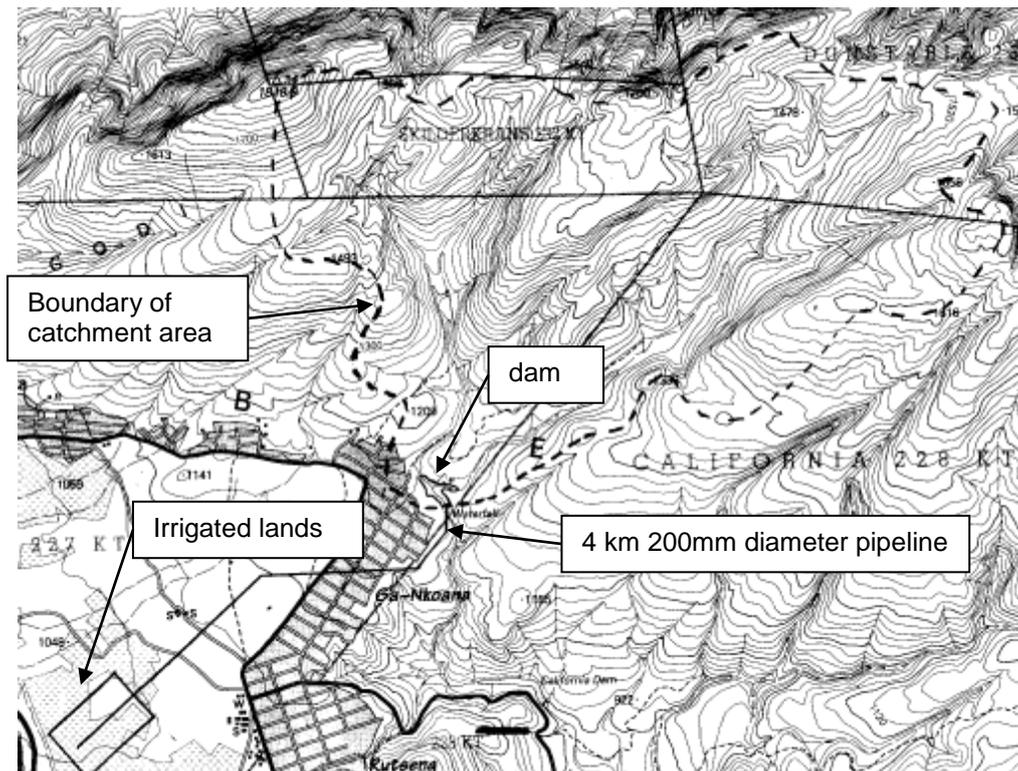


Figure 1 – Topographical map showing the position of the proposed dam, pipeline and plantations.



Figure 2 – Flow as observed on 27/02/2002 at a point just downstream of the proposed site.

3 Agricultural Considerations

Irrigable water makes banana cultivation a definite possibility, in the area indicated in figure 1. This crop has several advantages:

- It is a high value crop, with gross margins ranging between R8600 to R12700/ha (see appendix A).
- It only takes 13 months before the first harvest.
- Bananas can be grown in sub-tropical climates
- Marketing costs such as carton prices, transport, ripening, agents fees can be predicted with a high degree of accuracy
- Farming with bananas is relatively labour intensive, and as such will provide many jobs to the local inhabitants of Leboeng.

The various agricultural requirements are discussed in appendix A. These may be summarised as:

- Substantial and uniform application of water at regular intervals
- Favourable temperatures (cold slows down growth and extreme heat is detrimental to the plants)
- Large dosages of mineral nutrients

4 Pipeline and Irrigation

During dry periods in the hot summer months irrigation is all important. At these times it will be necessary to irrigate day and night as the design capacity of the 4km x 200mm diameter gravity pipeline is only 180m³/hour. At this rate of delivery it is just possible to apply the recommended 6mm of water to 3 hectares, or more correctly 17mm of water every 3 days. This translates to 72 hectares receiving the prescribed dosage of water.

