Business Plan

Thabina River Project

Sangoma Farmer's Forum

Limpopo

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Business Plan - Thabina River Project

1 Background

In the interests of food security, poverty eradication, job creation, and entrepreneurial development, the Sangomo Farmers Forum (see figure 1) invited Mr L Moroasui of Peoples Agricultural Development (PAD) and the writer of Dams for Africa (DFA), to join their deliberations on 28.04.2002 on ways of obtaining *water from the Thabina River for irrigation*, which would make it possible to *cultivate high value crops*. A physical inspection of the river revealed an ideal site for building a small dam, at a point about 150m downstream from where the Rigo-rigo river joins the Thabina river (see figure 2). This was followed by discussions, whereupon PAD and DFA were commissioned by the forum to come up with a business plan.

There is 100 hectares of ground suitable for agricultural development east of the river (see figure 2). Table 1 shows how drawing water from the river will allow all 100 hectares to be irrigated.

2 Hydrological, Topographical and Other Design Aspects

The Thabina river (see figure 2, from a 1:50000 topographical map, 2330AD HILDRETH RIDGE) is in the Limpopo Province. It joins the Letsitele river about 2km downstream of the proposed dam, and after another 4km flows into the Groot Letaba river, at a point about 30km (as the crow flies) downstream of the Tzaneen dam. The water from the Thabina river thus currently flows into Mozambique without being dammed in South Africa.

A consideration of topographical maps indicates that the proposed dam will have a catchment area of approximately 200 km^2. The site is ideal for dam construction in terms of flanks that are relatively close together with exposed rock on the river-bed and some way up the flanks (see figure 3). The river bed also contains an abundance of small rocks and river sand, making the construction of a dam from 'rock masonry', using local labour, very cost effective.

Owing to relatively low flanks the structure will be limited to a height to 5m. By factoring in a number of the physical characteristics of the river and dam, table 1estimates the storage capacity at 61607 m^3. The dam serves two purposes:

(1) It creates sufficient depth for the intake/suction pipe of the pump to deliver water to the cultivated lands.
(2) The storage capacity would allow irrigation to continue at a rate of 6mm per hectare over 100 hectares for a period of 10 days, in the event of the river ceasing to flow completely, although this is unlikely given that it is a perennial river with a relatively large catchment area.

It is understood that the usual approvals from DWAF will be required for the dam.

Available Water vs Consumption: Based on an estimated residual flow rate of 200 litres/s (considering only 'seepage water'), together with the storage capacity of the dam, the total quantity of water available for irrigation is given in table 2 as 6368807m^3.

Given that bananas generally require an average of 6mm of water daily, the forum's total annual off-take from the river, assuming 100% utilization of the land, is 6mm/m^2 x 10000m^2/hectare x 100 hectares x 365 days/yr = 2190000 m^3/yr. This represents 34% of the 'seepage' water entering into the dam, but excludes water generated from 'surface runoff', a quantity estimated as 4000 000m^3 (see table 2). In determining the available water for irrigation no deduction is made for evaporation, as it may be assumed that whatever does evaporate, will be replenished by the surface runoff.

Figure 1 – Members of the Tiyani Farmers Forum at the proposed site for the second dam. Chairperson Mr S T Mabasa is on the far right, and agricultural technician, Mr F R Khosa is in the first row on the left. (The forum also represents other projects that lie between 500m and three kilometres away from the river, which will not therefore fall in the scope of this business plan).

