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COMMERCIAL FISH FARMING IN ZIMBABWE

- Protea Valley Farm Fish Culture Option -

by

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For and on Behalf of
Rothmans of PALL MALL (ZIMBABWE) LTD.

Baobab Farm Limited
JDB/SMM/2/4/86

NB: No executive summary is provided to such a short report but the conclusion aims to sum up the consultants views.

PROTEA VALLEY FARM FISH CULTURE OPTIONS

1. INTRODUCTION:

In a proposal dated 2nd January 1986, Baobab Farm Ltd. (Kenya) offered to undertake a techno-socio-economic feasibility study on behalf of Rothmans of Pall Mall (Zimbabwe) Ltd. Following a Board meeting on 21st January 1986, Rothmans expressed caution at committing themselves. Subsequently Henderson Research Station, planned a Fish Forum for 21st March 1986. Rothman's very kindly provided the airfare for John Balarin to attend this forum as well as an opportunity to discuss further their plans for investment in aquaculture. This visit took place between 17th to 24th March. On 18th March Rothmans Protea Farm at Ruwa was visited accompanied by Mr. M. Lynton-Edwards and Mr. R. Evans and discussions were held with the Farm Manager Mr. R. J. Roos. This report is intended to compliment the report submitted by Evans [1985] "Feasibility Study of Protea Valley Farm, Ruwa".

2. BACKGROUND:

Protea Valley Farm prior to purchase by Rothmans, was owned by Mr. R. Senior and was known as Green Valley Farm. Developments included minimal land cropping, a battery poultry unit and a small fish farm. The fish farm was built in 1981 and currently consists of the following facilities:

Brazilian Type Earth and Concrete Wall Breeding Ponds: 25 x 10m units x 4 = 1000 m^2.

Ongrowing Earthen Ponds: 50 x 50 m units x 9 = 22400 m^2.

All are provided with underground water supply of 50mm PVC piping plus 75mm outflow pipe to each pond. The arrangement of ponds is in 3 tiers of 3 ponds each with a 3m high wall between ponds. The ponds lie adjacent the homestead along river frontage with a total lift head from water source to upper pond of approximately 15 - 20m. Water is from a 30 000m^3 weir fitted with a 8 - 10m^3/hr pump [Evans, 1985].

Present developments involve the establishment of a Protea crop on the 60 ha of land adjacent the fish ponds. Eventually 70 000 plants are planned with a daily water requirement of 40m^3. The fish farm has been fenced off and currently only a few ponds have water and hold a mixed stock of fish. Two boreholes of potential delivery of 10.5m^3/hr and 3.8m^3/hr have been dug to a depth of 55m for water security.

The intention of Rothmans is to utilise this existing fish farm facility as an experimental base to determine the likely viability and future investment potential of this sector. In this respect it was thought that production of quality fish seed for sale to farmers may be a lucrative option to consider. The site is therefore evaluated with this intention in mind.

3. SITE APPRAISAL:

The following notes are not necessarily recommendations for immediate action but bear consideration if the project is to run correctly:

[a] Site Location: situated in the highveld at an altitude of +1300 m, farm water temperatures for 6 months of the year [i.e. April to September] are likely to be below 20^{o}C. This would mean the farm potentially would have a 6 month grow-out season for warmwater fish species such as tilapia or Clarias. Such species would therefore require overwintering to ensure production continuity. Equally, fattenning of a cold water species such as trout may be feasible in winter but perhaps a more temperate carp variety may guarantee an all year round production. Before production potential can be ascertained therefore, seasonal temperature data is necessary in order to permit the formulation of a management policy.

Action: Maximum/minimum temperature data should be kept of both river/lake water [and borehole] and pond water. Records should be taken at least once a week and represented graphically. An annual record is required before a production cycle can be programmed. Thereafter temperature recording should become a routine part of management.

[b] Site Design: The ponds appear well surveyed and of sound construction. Of concern is that in places the excavation has broken through to bedrock. Although no lateral seepage is apparent in those ponds which hold water, those that are currently empty do show evidence of a previously introduced clay linning. This could suggest that vertical seepage may have been a problem in the past. The extent of this water loss can only be determined once the ponds are filled. In time, due to organic sediment build-up, this loss would be minimised. However if excessive water loss is apparent clay paddling may become necessary.