Table 3 shows the design parameters that were used. It may be seen that a 4km x 200mm pvc pipe with a flow of 180m³/hr has a friction head of 38.4m, and this conveniently approximates the fall of the ground (see figure 1).

A permanent micro-sprinkler irrigation system within the plantations has been incorporated into the cost structure.

5 Dam design

A preliminary investigation of the site has revealed that it is ideal for the construction of a 'rock concrete' dam. In this type of construction rocks are packed together with mortar filling the voids in between. Both rocks and river sand are in abundant supply at the site, so that only the cement has to be purchased and trucked in. Fortunately the cement only makes up approximately 7% of the volume of such a dam. Furthermore, the gorge is relatively narrow (about 50m) which significantly reduces the materials required, and hence the cost. Finally, the river bed consists of exposed rock, ideal for founding a dam.

(See the proposal 'Sustainable Empowerment of Rural Communities' for more insight and examples of 'rock concrete' dams).

6 Business Plan

Table 1 below may be regarded as the heart of this business plan. It summarises the capital investment that is required, as well as the expenditure and income. It anticipates a distributable surplus of R407 226 per annum.

Table 1 : Bussiness Plan for Banana Production

	units	unit cost	Total
Capital Expendature			
Viability Study (see tables 4 and 5)	ea	1 100000	100000
Cost of dam ⁴	ea	1 300000	300000
Pipeline (see table 3)	km	4 125000	500000
Packing shed/office/furniture	ea	1 100000	100000
Start up capital			230000
Vehicle - bakkie	ea	1 100000	100000
Farm Establishment (incl irrigation)	ha	72 25150	1810800
			3140800
Expendature			
Interest	%	0.12 1570400	188448
Depreciation over 30 yrs ¹		0.033 900000	30000
Vehicle depreciation over 5 years		0.200 100000	20000
Production costs ²	ha	72 21052.14	1515754
Total			1754202
Income at gate²	ha	72 33214.29	2391429
Gross margin p.a.			637226.3
Less:			
Farmer manager/technical expert ³		150000	
Supervisor		40000	
Telephones/teas/electricity		20000	
Vehicle maintenace and fuel		20000	230000
Distributable Surplus			407226.3

Notes

1 This only includes the viability study, the cost of the dam, and the pipeline.

'Farm establishment' (including irrigation equipment) is depreciated in the production costs over a period of 7 years (15%) - See appendix A.

2 These are based on both the 'plant crop' and 'first ratoon' values (see appendix A). The former applies to the first year, while the second applies to the following six. To compensate for slightly cooler than ideal weather conditions, a 12 month cycle has been assumed in all cases.

3 Optimum management of the palntations is essential for high yields of healthy bananas.

4 This cost allows for drilling and grouting of cracks and fissure in the bed-rock.

Table 3: Analysis of Pipeline Costs of 72 Hectares

Length m	constant roughness	Q for 3 ha ie 72ha/d m3/hr	Pipe diameter mm	Friction loss units mm days m	quantity Unit cost R/m	comments Total Cost R
4000	4.53E-10	180	50	28569.6	7.32	29280
4000	4.53E-10	180	63	9487.2	11.36	45440
4000	4.53E-10	180	75	4130.0	15.76	63040
4000	4.53E-10	180	90	1730.8	22.89	91560
4000	4.53E-10	180	110	664.6	26.83	107320
4000	4.53E-10	180	160	111.3	55.15	220440
4000	4.53E-10	180	200	38.4	84.42	337680
4000	4.53E-10	180	250	13.2	126.27	505080
4000	4.53E-10	180	315	4.4	204.50	816800
4000	4.53E-10	180	355	2.5	264.15	1057800
4000	4.53E-10	180	400	1.4	335.32	1341280
4000	4.53E-10	180	450	0.8	404.67	1618680
4000	4.53E-10	180	500	0.5	492.00	1968200
Volume of water required per hectare				m3	6150	
Total hectares						
Total requirement from da						
Estimated Catchment Area						
Assumed Run-off per ann						
Annual volume						
Residual average flow in s				seepage	m3/s	
Annual flow					m3/yr	
Total volume generated per year					m3	2130720

Note:
In the bussiness plan of table 1, it is assumed that the installed cost of the pipeline is R500 000.

