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Revolving Fund for Tree Plantation

A Case Study of

Eucalyptus Plantation by The Society for Human Empowerment & Rural Development

in Mitha Tiwana, District Khushab

Final Report

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AUSAID	Australian Agency for International Development
CBO	Community Based Organisation
EPA	Environmental Protection Agency
FAO	Food and Agricultural Organisation
GEF	Global Environment Facility
GoP	Government of Pakistan
IWASRI	International Waterlogging and Salinity Research Institute
ME&UAD	Environment and Urban Affairs Division
NEQS	National Environmental Quality Standards
NCS	National Conservation Strategy
NGO	Non Governmental Organisation
PLC	Pakistan Literacy Commission
SGP	Small Grants Programme
SHER	The Society for Human Empowerment & Rural Development
SLUGS	Salt Land User Groups
UNDP	United Nations Development Programme
WIGs	Women Interest Groups

EXECUTIVE SUMMARY

Increasing efforts are being made all over the world to plant new and improved varieties of trees that have a good growth rate as well as multiple uses. In Pakistan too a number of experiments have been made and fast-growing, short rotation trees have been cultivated. A relatively new—but so far unsuccessful—introduction has been that of the *Eucalyptus camaldulensis*. This is a tall, aromatic, evergreen tree of Australian origin that grows rapidly and is known for its adaptability and resistance. Although *Eucalyptus* has not yet found a diverse and profitable market in Pakistan, it has been used widely in the plywood and particle-boards industry, furniture, sports goods, fencing, shuttering and scaffoldings, turnery, firewood, flooring, construction material etc. Other benefits include its use in producing oil, herbal medicine in treatment of many diseases, aches and pains. But the fact remains that its market is still in an evolutionary stage as more research and experimentation is carried out on the many properties of the tree.

There are both proponents and opponents of the tree. Some say that *eucalyptus* trees are one of the most feasible options for cultivation where the soil and water are moderately saline, especially if the soil has a dense structure with a water table close to the surface. If planted on uncultivated land, *eucalyptus* results in lowering the water table significantly, especially with young and succulent growth of the trees. These are attractive features of the tree in Pakistan, where about 16 million acres of land are salt affected and severe salinity and waterlogging have resulted in severe problems and made several million acres of land uncultivable and/or barren. There is also, however, mounting criticism of its potentially harmful ecological (environmental), economic and social effects. Some of the reported disadvantages and harmful or potentially harmful effects of the tree include soil degradation, reducing land productivity and difficulty in sawing, drying and processing of wood. By now, enthusiasm for this tree seems to have waned in Pakistan and very few organisations are advocating the plantation of *eucalyptus*. The case documented here is no exception to this trend but it involves a rather more complicated story than one heard from most.

This case study is about a *eucalyptus* tree plantation project in Mitha Tiwana, one of the oldest villages in Pakistan that lies at the foot of the Salt Range. The implementing agency is a local CBO called the Society for Human Empowerment & Rural Development (SHER). The Society is working in education, health, environment, social welfare and economic development. The land in and around Mitha Tiwana is mostly waterlogged and saline. Indigenous annual crops grown here are mostly channa and gawara.

The project was initiated in view of the Society's experience in environment and forestry projects and local needs. It was financed by UNDP under the GEF small grants programme. The *eucalyptus* plantation was initiated in 1995 and the project envisaged a five-year plantation campaign and the approach included the creation of a revolving fund for long rotation crops that would help sustain the project on a long-term basis. The aims and objectives of the project as described in the project document include an increase in forest cover, sustained yield of *eucalyptus* tress, control of the water table level and economic development. With a GEF grant of Rs 450,000 over a five-year period, the farmers were expected to plant about 125,000 trees with the technical assistance and seeds provided by the Society. The UNDP GEF programme also assisted the Society in establishing linkages with the Forest Department for technical assistance and provided informative literature on the trees of Pakistan and on tree planting.

