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A successful land rehabilitation programme in Kenya

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Summary

Open strip mining for cement production, out of fossil coral limestone has left hectares of man-made quarry, a stone desert at Bamburi near Mombasa. A rehabilitation programme initiated in 1971, started with a Casuarina plantation and fish pond culture. Later on, the production of humus assisted by introducing millipedes created soils, which enabled the planting of other trees and the creation of a forest. Simultaneously, intensive Tilapia tank culture was developed to a pilot commercial scale. A small nature trail has also been set up with tortoises, hippopotamus, crocodiles, waterbucks, antelopes, and numerous other wild animals as well as plenty of birds. A small herd of oryx and elands is also successfully reared while snail, earthworm and wild fowl production experiments are under way. The principles adopted here constitute a very impressive example of how man can correct the environmental damage he is making, and that reforestation and rehabilitation programmes can be effective under near desert like conditions.

Résumé

L'exploitation à ciel ouvert de chaux fossile corallienne pour la production de ciment a entraîné la création par l'homme d'un désert de pierre à Bamburi près de Mombasa. Un programme de remise en valeur a débuté en 1971 par la plantation de Casuarina et par la pisciculture dans des excavations de ces carrières. La production d'humus a été favorisée par l'introduction importante de myriapodes, ce qui a rapidement permis la plantation d'autres arbres et la création d'une forêt. Simultanément, l'élevage intensif de Tilapia en bassin a remplacé les anciennes méthodes jusqu'à atteindre une échelle commerciale. Un petit parc naturel a été créé avec tortues, hippopotames, crocodiles, cob Defassa, antilopes, plusieurs autres animaux sauvages et de très nombreux oiseaux. Un petit troupeau d'oryx et d'élands est élevé avec succès, et la production d'escargots et de vers de terre est en cours. Les principes adoptés ici constituent un exemple très impressionnant de la manière dont l'homme peut corriger les dégâts qu'il commet. Cela prouve aussi que des programmes de reforestation et de remise en valeur sont réalisables dans des conditions quasi désertiques.

The Bamburi Portland Cement Company located 10 Km north of the port town of Mombasa, Kenya, stands less than 2 Km inland from the beach and produces 1.3 million tons of cement a year. To do so, it excavates annually up to 20 ha of scrubland, laying open a massive quarry scar extending down to the watertable (1,3) which is at sea level and slightly brackish. The limestone used to produce the cement is provided by the ancient coral reefs dug out by an open cast mining system. This process has left a desert which was becoming a conservationist's nightmare.

Established in 1959 to make use of 1400 ha of land belonging to the Bamburi Portland Cement Com-

pany, Baobab Farm Ltd. was initially faced with the prospects of turning waste land into arable land for crop production and vegetable gardening as well as utilising coral brushland for sheep and goat grazing. It later took on the task of rehabilitating old quarry sites through reforestation in order to create a new balanced ecosystem (2). In 1971 pond culture in a series of minor excavations commenced with Tilapia but the productivity was low (1,5 ton/ha-year). Tank culture proved better suited which lead to the development of an intensive fish farming system with yields of 100-200kg/m³-year (4) the highest for any African country. However, fish production was not the sole objective as the true goal was and still is the rehabilitation of the exploited land.

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Trials of different species of tree were initiated and a real reforestation programme implemented. Under the prevailing extreme and harsh conditions, *Casuarina equisetifolia* or Filao tree proved to be the best to develop and *Conocarpus* proved a compatible polyculture species. Both were tolerant of saline waters. This evergreen species, the Filao tree, which is not a pine, has the tremendous advantage of developing root nodules able to fix atmospheric nitrogen so permitting the plant to grow on a quasi sterile soil. Tree planting in the old reef basement necessitated the digging of a hole for each seedling and an initial handful of manure for encouragement. Today, there is shade from 25 m high trees where 13 years ago there was only desert landscape.

Leaf fall (Filao needles and fruits) were progressively transformed into an active humus, the maturation of the mulch being activated by the feeding habits of thousands of millipedes *Epibolus pulchripes* specially introduced for that purpose (5). The land has consequently been transformed from a dead stone quarry into a living and true soil formation.

Later on, seedlings of *Prosopis*, *Acacia*, etc... have been planted and seeds of indigerous plants from surrounding areas have also developed. A secondary polyspecific flora is now present in some areas which is a very positive evolution toward a forest ecosystem. Further more, bananas have been recently planted directly in holes dug into the rock floor and filled with soil and manure, and the operation is successful, yielding fruits for sale.

The development of the tree plantation allowed the introduction of other activities, thanks to shade and water from the watertable. Streams, glades, ponds and swamps were created and some species of the local fauna were introduced. Most of the animals and birds initially welcomed were brought in for reasons like injuries, broken leg or wing, or as orphaned young. This is the case amongst others for a hippo now 9 year old and 1,5 ton live weight, a wonderful fish eagle, a tame buffalo, serval cats, warthog and bushpig.

Enclosures have recently been set up together with the organization of a mini-safari park where tourists can see from very close distance quarters the animals mentioned as well as elands, oryx, waterbucks, crocodiles, cormorans, pelicans, tortoises and lizards. More than one hundred different species of birds have been identified. Not only foreigners but also Kenyans do visit the place. With always the same objective of making the best use of this extremely poor land progressively rehabilitated, game ranching at a deliberately small pilot scale has been set up. A herd of approximately 20 elands *Taurotra-*

gyx oryx and 20 fringed-ear oryx *Oryx beisa callotis* is grazing and browsing on some 15 ha of quarry land. The herdsman releases the animals early in the morning from the night-paddock, where they come spontaneously back to rest in the middle of the day before going out again in the afternoon. Reproduction is good as well as growth, and both species look very tame. No domestic livestock would withstand these conditions.

Snail production has been recently undertaken, by using the big *Achatina fulica* which can weigh as much as 250 g for an adult. Snails are indeed herbivorous and convert consequently the primary production of green matter into animal protein usable for poultry feed or even as direct human food. Earthworm production is envisaged as well and a Guinea fowl and Egyptian geese breeding programme is underway.

Similarly, a crocodile *Crocodylus niloticus* section has been developed with presently more than 500 animals reared in ponds. Crocodiles are now threatened with extinction in many countries, and the obvious solution to this problem lies in crocodile farming. This is the first such project in East Africa and has been integrated to make use of trash fish from the fishfarm.

Finally, a legume tree must also be mentioned: the algaroba tree *Prosopis glandulosa*, as it produces pods usable either for human food or livestock feed, good wood for charcoal production and excellent pollen for honey not mentioning the improvement of the soil through the *Rhizobium* root-nodules.

Baobab Farm Ltd. is actively engaged in applied research, encourages and maintains close ties with many scientific institutions in various countries (2). However, the most interesting achievements are surely the positive control of the environment and the rehabilitation of a man-made quarry scar, showing that man's ingenuity and will can overcome many acute problems.

The ecology of the Southern Kenya coast is not similar to that of the Sahelian zone, but the principles used at Baobab Farm could be adopted and adapted. It has been shown here that reforestation is possible, which means that flora and fauna can and will develop.

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