Table 4: Budget for Feasibility Study into social, agricultural, irrigation and economic aspects towards establishing irrigable lands for the Leboeng community.			
Step	Description	Feasibility hours	
		Main Person	Assisted by
1	Discussions with the community, relate the benefits, but also stressing the responsibilities that go with.	10F	
2	Discuss with DWAF aspects relating to permits for the construction of the dam and subsequent use of the water in the agricultural scheme.	6P	
3	Test and analyse the soil to determine what types of crops may be grown	30A	2P,2F
4	Budget for design, supply and installation of the pipeline and irrigation system ² .	16E	2A,2F
5	Determine the cost of land preparation ²	4A	1P,2F
6	Establish the cost of planting, nurturing and harvesting ²	8A	2P,5F
7	Determine the cost of storage and packing of produce	6A	1P,3F
8	Investigate managing and marketing costs.	6A	1P,3F
9	Do a detailed viability analysis	8P	5A,5F
10	Report back to community on feasibility study findings to get buy-in and commitment for the project	9F	
11	General Project management and co-ordination	10P	6F
12	Travelling time from Johannesburg.	9P,18F,9A	
13	Total professional hours, including: agriculturalist(A) – PAD engineer(E) – Dams for Africa facilitator(F) – PAD project engineer(P) – Dams for Africa	63A 16E 37F 33P	7A 0E 28F 7P
14	Total Professional Costs (Rands) Agriculturalist (A) = R 200/hr Engineer (E) = R 250/hr Facilitator (F) = R 200/hr Project Engineer (P) = R 200/hr	70A 16E 65F 40P	14000 4000 13000 8000
15	Traveling expenses (Rands) - 5 trips from Jhb to site and back @ 900km/trip - Accommodation 4 nights @ R300		9000 1200
16	Soil tests		2000
17	Contingencies and sundries		4000
18	Sub total		55200
<p>Notes:</p> <p>1 A brief written progress report is to be written by the 'main person' and circulated to all parties after each of steps 1 through 10 is completed. The report will give an overview of the work undertaken and what was accomplished, and will make recommendations on the way forwards.</p> <p>2 Some work has been done on this aspect</p>			

Step	Description	Feasibility hours	Cost R
1	Identify useful catchment areas from contour maps. Indicate suitable sites for dam construction.	4E*	
2	Calculate the km ² of the various catchment areas for each dam siting.	2E*	
3	Determine the expected inflow into each dam based on the annual average rainfall and estimated surface runoff for the area.	2E*	
4	Do a physical inspection of the sites, liase with client's representatives, and make a selection of the best site	13E*	
5	Do a more detailed engineering topographical survey of the dam site and storage area, using a theodolite. Establish profile of valley where wall is to be constructed.	13S	
6	Investigate the ground conditions at the dam. Cracks in the rock formations deserve special attention. Establish the depth of the rock-bed throughout. Determine best route for pipeline.	9E 9D	
7	Consider sourcing construction materials from area, and determine average conveying distances, rocks, and cement assuming a rock-concrete dam is to be built.	4E 4D	
8	Do a preliminary design to allow costs to be determined: (1) Do a preliminary design (2) Prepare sketch plans for dam (3) Calculate quantities of materials (4) Cost Clearing and excavation/grouting operations (5) Source/cost/plan materials/equipment (6) Quantify labour and source supervision (7) Plan and cost site establishment including an access track, communications, security, ablutions, site hut etc. (8) Prepare and submit viability report	8D 12T 2E 3E 5E 3E 4E 7E	
9	Survey pipeline route	9E 9S	
10	Total professional hours, including: engineer(E) dam-designer(D) surveyor(S) technician(T) Hours include travelling time to and back from site.	67E 21D 22S 12T	16750 7980 4400 2160 31290
11	Travelling expenses - 5 trips to site and back 1000km		10000
12	Accomodation E _{x2} +D _{x1} +S _{x2}		1500
13	Materials tests		2000
14	Total excluding VAT		44790
	Note - an asterisk '*' indicates that this aspect of the project has already been completed. Surveyor (S) = R 200/hr Technician (T) = R 180/hr Engineer (E) = R 250/hr Dams Specialist (D) = R 380/hr		

