Proposal for Growing Bananas

Tubex Community

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Synopsis

In the interests of skills development, job creation, food security and poverty alleviation the community at Tubex want to cultivate high value crops such as bananas on a 6 hectares of land. (Tubex is in Limpopo and lies on the southern slopes of a mountainous area, latitude S24°10' longitude E30°00' with the Olifants river about 4 km to the south). Bananas require a regular supply of irrigable water, and this will necessitate the construction of a dam on the stream that flows though the area. The dam should be at an elevation high enough to allow two things: (1) gravity flow in the pipeline that takes the water to the plantations, and (2) sufficient pressure for micro-sprinklers to operate. The desperation and willingness of the community can be gauged by the way they have already cleared away the bush and erected thorn fences around the periphery to keep goats out.

Background

On 20.03.2002, at the request of Kgosi Thobejane, Mr L Moroasui of Peoples Agricultural Development, Mr Jonathan Boulton, a visitor from the UK, and the writer of Dams for Africa made a physical inspection of the area. On the day of the visit a stream was flowing at a rate of approximately 20 litres/second – see figure 1. However the community's drinking water also comes from this source and it is not known how future requirements may increase or how the flow abates in the dry season. Therefore a storage dam of sufficient capacity should be constructed in the gorge to retain sufficient *storm water* to enable irrigation throughout the year.

In February 2003 Dams for Africa returned to do an engineering survey to determine a suitable site for the proposed dam and the length of the corresponding pipeline. The site should be higher up than the lands to allow gravity flow, and should ideally be positioned where the gorge is narrow with exposed rock on the bottom and the sides.

Figure 1 – Flow as observed on 20/03/2002 at a point about 1km upstream of the proposed site for the dam.

Engineering Specifics

Figure 2, taken from a 1:50000 topographical map shows the position of the proposed dam in a catchment area of 18 km^2, as well as the area west of the stream that has been set aside for cultivation. A 50m wide arched dam would be ideal for this site as there are near vertical rock cliffs (see figure 3) on either side. Furthermore the riverbed consists mostly of either exposed rock or loose boulders overlying the rock – also ideal. Taking into account the upstream slope behind the proposed site and an average gorge-width of 100m, the height of the dam should be 14m to store sufficient water for 300 days of usage based on the general rule whereby each hectare requires 60m^3 per day – for bananas or vegetables. (Thus daily usage is 60m3/Ha x 6 ha = 360Ha). Note that irrigation is not required every day in winter – hence 300 days rather than 365 days. The inflow from the stream has been ignored based on the assumption that this may all eventually be required for drinking water. However evaporation losses from the surface of the dam are assumed to be replenished by the stream.

An simple analysis of the above information will show that only 6% of the annual runoff (assumed to be 100mm per year) is required for irrigation purposes i.e. 108 000m3 of the annual runoff of 1800000 m3.

The dam should ideally be constructed of random-rock masonry, utilizing the abundant supply of rocks in the river bed (see figure 3).

The 2,5 km pipeline will consist of 110mm hdpe pipes, capable of withstanding a pressure equivalent to a 60m head of water. The pipeline will start at an outlet valve at the dam and run along the western side of the gorge to the fields. This route is indicated on figure 2. A drop in elevation of 7m in the pipeline over the 2,5km length is sufficient to supply water at a flow rate of 15 m3/hr (or 360m3/day) – for flood irrigation. A further drop in elevation will either have the effect of increasing the pressure for operating sprinklers, or alternatively increasing the flow in the case of flood irrigation. To operate micro-sprinklers a pressure of 1,5 bar is generally required, achievable with an additional 15m fall in the pipe. Note that a permanent micro-sprinkler irrigation system has been incorporated into the cost structure of appendix A.

Wherever possible the pipes will be buried to a depth of 400mm, but will run over the surface where large rocks or boulders are encountered.

Agricultural Considerations

Irrigable water makes the cultivation of high value crops such as bananas and vegetables a definite possibility in the area indicated in figure 2.

A banana 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, and thereafter every 10months.
- Bananas can be gown 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 for growing bananas 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