It was thought that 20 – 25 families, each owning 5 – 25 acres of land, would plant a total of 125,000 trees on a total of 125 acres over five years. Project reports show that 16 individual

farmers participated in the tree plantation. They were told that *eucalyptus* was suitable for their waterlogged non-cultivable land, that it would increase land productivity and give higher per acre yields and would also lower the water table and improve weather and environment conditions. As there would be no income from the trees for at least five years, it was proposed that each farmer would be paid one rupee per surviving plant (Rs 5,000 annually) for the first five years of the project. Subsequently, each farmer would hand over 1,000 of his 5,000 trees to the Society at the end of the first phase. The proceeds from these 1,000 trees were to be reinvested for further plantation during a second phase and the number of trees planted increased to 50,000 per year.

The entire project was planned with the consideration that a pulp and paper producing factory, expected to be made operational in the near future, would buy the wood from the farmers at a price of Rs 60 or (at the very least) Rs 40 per maund (approximately 40 kg). The mill could not be operationalised as expected and the project thus failed. The farmers were forced to sell the wood at Rs 16 – 20 per maund and only Rs 110,000 of the money lent to the farmers has been returned to the Society so far.

Of the 150 acres of land that were brought under cultivation, 100 acres was cultivable land and 50 acres was extremely water logged. Farmers have also reported that the trees showed considerable variation in girth, height, etc. and were also damaged by drought, windstorms and wildlife. Lack of technical assistance to the farmers was also a problem. Of the total harvested, only two farmers have recycled the plantation and it is said that farmers are no longer interested in taking the *eucalyptus* plantation any further.

The project staff is of the view that they would be interested in extending the project provided that they are given proper training and guidance on plantation methods and related aspects and increased incentive to the farmer community so that their interest can be revived. The International Waterlogging and Salinity Research Institute (IWASRI), near Lahore, is perhaps the leading centre of relevant information in the country. It is executing a bio saline farming systems project entitled the "Pakistan Community Development Project for Rehabilitation of Saline and Waterlogged Land" in Punjab. The institute is working primarily as a research organisation to conduct and consolidate research on the issue of waterlogging and salinity and disseminate economically and technologically feasible solutions to practitioners and researchers.

IWASRI's project has encouraged adoption of salt- and waterlogging-tolerant plants, in particular, *Eucalyptus camaldulensis*. The project is also trying to identify and improve the market and marketing of the various products acquired from this tree. IWASRI claims that *eucalyptus* can play a key role in land rehabilitation in Pakistan. Some benefits that it says can be obtained from *eucalyptus* and are specific to Pakistan include pulp and paper, use in low cost housing and as insulation material, use as oil for cosmetics and pharmaceutical industry, use as diesel oil for steel mills and electricity generation. The hope at IWASRI is that *eucalyptus* will find an appropriate niche in the landscape of Pakistan, and that farmers here will find a market sooner rather than later.

① INTRODUCTION TO THE WORLD OF *EUCALYPTUS*

1.1 The Context of Fast Growing Trees

Trees are being cut at a disproportionate rate as compared to their regenerative capacity. The situation has worsened due to an ever-increasing demand for fuel for domestic and industrial fuel needs. The rapid decline in forest cover has also led to increased environmental degradation, pollution, land degradation, loss of biodiversity and low agricultural yield. Increasing efforts are being made to plant new and improved varieties of trees and plants that have a good growth rate as well as multiple uses.

A number of experiments have been made in Pakistan for promoting fast growing, short rotation plants and trees. Trees are most commonly used as raw material for fuel and other resource based industries. The indigenous trees that are popular and mostly grown in Pakistan include *Dalbergia sissoo* (shisham), *Acacia nilotica* (kikar) and *Morus alba* (mulberry or shahtoot). The *Eucalyptus camaldulensis* has been a relatively new introduction, but unsuccessful so far. However, the enthusiasm for this tree seems to have abated and very few NGOs and organisations are now advocating the plantation of *eucalyptus*. The interest of the farmer community in *eucalyptus* has also subsided due to limited market uptake of the tree.