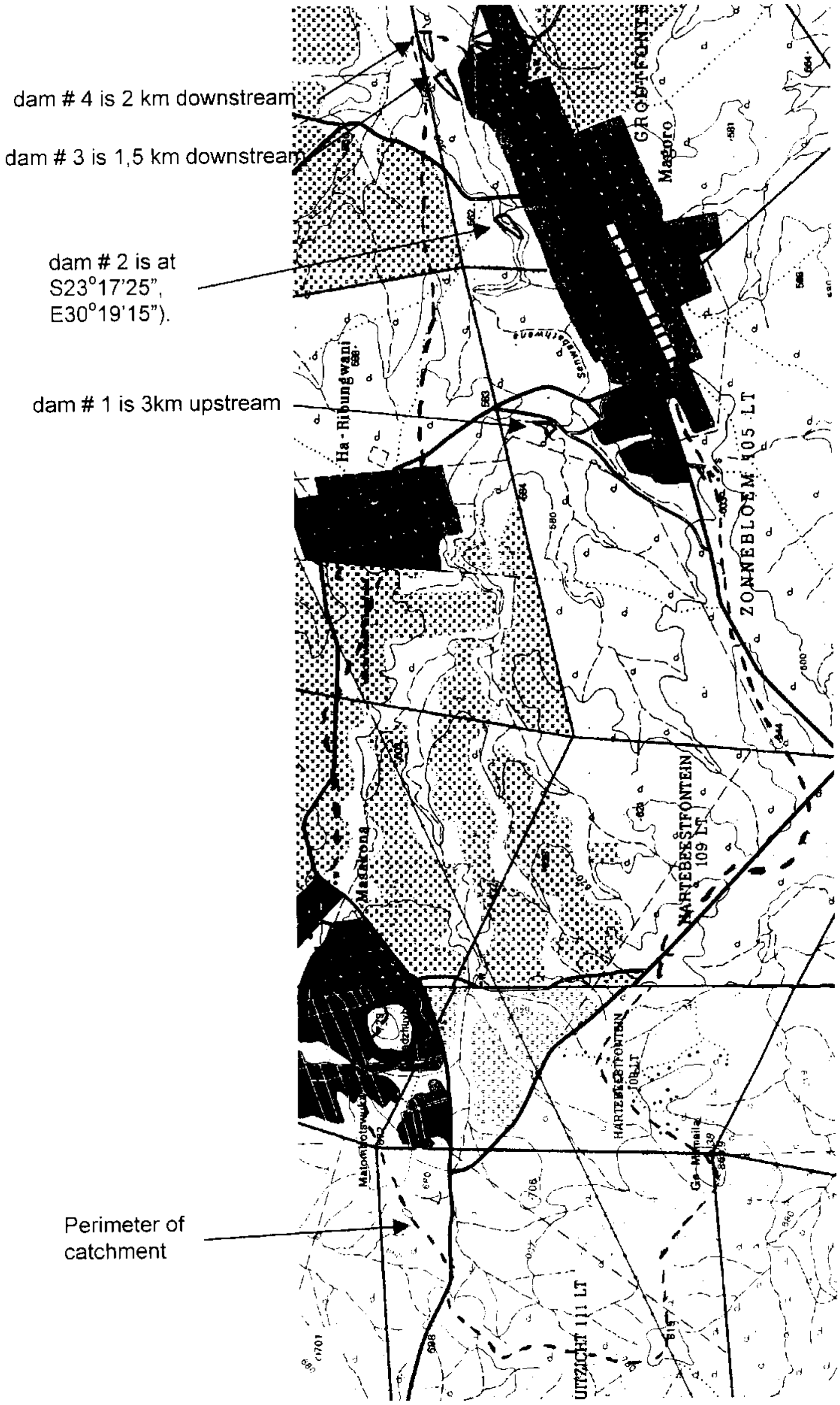


Figure 2 – Sites for the proposed four dams, superimposed on a 1:50000 topographical map (2330AD HILDRETH RIDGE)

Figure 3 – The river as observed on 29/04/2002 at the site for the second dam.

Figure 4 – Overview of the site where the second dam is proposed - seen from the left flank, showing exposed rock-bed and relatively steep flanks.