7 Conclusion

Based on the surplus shown in table 1, an approach to a lending institution such as the Land Bank, or the Development Bank of South Africa should be possible.

However, if the land belongs to the State, the banking institutions may require that the land first be registered as a legal entity, such as a community trust. Clearly this fosters a sense of ownership, responsibility and accountability.

Also included with this proposal are a number of other documents, which show how innovative engineering can alleviate poverty. Three are worth special mention; 'Transformation for South Africa'; 'Sustainable Empowerment of Rural Communities', and 'Criteria for Siting Dams'.

The first shows how the construction of small dams allows high value irrigation-agriculture and permanent employment for those that farm the land. This reduces urban migration. The associated reduction in unemployment results in less crime, with all the associated costs of fighting crime. The document shows that these savings can pay for the cost of the dam and irrigation schemes, even where the viability of the scheme may be in question!

The second relates to the construction of 'rock-concrete' dams, lists the advantages of this type of construction and gives some interesting examples and applications.

The third discusses the principles of siting a dam.

Finally, this proposal 'Business Plan for Leboeng Community' shows how the principles of the above stated documents may usefully be applied to a specific situation. It shows how innovative engineering can be used to eradicate poverty and under-development.

Appendix A

BANANA CULTIVARS

Prepared by Zaag de Beer
Institute for Tropical and Subtropical Crops

Until about 1977, the Dwarf Cavendish banana was the only cultivar grown commercially in South Africa. Dwarf Cavendish was [the] sole commercial cultivar for a very long time since it was believed that this cultivar yielded well under a wide range of soil and climatic conditions. It was considered to be the cultivar most suited to a subtropical climate as evidenced by its predominance in such localities as Israel, Brazil and [the] Canary Islands. Currently we know this is a false believe and in fact the opposite is true due to the choke throat phenomenon. It is no more tolerant to cold or hot conditions than any other Cavendish sub-group cultivar.

In 1968 the cultivar Williams was imported from Western Australia and became the most popular cultivar in South Africa. In 1983, a banana cultivar trial was established at Burgershall Research Station. The objective was to critically compare the horticultural characteristics of six imported cultivars with the local standards Dwarf Cavendish and Williams. Cumulatively, the cultivars Grand Nain and Chinese Cavendish jointly yielded the highest with an average of 58.1 t/ha/annum each over four cycles. This compared with 53.0 and 43.4 t/ha/annum for the standards, Williams and Dwarf Cavendish, respectively. In a cultivar trial conducted in Komatipoort, Grand Nain was the best performer regarding yield per annum over two crop cycles.

WATER AND CLIMATIC REQUIREMENTS FOR BANANAS

There is overwhelming evidence worldwide to support the necessity of supplementary irrigation of bananas. This is especially the case in a subtropical climate where rainfall distribution is seasonal and erratic.

The banana is a tropical and evergreen plant which has no natural dormant phase and which grows rapidly the whole year round under suitable temperature and moisture conditions. In this respect, the banana plant has several import characteristics:

- A high evapotranspiration rate due to the large, broad leaves and large total leaf area.
- A very shallow, superficial root system compared to most tree-fruit crops.
- A poor ability to withdraw moisture from soil which is drying out.
- Rapid physiology responses to soil water deficit especially in conditions of high evaporative demand.