This case study is an attempt to document one example in Pakistan where *eucalyptus* trees were planted with a lot of hope and expectations that did not materialise as a successful and beneficial experience. An attempt has also been made to go beyond a case specific experiment and to consolidate and highlight some of the facts and perceptions associated with *eucalyptus*.

1.2 Eucalyptus—Where is it Coming From?

A tall, aromatic, evergreen tree, *eucalyptus* originates in Australia, New Zealand, Tasmania, and nearby islands. Although native to Australia it has been successfully tried and cultivated in many parts of the world, in around 80 countries including the south of Europe (France, Italy, Spain, Portugal) and southern California. The *eucalyptus* grows rapidly, and many species attain great height of about 90 meters (300 feet) and a circumference of 7.5 meters. The *eucalyptus* tree adapts itself better in sub-tropical climate, with cool and deep soil. *Eucalyptus* is the most adaptable species which demonstrates fast growth rate in dry areas as well as rain forest; it is known to survive extremely varying temperatures from zero Fahrenheit to tropical hot summers.

The tree belongs to the *Myrtaceae* family and represents more than 700 botanical species and sub-species of the genus *Eucalyptus*. It is ever green and is characterised by its fast growth rate, high adaptability, high tolerance to different types of land and soil and multiple uses.

The *eucalyptus* classification is quite complicated. Taxonomists divide the genus *Eucalyptus* into several new genera based on their appearance. Common classifications divide it into the blue gum group (*E. nitens*, *E. cypellocarpa*, *E. globulus*, etc.), the swamp gum group (*E. camphora*, *E. ovata*, *E. yarraensis*, etc.), the peppermint group (*E. tenuiramis*, *E. pulchella*, etc.), stringy barks, ashes etc.

The *Eucalyptus camaldulensis,* or the River Red Gum as it is commonly called in Australia, is one of the best known of all *eucalyptus*. It is common in many parts in the semi-arid Australia. *E. camaldulensis* is a hardy tree in cultivation and adapts to different kinds of land and soil types but grows best when it has plenty of water. It grows to a medium to tall height (30m to 50m) in woodlands and thick forests. In Australia the eucalypti are commonly known as gum trees or stringy bark trees. The outer bark is smooth, white, greyish or pinkish in colour; leaves can be up to 250mm long and flowers can be seen in spring and summer. It is the most widespread species in the genus and exhibits great variations. The trees are good producers of pollen and nectar for honey.

1.3 The Many Wonders Still Not Known

Although *eucalyptus* has not yet found a diverse and profitable market in Pakistan, it has been successfully cultivated in many parts of the world and is being used as a vital input as raw material for many products and resource based industries. It has been used widely in the plywood and particle boards industry, furniture, sports goods, fencing, shuttering and scaffolding, turnery, firewood, flooring and construction material. The fact remains that its market is still in an evolutionary stage as more research and experimentation is carried out on the many properties of the tree. Some of the benefits and/or derivatives that are being produced and used more commonly include the following:

E. camaldulensis: scientifically speaking:

Tree commonly to 20 m to 45 m. Bark smooth throughout, white, grey, brown or red. Juvenile leaves ovate to broadly lanceolate, green, grey-green or blue-green, slightly discolorous. Adult leaves lanceolate to narrowly lanceolate, acuminate, moderately thick; lamina 8-30 cm long, 0.7-2 cm wide, green or grey-green; lateral veins at 40°-50°; intramarginal vein up to 2 mm from margin; petiole terete or channelled, 12-15 mm long. Umbels 7-11- flowered; peduncle slender, terete or quadrangular, 6-15 mm long; pedicels slender, 5-12 mm long. Buds globular-rostrate or ovoid-conical; operculum hemispherical, rostrate or conical, obtuse, 4-6 mm long, 3-6 mm wide; hypanthium hemispherical, 2-3 mm long, 3-6 mm wide. Fruits hemispherical or ovoid, 5-8 mm long and wide; disc broad, ascending; valves 3-5. Seeds yellow.