Table 2 - Analysis of Proposed Dams

		2m deep	5m deep
estimated height of head of water when full	m	2	5
average flat width of river bed	m	14	14
slope of left flank	%	35	35
slope of right flank	%	25	25
total length of waterline at wall (I.e. perceived width)	m	28	48
submerged elevational area of dam wall	m^2	42	156
longitudinal slope of river	%	0.5	0.5
surface length	m	400	1000
shape factor		2	2
storage capacity per dam	m^3	8343	77857
number of dams	ea	4	4
combined storage capacity of all dams	m^3	33371	311429
average residual flow in stream from seepage (2)	m^3/s	0.012	0.012
annual inflow from stream due to seepage	m^3/yr	378432	378432
Ratio : [seepage inflow]/[storage]		11.3	1.2
annual water available for irrigation, ignoring evaporation(3)	m^3/yr	411803	689861
land to be irigated from the stream	ha	18.5	18.5
average daily usage	mm/day	6	6
days per year	days/yr	365	365
Total consumption	m^3/yr	405150	405150
[consumption] / [storage + seepage inflow]	%	98	59
estimated surface run off (1)	mm/yr	20	20
catchment area	km^2	28	28
annual inflow from surface runoff (5)	m^3/yr	560000	560000
combined surface area of all reservoirs	ha	4.4	19.3
annual evaporation loss	mm/yr	2000	2000
annual evaporation loss for given depth (4)	m^3/yr	88685.7143	386285.7

Notes

(1) The surface runoff of 20mm is based on an assumed annual rainfall of 600mm (from rainfall map).

(2) At this stage this is an estmate and must be confirmed.

(3) Note that in determiniing the water that is avaiable for irrigation, only the inflow from seepage (378432m^3) has been added to the storage capacity of the dams, and inflow from surface runoff (560000m^3) has been ignored. However, no deduction is made for evaporation (4), as it is assumed that whatever does evaporate, will be replenished for by surface runoff (5).

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 grow well 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 Sangoma.

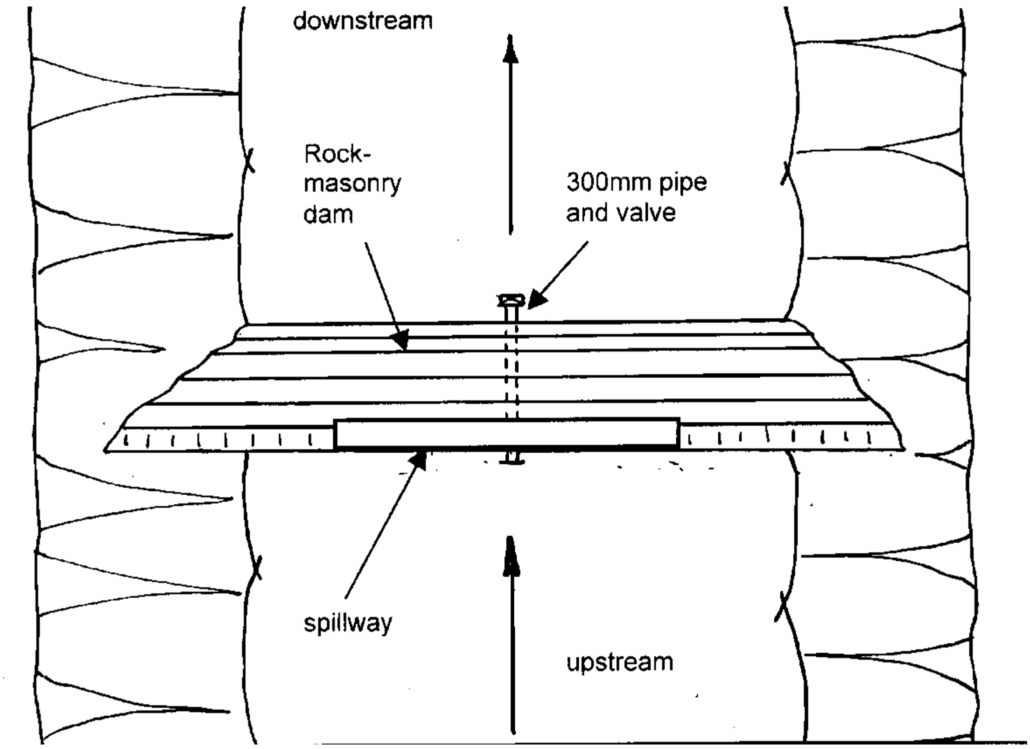
The various agricultural requirements are discussed in appendix A. These may be summarised as:

- 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 Dam design

A preliminary investigation of the various sites has revealed that they are ideal for the construction of 'rock masonry' dams. (See the document 'Rock Masonry Dams' for more insight and examples of 'rock masonry' dams). 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 (see rapids in figure 5), so that only the cement has to be purchased and trucked in. Furthermore the cement only makes up approximately 7% of the volume of such a dam. In addition the valley is relatively narrow (about 35m when full, see table 1) and this significantly reduces the materials required, and hence the cost. Finally, the river bed consists of exposed rock. Thus excavation costs will be minimal.

Spillway design considerations: The hard river bed of exposed rock also allows for a central over-the-top spillway, which is the most cost effective way of dealing with excessive inflows. Clearly the spillway must be designed to cope with significant flows at times of heavy/extended rainfall, corresponding to a catchment area of 200 km^2. The spillway is designed to cater for a 1:50 year flood, the size of the structure not warranting a more conservative period.



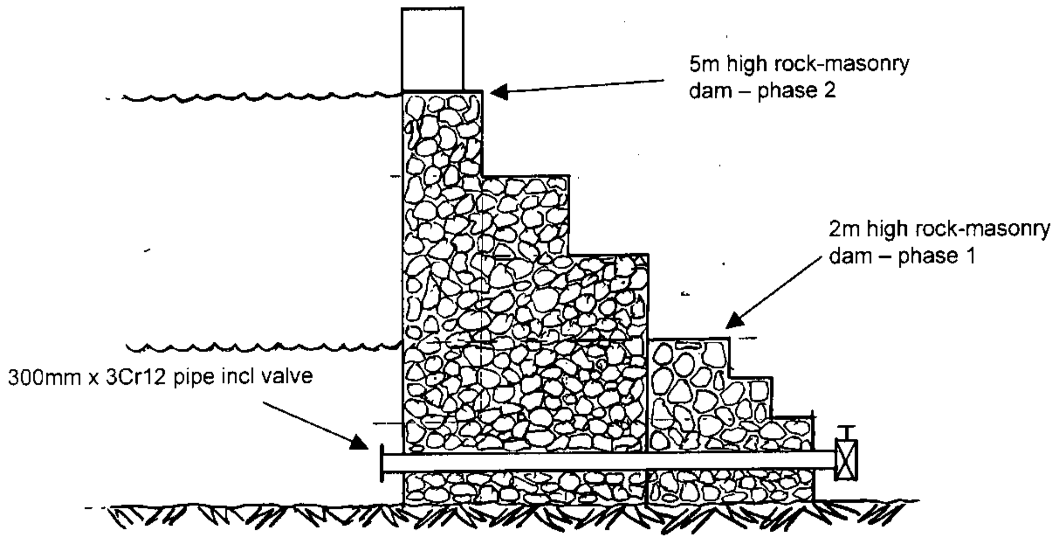


Figure 5 – Sketch of a proposed dam – the plan shows the completed 5m structure, while the section shows the 2m high wall in front, as well as the eventual 5m wall butting up against it immediately upstream.

5 Pump and Pipeline Infrastructure

The cost of providing the essential pump and pipeline infrastructure is given in table 3. Note that this does not include the irrigation system in the fields, as this is provided for in appendix A. The pipes are therefore only taken to the periphery of the various hectares, terminating in 50mm valves, one for each hectare. The DWAF subsidy (see table 3) only applies up to this point.

The rate of flow in a pipe is a function of its length, gradient, roughness, and especially its diameter, as indicated in Table 2. For example the table shows that if a 90mm PVC pipe conveys 250m^3/hour over a distance of 100m then the friction loss is 1.3m. (Note that this flow rate is required if 100 hectares are to be irrigated in 24 hours i.e. 24 hours/day x 250m^3/hour = 6000m^3/day = 0,006m/day x 10000m^2/ha x 100ha).