In the Subtropics, the main limiting factor is that night temperatures in both summer and winter, but especially in winter, are sub-optimal for growth and development. Total annual development rate is therefore much slower in a subtropical climate (approximately 25 leaves per year compared with 40 in a tropical climate). Nothing can be done to increase temperature, but much can be done to improve the other climatic limitation, namely, the seasonal and erratic rainfall pattern. It is widely quoted that an evenly distributed rainfall of 100 mm/month is the minimum requirement for bananas.

According to the Umbeluzi weather station, which is in the Mafavuca area, there are 8 months during which rainfall is below [the] 100 mm minimum required. However, during four of these months (May to August) water requirements are also considerable less since growth rate is severely restricted by low temperatures. During the months April, September and October, rainfall is generally too low and erratic to support the faster

prevailing growth rate. During the summer months (November to March) when growth rate is rapid, rainfall is more than 100 mm/month, but despite this there are two main problems.

- Uniform distribution of rain throughout the month is vitally important, and this does not occur in a subtropical area. In fact dry spells of more than 7 days are frequent and this is detrimental to banana growth.
- Occasional severe droughts are devastating without the facility for supplementary irrigation.

The question is how much water to apply at each irrigation. All depends on the soil type. Sandy soils require much more water than clay soils. Some growers apply up to 50 mm per irrigation every 10 to 14 days. This however, is a rule of thumb for practical reasons. An irrigation schedule of 17 mm every +/- 3 days in summer and +/- 7 days in winter is more appropriate for bananas.

NUTRITIONAL REQUIREMENTS

Bananas require large amounts of mineral nutrients to maintain high yields in commercial plantations. Sooner or later the most fertile soils become depleted and require fertilization.

Bananas have a high demand for nitrogen and particularly for potassium. The early stages of vegetative growth are critical for later bunch development, thus minerals must be available to the plant at establishment and at the setting of ratoon suckers. Nitrogen should be applied at short intervals during growth, whereas potassium should be applied at planting and thereafter twice a year. Phosphate may only be required at planting. Micro elements required for a banana plant are Magnesium, Sulphur, Zinc, Manganese, Boron, Iron and Copper.

To fertilize bananas correctly, it is essential to determine the nutrient status of the plants and the availability of plant nutrients in the soil by leaf and soil analysis. The results of such an analysis will enable the application of these nutrients as required, for a high yield with a good quality fruit. Leaf analysis determines the concentration of the various elements. It is thus possible to identify those elements which are deficient or in excess. Once this information is available, it is possible to determine the nutrient status of a plantation and a fertilizer recommendation can be done in accordance with the analysis.

GROSS MARGIN ANALYSIS OF IRRIGATED BANANA PRODUCTION IN SOUTH AFRICA

Costs refer to [a] new commercial banana block in which a permanent micro-sprinkler irrigation system is installed. Initial establishment costs are written off over 7 years (15%). This scenario assumes optimum management of Grand Nain bananas at a density of 2000 plants per hectare. For some input costs, labour costs are included and for others, labour is quoted separately.

Establishment costs (R/Ha)

	Rand
Land preparation (ripping ploughing, etc.)	3 000
New irrigation system	10 000
Pre-plant fertilizers (lime, phosphate, potash)	3 000
Tissue culture plants and transport	7 500
Labour – digging holes and planting out	650
New plantation equipment (sprayers, tools, ladders, etc.)	1 000
Total	25 150

Production Costs – Plant Crop (R/Ha)