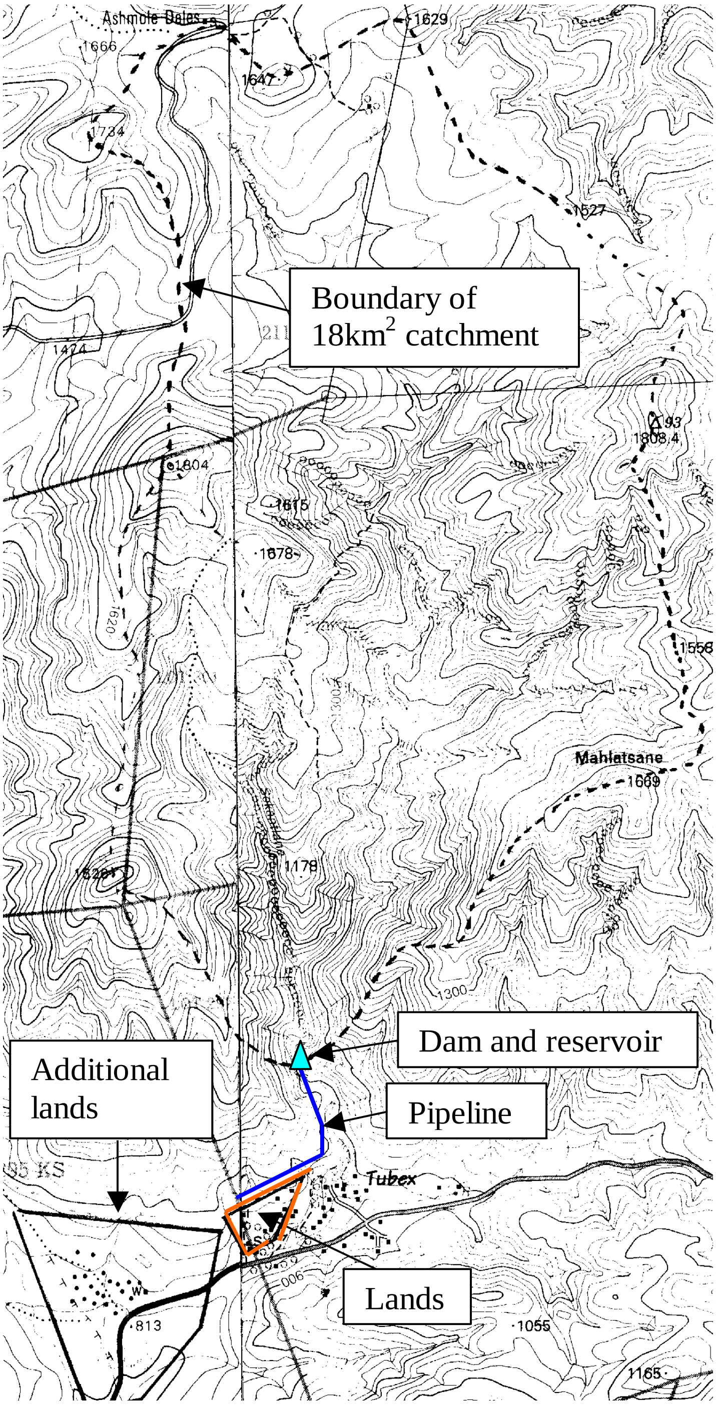

Figure 2 : Portion of the 1:50000 topographical map showing the proposed dam, pipeline and irrigated lands for Leboeng

Figure 3 – the near vertical cliff face on the RHS is in evidence. A similar face is on the LHS. Note also the abundance of rocks that are available for the construction of the dam.

Business Plan

Table 1 below may be regarded as the heart of the business plan. It summarises the capital investment that is required, as well as the expenditure and income. It anticipates a distributable surplus of R62080 per annum, to be shared amongst the participants according to their various contributions.

Note that certain amounts have been allocated to feasibiltiy studies, and the project will only go ahead if these reports are positive.

Conclusion

Based on the surplus shown in table 1, and considering the benefits relating to skills development, job creation, food security and poverty alleviation, funds should urgently be sought.

Table 1 : Bussiness Plan for Banana Production

	unit	qty	unit cost	Total
Capital Expendature[4]				
Soil Potential viability study				12000
Marketing/Viability study				44000
Hydrological study				10000
Ecological study				10000
Cost of dam and 2,5km pipeline				1000000
Shed/office/implements/furniture				200000
Start up capital				104000
Training and Mentoring				100000
Vehicle - bakkie				120000
Farm Establishment (incl irrigation)[1]	ha	6	30180	181080
				1781080
Production costs[2]	ha	6	16695	100170
Income at gate[2,5]	ha	6	44375	266250
Gross margin per crop.				166080
Less:				
Supervisor[3]			40000	
Telephones/electricity			20000	
Vehicle depreciation			24000	
Vehicle maintenace and fuel			20000	104000
Distributable Surplus per crop				62080

Notes

1 'Farm establishment' (including irrigation equipment) has been increased by 20% relative to the values of appendix A to allow for cost increases since that analysis was done. Depreciation at 15% (equiv to 7 yrs, or 8 crops) is allowed under the 'production costs' - See appendix A.

2 These are based on both the 'plant crop' and 'first ratoon' values (see appendix A), after labour costs have been taken out, since the participants will supply the labour and recover their efforts through the distributable surplus. The former applies to the first crop, while the second applies to the following seven.

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

4 This will take the form of a grant.

5 This is based on R20 per carton at the gate, after allowing R13 for marketing costs. As only 6 Ha has to be disposed of it is assumed that marketing costs will come down from R18 for R13 per carton, so that income at the gate will increase from R15 to R20 - refer to appendix A. This assumption is to be confirmed in the marketing/viability study.

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, Maganese, 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 marking 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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