Common Name: River Red Gum; in Pakistan, sufaida and lachi.

Distribution: Occurs in most of the Australian mainland. Grows along and near watercourses, sometimes extending to hills or ranges, usually in open forest

- The *eucalyptus* tree leaves are used to extract an essential oil. The oil contains a chemical called eucalyptol that has decongestant and antiseptic action. *Eucalyptus* oil is known for its treatment against respiratory problems; it is used as an inhalant and in diffuser for asthma, bronchitis, flu, coughing, inhalation and sinusitis. The oil extracted from the leaves is also being used as an essential input in the manufacture of cosmetics.

- As a timber, *eucalyptus* is sturdy, straight, termite resistant, tall and has a medium to high density. It is popular for its use for pulp and paper, sawn wood in processed wood products and furniture. Due to lack of information on proper processing treatments and seasoning problems, it is not being used on a wide commercial scale.

- It is commonly used as fuel wood.

- *Eucalyptus* has a unique aromatic essence and is used as herbal medicine; various oil containing ointments, lozenges, cough drops, aromatic candles, relaxing balms and other herbal products are made.

- Natural *eucalyptus* forests are known for their positive impact on controlling leaching and run-off of nutrients.

- The tree is also known for its adaptability against diverse soil and land types, and environmental degradation, and its pest resistance and reproductive capacity of harvested stem. It is often planted as a protective cover for windbreaks, soil stabilisation and natural landscaping. *Eucalyptus* planted on nitrogen-rich peat have been shown to take up large quantities of nitrogen and could thus be used for reducing eutrophication. Most trees will grow in very poor soil conditions.

- *Eucalyptus* was amongst one of the first few plants recognised for its medicinal use and has great medicinal value; its antiseptic, antibiotic, astringent, decongestant, tonic, antispasmodic, deodorant, expectorant and stimulant properties have made it a valuable cure for many diseases and ailments. A few examples are lung diseases (bronchitis), sore throat, colds and coughs, gout, syphilis, typhoid, pyorrhea, fevers, asthma, piles, malaria, etc. It is used as a disinfectant; an external application of it can cure minor cuts and wounds, burns, infections, boils, ulcers, sore muscles including arthritis, rheumatism. It is also known to stimulate blood circulation. The dried leaves are used for preparation of insecticides and *eucalyptus* is a strong insect repellent.

- The *eucalyptus* leaves have many healing properties associated with them; the oil is used in many medicines, antiseptics and astringent products (mouthwash, toothpaste etc.). It is also used to clear up sinuses, treatment of cuts, sores and stressed muscles and other aches and pains in the joints. Oil extracted from young and succulent growth was used as a cure for intestinal disorders.

- The tree is also commonly called the 'fever tree' as it was used as a traditional aboriginal fever remedy. It has been grown to drain swamps, a breeding place for malarial mosquitoes. It is also said that the tree purifies its surrounding air.

- *Eucalyptus* is also recognised for its gum. Several species of *eucalyptus* are used for tonics for gastric problems (e.g. the peppermint gum). A dilution of the gum has been known to cure diarrhoea.

1.4 The Other Side of the Picture

Eucalyptus has remained a controversial tree and there has been mounting criticism of its potentially harmful ecological (environmental), economic and social costs. The "ills" associated with the tree include detrimental effects on land, productivity, environment, soil quality, etc. Although authentic research does not exist regarding area specific comparative analysis of *eucalyptus* and other tree species, a number of negative perceptions seem to be common. Some disadvantages of the tree and other harmful or potentially harmful effects associated with it include the following[1]:

- *Eucalyptus* species attract a number of insect pests and fungal diseases. The wood is very defect- and damage-prone and needs stabilisation treatments. The problems associated with wood include cracks, twisting, splitting up of wood due to excessive shrinkage, and collapse (caving-in of wood cells) during drying above the fibre saturation point. This is very common in medium to low density *eucalyptus* timber but can be treated by steaming, thereby restoring the lost volume.