Table 3 - Analysis of Pump and Pipeline Infrastructure

PROJECT		EHLEKETANI		MABASA	BALOYI	MAHWAYI
Pipeline Specifications						
Length	m	100	1000	600	400	400
Constant (roughness)		4.53E-10				
Area	ha	10.5	10.5	4	2	2
Q/ha	m3/hr	2.5	2.5	2.5	2.5	2.5
Q total	m3/hr	26.25	26.25	10	5	5
Pipe ID	mm	90	90	63	63	63
Friction Loss	m	1.4				
Costs						
Unit Cost of pipe	R/m	25.53	25.53	9.24	9.24	9.24
Cost of pipe		2553	25530	5544	3696	3696
Unit Cost of coupling	R/m	574	574	200	200	200
Number of couplings		2	20	12	8	8
Cost of couplings		1148	11480	2400	1600	1600
Clampsaddle + upstand + 50mm valve	R/pipe		481	450	450	450
Number of assemblies			11	4	2	2
Cost of assemblies			5291	1800	900	900
Total Cost	R	3701	42301	9744	6196	6196
Power connection	R	10000			3000	3000
	R	6000			6000	6000
Installation excl trenching (3)	R	1000	1000	1000	1000	1000
Pump, fittings, starter, pressure switch	R	6000		5000	3000	3000
Sand filter	R	12000		6000	6000	6000
Delivery	R	1000		350	350	350
Trenching (4)	R	0		0	0	0
Accomodation	R	200		200	200	200
Travelling	R	500		500	500	500
Total	R		83702	22794	26246	26246

Notes
1 Friction loss = constant x length x Q^1,77 / D^4,77
3 It is assumed that the community will dig the trenches at their cost as a sweat equity contribution.
4 A specialist contractor will do the supervision and connection, but the price assumes the community will contribute the labour assist with unrolling and carrying, etc.

6 Business Plan

The main **capital items** consist of the construction of the four dams, the associated pumps and pipes to convey the water to the farms, land establishment (land preparation, tree removal, ripping), and irrigation systems, which are summarised in table 4.

Income is based on the sale of produce (vegetables) that have been priced conservatively. It is assumed that only 75% of the 18,5 ha is being cultivated at any one time.

Expendature covers three areas:

(1) Production costs pertaining to the cultivation of cabbage, beetroot and onion. This includes such aspects as ploughing, fertilizing, seeds, planting, insecticides, weeding, harvesting, labour, supervision, fuel, etc.

(2) Water, assumed to cost R0,2/m^3, which is typically what farmers pay for agricultural water.

(3) Interest and loan repayment – this applies to both the short and long terms loans.

The **distributable surplus** of R1956 667 for a capital investment of R 2097 815 is very favourable. In the case of the 2m high structures the investment : return ratio is even more favourable, but the risk of running out of water is significantly higher. The average R/ha for the 5m high wall is R 105768 and that for the 2m high is R 119675. Generally this will vary from one farmer to another depending on their specific input costs and sales.

7 Conclusion

This proposal was done in response to a request by the Tiyani Farmers Forum. In presenting it Peoples Agricultural Development and Dams for Africa will at all times respect the sense of ownership, responsibility and accountability that is clearly in evidence in the forum.

Based on the favourable calculated annual surplus shown in table 4, an approach to a lending institution such as the Land Bank, or DBSA, or IDC can be made.

It is important that the participants organised themselves into a Water User's Association, to qualify for the DWAF subsidy. The necessary licenses for the use of water must also be obtained. PAD and DFA will assist with the various technicalities.

Finally, this proposal shows how innovative engineering can assist community initiative to facilitate food security, poverty eradication, job creation, and entrepreneurial development.