Action: All ponds should be filled, a measuring stick placed in each pond and a regular record maintained of any drop in water levels. Allowing for evaporation water loss through seepage can be calculated and remedial action taken where necessary. Seepage loss estimates would also help in determining seasonal water budgets.

[c] Water Inlet/Outlet: The existing water supply system is underground and its state of disrepair is not immediately apparent. What is of concern is that the system is of a very small diameter PVC pipe. The restriction due to such a narrow bore, coupled with the high lift head from the wier would mean that a high pressure pump is necessary. The high power ratio requirement to unit of water delivered, is not a very cost efficient method of operation!

Given that at best a 50mm pipe could deliver ±75 m^3/hr, and that the ponds range from 1 to 2m in depth [$\overline{x}$ = 1.5m] such that each pond holds 3750 m^3 of water, therefore at best using the existing pipe system it would require 50 hours of constant pumping when filling. However if the pump only has a capacity of 10m^3/hr, then 375 hours would be needed. Similarly when draining, the narrow diameter outlet pipe would take 2 days for total draw-down. The time required is excessive such that the system needs modification.

It appears that pond drainage is from one pond to the next level of ponds and only the lower series has independent drainage. This inter flow arrangement could represent water saving in that at harvest only water from the lower pond need be wasted. The other ponds could be then drained to refill the next in the series and only the top pond need be refilled by pumping. To facilitate harvesting by drainage and prevent fry entering from one pond to the other a suitable catch box would have to be designed for each pond.

It should be cautioned that when topping-up or filling ponds independently, water should not be pumped first to the top of the series and by gravity supplied to the pond where required. The additional lift head involved can be costly. Ideally an independent supply per tier of ponds is needed and open channelling or large diameter pipes should be considered.

Total Water Requirement can be worked out as:

- loss due Evaporation	[23 500m^2 x 1.98m] =	46 530m^3
- loss due Seepage	[23 500m^2 x 1.0 m] =	23 500m^3
- loss due Drainage	[23 500m^2 x 1.5 m] =	35 250m^3
	Annual Total	105 280m^3

Daily requirement = 288.5m^3/day

Pump size [at 6 hour operating/day] = 50m^3/hour.

Action: It is recommended that when planning the irrigation for the Proteas, that a versatile system be considered. Movable irrigation pipes can be used to both fill ponds individually and disconnected when needed in the fields. The cost of pumping direct from wier or borehole to irrigate Proteas may be costly in view of the high lift head necessitating a high pressure, low volume pump. It may be an economic option to use the top series of ponds as reservoirs and from these to use a small booster pump to irrigate the nearby Protea fields. The excessive depths of the boreholes means uneconomic pumping and should not be used for the fish farming except in an emergency situation. The present weir pump unit is inadequate and needs to be uprated.

[d] Fish Species: There is evidence of fish in the ponds but of unknown lineage and species.

Action: Stocks should be netted, destocked if necessary, identified if possible and used until such time as replaceable by good quality stock. Stocks should be aquired from Henderson or wherever available and every attempt should be made to keep new stock isolated from contamination by existing stock i.e. all ponds interdrainable in a series should be kept pure. The Brazilian style brood ponds should be reactivated but it is most unfortunate that they are so distant from the homestead and as such valuable brood stock is at a high risk from poaching.

[e] Fish Feeds/Fertilisers: Currently the farm has no livestock or crop by-products that could be used for feeding or fertilising the ponds.

Action: Crop wastes and/or manures from neighbouring farms should be secured on a contract basis and stock piled [e.g. in silaging pits]. Grass/weeds on the farm are to be mowed between Protea rows. This could be collected and composted as a nitrate source to fertilise the ponds as well as the plants.

4. PROJECT OPERATION OPTIONS:

The site has two main options of modus operandum, either to function as a seed centre for sale of top quality fingerlings or to enter into production of table size fish.