	Rand
Irrigation costs (energy and maintenance)	1 200
Post plant fertilizers and application	5 500
Bunch covers and covering (50% of initial cost)	1 500
Props and propping (25% of initial cost)	1 500
Pest and nematode control (if necessary)	2 200
Desuckering (labour)	800
Weed control (labour)	800
Cutting leaves (labour)	800
Harvesting (labour)	800
Transport to pack house	1 000
Packing (labour only)	1 500
Establishment cost (15%)	3 795
Total	21 395

Gross Margin Analysis (Plant Crop)

Expected marketable yield (plant crop)	40t/ha (2 000 cartons)
Average municipal market price (2001)	R 33/carton
Less marketing costs (carton price, transport, ripening, agents fees)	R 18/carton
Average farm gate income (market price less marketing costs)	R 15/carton
Gross income/ha (2000 cartons x R15)	R30 000/ha
Gross margin (gross income less production costs)	R 30 000 – R21 395
	R 8 625

Note : Time from planting to harvest the plant crop will be about 13 months

Production Costs – First Ratoon

	Rand
Irrigation costs (energy and maintenance)	1 200
Fertilizers and application	5 500
Bunch covers and covering (50% of initial costs)	1 500
Props and propping (25% of initial costs)	1 500
Pest and nematode control (if necessary)	2 200
Desuckering (labour)	500
Weed control (labour)	500
Cutting leaves (labour)	1 000
Harvesting (labour)	800
Transport to pack house	1 000
Packing (labour costs only)	1 500
Establishment cost portion (15%)	3 795
Total	20 995

Note : The cost of irrigation, fertilizing harvesting and packing is higher in the first ratoon than in the plant crop, due to the higher yield achieved. Cost of desuckering and weed control is less in the first ratoon.

Gross Margin Analysis (First Ratoon)

Expected marketable yield	45 t/ha (2 250 cartons)
Average municipal market price (2001)	R 33/carton
Less marketing costs (carton price, transport, ripening, agents fees etc.)	R 18/carton
Average farm gate income (market price less marketing costs)	R 15/carton
Gross income/ha (market price less marketing costs)	R 33 750/ha
Gross margin (gross income less production costs)	R 33 750 – R 20 995
	R 12 755

Note : The gross margin for the second ratoon and onwards will be the same as for the first ratoon, excluding the inflation rate.

Time from harvested the plant crop to harvesting the first ratoon crop is 9 – 10 months.

About Dams for Africa

Dams for Africa are turnkey project engineers committed to the sustainable empowerment of communities in remote rural areas by means of dam-construction/water-supply, for irrigation/agriculture as well as purification/reticulation.

The firm recognises the need to be flexible and will tailor its involvement according to need, from minor consultations to relatively large turnkey construction projects.

The firm's contribution to a typical project would ideally be an initial feasibility study, followed by the design and supervision of the dam construction and related canals/pipes for irrigation to farms. The scope of the work may also extend to the construction of a water purification facility and related reticulation to houses.

Ideally labour intensive methods (that are at the same time cost effective) will be used in the construction process.

The firm is also in a position to provide the necessary hydrological, topographical, geological, ecological and social impact studies, and attend to the technicalities and legalities associated with a dam.

Dams for Africa fully appreciates the need to

network and co-operate with partners such as:

1. Community based organizations that are in touch with the needs of the resident population.

The firm is aware of the importance of *community involvement* and is, if required, prepared to participate in all stages of this process. This would include a response-to-need request as the first step, assistance with visualization, participation in negotiations, recruitment and training of local residents for the construction stage, facilitation of training in subsequent agriculture and irrigation, and ongoing mentoring as may be required.

2. Donors/funders and /financial institutions.

The company is prepared to participate in *fundraising* for worthwhile projects, and in the production of 'bankable' documentation.

3. Training organizations who teach on farming-methods/produce-marketing, and who have a heart for ongoing mentoring if required.

The firm would like to know that its engineering contribution is placed in the hands of a motivated community that has been *equipped* with the necessary skills to put the dam and related works to good use for many years to come.

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