Table 4 - Business Plan

Capital Expendature

	unit	qty	unit cost	2m high total	5m high
Cost of dams	ea	4	58800	235200	1008000
Cost of 150mm x 3Cr12 pipe	ea	4		9752	25324
150mm gate valve, non rising spindle	ea	4	1771	7084	7084
Pumps and Pipeline - project [7]	various	1	83702	83702	83702
Pumps and Pipeline - Mabasa [7]	various	1	22794	22794	22794
Pumps and Pipeline - Baloyi [7]	various	1	26246	26246	26246
Pumps and Pipeline - Mahwayi [7]	various	1	26246	26246	26246
Total Water works				411024	1199396
Less DWAF subsidy	ha	18.5	10000	185000	185000
Net Cost of Waterworks				226024	1014396
Farm Establishment[9]	ha	18.5	5000	92500	92500
Equipment [10]	ha	18.5	1000	18500	18500
Drip Irrigation [11]	ha	18.5	16000	296000	296000
Storage shed/office/furniture	ea	1	60000	60000	60000
1.2 m high stock proof fence	m	2500	12.52	31309	31309
roadworks [12]	km	4	5000	20000	20000
Project management fees	%	10	744333	115536	273210
Start up capital [13]				101900	101900
Training [5]	persons	80	1000	80000	80000
bakkie	ea	1	110000	110000	110000
Total Capital Cost				1151768	2097815

Income from Vegetable Crops

Type	Selling Price [1]	Density/ha	months to maturity	Equivalent monthly return	Equivalent annual return	Equivalent annual return
	R			R	R	R
cabbages	2.00	33333	3	22222	266667	266667
beetroot	0.25	250000	3	20833	250000	250000
onions	0.25	500000	6	20833	250000	250000
		average/ha for 100% utilization			255556	255556
		average/ha for 75% utilization [4]			191667	191667
Total income			18.5	191667	3545833	3545833

Expendature

	unit	qty	unit cost	2m high total	5m high
Production costs/ha [2]	ha x crops/yr	55.5	12000	666000	666000
Water usage [14]	m^3	405150	0.2	81030	81030
Overhead costs					
Marketer/manager/advisor			100000		
Assistant			40000		
Agricultural mentoring fees			12000		
Fascilitation Fees			12000		
Telephones/electricity/stationery			20000		
Vehicle maintenance & fuel			19800	203800	203800
Cost of money					
Long term loan required after subsidy - 2m [8]		2097815			
Long term loan required after subsidy - 5m [8]		1151768			
Short term loan for crop financing [15]		249010			
Interest at 12% on long term loan [3]	%	12		82927	151043
Repayment of long term loan	%	20		230354	419563
Interest at 15% on short term loan [3]	%	15		17929	17929
Repayment of short term loan	%	20		49802	49802
Distributable Surplus [6]				2213992	1956667

Notes on Business Plan

1 The selling prices used here are shown as 50% of those obtained from Mabasa S T, since production on such a larger scale will inevitably mean that produce must be sold further away at more competitive prices.

2 A unit value for production costs of R12000 to R15000 for a single crop was obtained from the Agricultural Reseach Commision (Dr Finnie Niederwieser), and pertains to cabbage, beetroot and onion production. They include such aspects as ploughing, fertilizing, seeds, planting, insecticides, weeding, harvesting, labour, supervision, fuel. They exclude capital items such as tractors, irrigation systems, sheds, etc. The lower figure of R12000 is used since 'supervision' is budgeted for under overheads. Furthermore the 'labour' cost will be zero in the Ehleketani project since the participants are all entrepreneurs who are remunerated via their share of the surplus. It is assumed that three crops are grown per year.

3 Note that interest is only calculated on the outstanding loan, which is repaid over 5 years in 5 annual instalments at the end of each financial year. On this basis the average interest is 60% of the initial payment.

4 The 'utilization' is reduced to to 75% to allow for some inefficiencies and that low value dry-crops are grown in the summer.

5 Training will mainly be spent on the Ehleketani project. It will include the fundaments of cultivation, irrigation, productivity, bussiness principles, etc.

6 A record will be kept of each farmer's expenses and income to arive at the distributable surplus that each farmer is entitled to.