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1 The *Eucalyptus* Of California. Seeds Of Good Or Seeds Of Evil? Robert L. Santos. California State University, Stanislaus. 2001.

- Although suitable for pulpwood and chip production, *eucalyptus* is generally difficult to process for sawn timber and requires extreme care in sawing and drying. But if dried properly it has good finishing properties and is suitable for a variety of products.

- The strong and deep-rooted tree can cause soil erosion under dry conditions. The tree requires large amounts of water and if planted with other ground vegetation it can compete vigorously with neighbouring crops and vegetation for water and nutrients. It is said that terracing can reduce this effect.

- The cropping of *eucalyptus* trees on a short rotation can lead to a fast decline of soil nutrients in dry land. Some *eucalyptus* trees are known to produce a harmful toxin that can restrict the growth of annual herbs.

- It is also alleged that *eucalyptus* plantation reduces/erodes previously existing ecosystems. As compared to natural forests, the plantation of *eucalyptus* trees is alleged to reduce the diversity of mammals, birds and insects, etc.

- The *eucalyptus* oil, if brought into direct contact with the eyes or broken skin, can cause severe irritation. Moreover, the use should be infrequent because it is difficult to pass through the kidneys. An overdose is known to cause nausea, vomiting, muscular weakness and indigestion.

The following is an interesting extract from an article published in the newspaper *Dawn* in 1999 criticising the large-scale introduction of *eucalyptus*:

> In August 1999, an anti-pollution rally organised by various government departments and NGOs planted 1000 saplings of *Eucalyptus*, neem, and Conocarpus around Keenjhar Lake to "save the lake" (*Dawn*, August 29, 1999). They do not know that they had actually damaged the lake surroundings by planting these alien species. Like Melaleuca, *Eucalyptus* is also capable of lowering water-table due to fast growth and excessive transpiration, besides having allelopathic effects on indigenous vegetation, and having highly inflammable volatile oil contents, which can trigger forest fires in hot and dry season. The large-scale introduction of *Eucalyptus* has not only changed the characteristic landscape of Sindh and many other parts of Pakistan, but in the long run it would show detrimental effects on water resources also. Both *Eucalyptus* and neem harbour fruit-eating bats, a potential serious threat to orchards, which actually serve as the seed-dispersal agents for the latter. Although these species have not so far become invasive, but may become so in future, given their large scale and repeated introduction coupled with targeted destruction of native vegetation in the name of "cleaning" the environment. The awareness campaigns on the importance of indigenous flora and the danger of alien species are needed in Pakistan more than anywhere else in the world."

1.5 The Limiting Factors for *Eucalyptus*

According to a report published by the Food and Agriculture Organisation (FAO), "*eucalyptus*, especially on a large scale, should be planted only after a careful and intelligent assessment of the social and economic consequences, coupled with an attempt to balance advantages against disadvantages. This can probably best be done by a sympathetic examination of the ecological circumstances and needs of local people, assisted by an understanding of the results of the fundamental research on water, nutrients, etc."

A number of studies and research conducted on the tree plantation methods and care have been published. A number of noteworthy characteristics and findings[1] that are essential for healthy and successful growth are reproduced below:

- A careful analysis of the area where the tree is to be planted is very important since different tree species will respond differently to climatic and land variations, with the result that a number of trees planted in a patch of land can demonstrate divergent characteristics. The changes are usually observed in a year and a half's time.