[a] Seed Centre: Ideally, to produce top quality fingerlings the unit would aim for all male hybrids [e.g. O. nilioticus x O. aureus] but as this cross is difficult to maintain pure, a combined methyltestosterone treatment phase is advisable or can be considered as a viable option on its own. For this a controlled hatchery and hormone treatment unit would be needed preferrably under a greenhouse to ensure all year round performance. The ponds would then be used to grow-out fry to the required size as well as overwinter stock for the next season. Potentially the site could raise between 1.5 - 3.0 million fingerlings of upto 10g size. Each pond of 2500m^2 at capacity could at best hold a biomass of 0.5kg/m^2 [i.e. 5t/ha equivalent]. Provided water quality and fertilising is good, this would represent 1250kg per pond, or 125000 x 10g fish per pond or 1125000 for all nine ponds. Assuming that for each cycle, from stock out to 10g takes 90 days, including pond preparation time, then two cycles are possible in the warm months. A third cycle may be possible during the over-winter period. Potentially a maximum of 3.4 million fingerlings is feasible but allowances must be made for system and climatic variations and mortality losses such that the efficiency of operation is set at 50% of this and 1.5 million is considered a likely target yield. It should be noted that if a 5g end size is selected, yields would double, or quadruple in number if a smaller 2.5g fingerling is produced.

The outcome of the Fish Forum at Henderson suggests that farmers would consider buying fry for stocking of farm dams but demand remains unquantified. Assuming sales at current National Parks and Government rates of Z$ 1.50 per kg of fry irrespective of size, a 10g fish would therefore fetch a farm gate price of 1.5 cents. The farm would generate at minimum an annual revenue of Z$ 22 500. Alternatively sales could be sold by length as are trout fingerlings.

The present Government Hatchery at Inyanga sells trout at 2.0 cents per cm length while Willards sell at 4.0 cents/cm. Trout when marketed whole fetch about 5 times the value of tilapia thus if the same mark-up is assumed on fingerlings, the price for tilapia would be one fifth that of trout, between 0.4 to 0.8 cents/cm or 4.0 to 8.0 cents per 10g fish. This would generate an income of between Z$ 60 000 to 120 000 per annum.

Before Protea Valley could venture into this market it would have to develop a hatchery, fingerling purge tanks and a packaging plant, and/or fish transporter. Delivery charges and insurance should be considered as a means of generating an added revenue. However it would be essential to first establish the market requirements, [i.e. quality of fry, size of fish, quantities required, seasonal requirement, distances to market, and expected purchase price] before investing further capital into such a venture.

[b] Production of Table Fish: Assuming that the ponds are capable of sustaining a biomass of 5t/ha at any one time, given good water and adequate feed and/or fertilising and assuming that by staggered stocking and overwintering 2 cycles are feasible in a year, the system of 2.25 ha of ponds could potentially yield 22.5 tonnes per year of 100 - 150g tilapia. However as there is no intermediate on-growing facility, and given variations between ponds and likely climatic variables, the efficiency of operation is more likely to be 50% of this, approximately 10 tonnes per year. At a farm gate price of Z$ 3.0 per kg ungutted this would represent an annual revenue of Z$ 30 000.

Before Protea Valley considers fish production, a supply of cheap feeds/fertiliser would have to be ensured. Stocks would need to be improved and ponds modified slightly. One or two ponds would perhaps have to be laid aside as an on-growing unit.

5. CONCLUSION

The fish forum emphasised that there was a large market demand for fish but that as yet farmers who had `experimented' with various techniques of fish production were not operating commercially and there was a large demand for seed. Perhaps what emerges clearly from this Forum is that farmers who entered fish farming as a hobby and those who have a research orientated approach are unable to recover the overhead cost of such activities. Clearly, the current price and demand for fish represents a potentially lucrative industry. The technology to produce fish for that market is readily available but instead farmers have chosen to pioneer their own techniques. A costly exercise which can only bring about results in the long term. Protea Valley Farm would be well advised to consolidate what they have and operate as a pilot project. Research should be minimal and set guidelines should be followed. Unfortunately as there is no existing complimentary farming activity on site which would integrate with fish production operation costs will be high.

It is recommended that with the exception of improving water supply all ponds should be immediately filled and stocked with fish. Existing stocks are to be held separate from new stocks. The objective would be with limited additional labour the farm fatten existing stocks and treat new stocks as hatchery units and monitor performance. Overwintering should be with minimal inputs but rapid grow-out in summer. Trout could be tested in winter. The resultant nominal production would then be used to test the market in the next season: Factors which need to be known are: Optimum size of fingerlings and table fish, market demand, price structure and associated problems. From this first seasons "hands-on experience" at minimal efficiency Rothmans would then be better informed inorder to make a decision regarding the future of the project without having incurred excessive expenditure.