7 See table 3.

8 The long term loan equates to the sum of all the 'capital' items.

9 Farm establishment covers such aspects as clearing trees, ripping, etc.

10 Equipment includes such items as spades, hoes, sprayers, barrows etc.

11 Drip irrigation includes a pressure regulator between each 50mm valve and the surface pipe from which the dripper lines eminate (12mm x 1mm thick dripper lines spaced at 1m). Perforations are 1mm in diameter and are spaced 300mm appart. Each perforation allows 2 litres per hour at a 10m head.

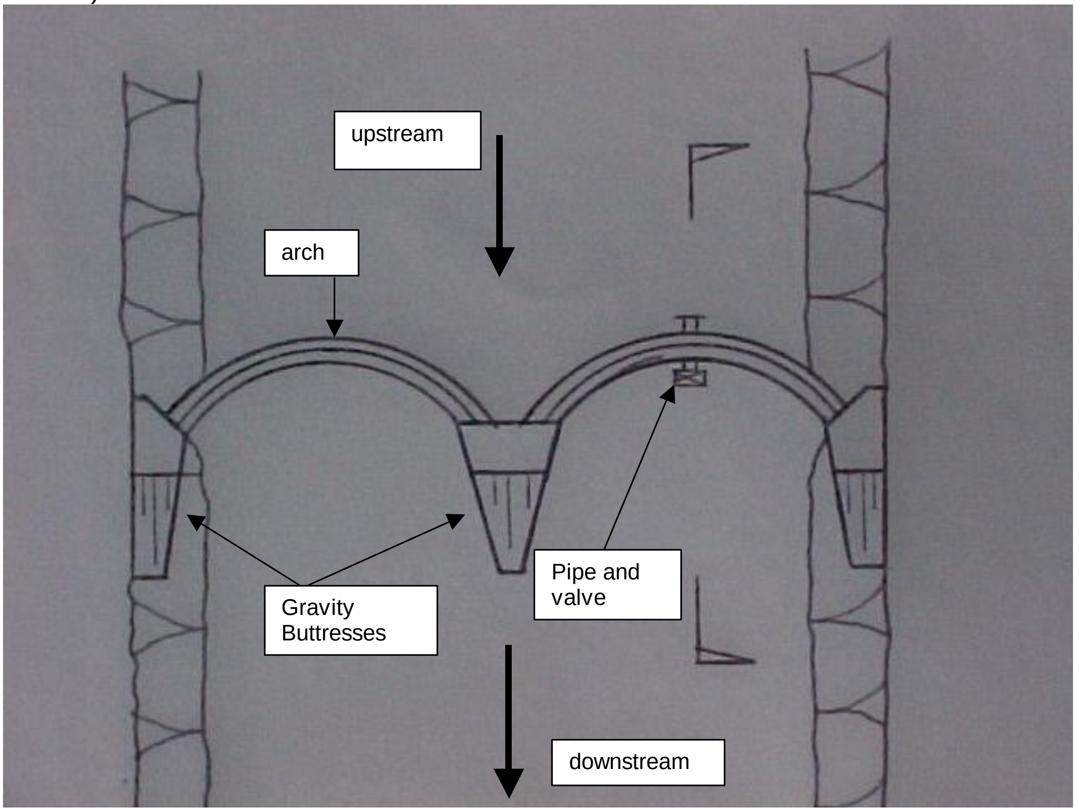
12 Implies a simple scraping exercise with a grader, possibly with some shaping of the road's profile to get the water off. Thereafter each entrepreneur should maintain the road adjacent to his/her plot. A serviceable road is an important aspect of getting the produce to the market.

13 Start up capital is taken as 50% of the overhead costs, and allows for 6 months of 'overhead costs', after which this expense will be paid by income that is generated from the sale of produce.

14 Water usage is based on 6mm/day x 10 ha x 10000m2/ha x 365 days/yr. This is clearly conservative given that no irrigation is required when it rains, and that the projected

production efficiency is only 75%, and that drip irrigation has been allowed for, but it does allow for future expansion.

15 The short term loan relates to financing production (listed in note 2) as well as the cost of the water. It is taken as 1/3 of the 'production' and 'water usage' costs (i.e. it covers 4 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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