- The tree requires a regular supply of water, in certain cases phosphorous rich fertiliser to accelerate the rate of growth, adequate sunlight and protection for the first year or so when it is vulnerable to damage by adverse weather conditions, root damage, frost damage, damage from livestock and animals, etc. After this the tree survives on groundwater and once the roots are strong and spread out the tree is firmly anchored in the ground and usually resistant to such externalities. It is best grown in warm climates and can reach up to 300 plus feet in height.

- Some species of the tree are more sensitive to damage than others. A common insect threat to the *eucalyptus* tree is from the long-horned borer and the snout beetle can cause defoliation.

- Once established, the tree requires very little care. The roots of well-established *eucalyptus* trees are swollen and called a "lignotuber." This helps them to re-grow even after severe damage from frost or after the tree has been cut down. The growth rate also increases significantly if the surrounding area is kept clear of other plants and trees. The tree can basically be planted any time of the year but various experiments have shown that spring-time plantation is the best. A wrong species selection of a *eucalyptus* can present many problems and requires extensive care.

- The species selection and seed provenance are important factors to be kept in mind before the plantation of the tree. The seeds collected from places differing in elevation, climate, latitude, etc. can produce very different results. The genetic variations within the same tree species are so diverse that two trees may be completely different in their growth rate and size.

- If the soil is liable to dry up or freeze or become infested with weeds or grass, then mulching is recommended. In a moist and mild environment it is, however, not important. The mulch prevents the soil from losing moisture through evaporation and keeps the soil from freezing. Many products can be used as a mulch including bark,

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[1] The Hardy *Eucalyptus* Page. Ian Barclay. November 3, 2001. www.angelfire.com.

wood chips, leaves and grass clippings. Compost, manure and other products that contain a lot of nitrogen are generally not recommended.

- The base of the tree should be kept free from wild grass, weeds and shrubs as these can restrict growth.

- *Eucalyptus* should generally not be transplanted as it is much more sensitive to root damage than other trees when young.

- For a sturdy trunk the tree can be cut back after a couple of years of growth and the branches pruned without reducing the tree's height. *Eucalyptus* responds well to pruning and its branches sprout vigorously. A trunk that is allowed to sway naturally with the wind results in a strong tree.

- Being very prone to severe damage from freeze, parts of the tree can become dead and it may not be possible to detect the damage even in one or two years. Other forms of damage include splitting up of the bark of tree especially when it is newly planted that indicates that the growing tissues of the tree have been damaged.

1.6 *Eucalyptus* in the Context of Waterlogging and Salinity

In Pakistan, about 16 million acres of land are salt affected[1]. Severe salinity and waterlogging have resulted in severe problems and made several million acres of land uncultivable and barren. Dry land salinity can occur in non-irrigated land as a result of vegetation clearing. Irrigation salinity in which salinisation of irrigated land occurs results from extensive irrigation or vegetation clearing. Salinity exists in three main forms—white, black and white-black salinity. It is one of the major causes of low per acre yield. Plants and trees can usually not be grown where there is black and black-white salinity that has a high content of salt and sodium.

Eucalyptus is one of the most feasible options for cultivation where the soil and water are moderately saline and especially if the soil has a dense structure with a water table close to the surface. If planted in an uncultivated land, *eucalyptus* results in lowering the water table significantly especially with young and succulent growth of the trees. The tree seedlings take up a lot of water and help in reducing groundwater recharge and directly using groundwater for transpiration. *Eucalyptus* trees are, therefore, often planted in marginal lands for land rehabilitation and reclamation.

[1] Newsletter On Bioeconomic And Social Research On Sustainability And Economics In Agriculture. Issue 4, June 1999.

② THE CBO, ITS PROJECT AND PREDICAMENT

2.1 Mitha Tiwana

Mitha Tiwana is one of the oldest villages in Pakistan. Its history is traced back to the times of the great medieval warrior and conqueror, Sher Shah Suri, who defeated Humayun, the second Mughal emperor in 1540 and later captured Delhi and Agra. It is located on the periphery of the Noor Poor (Thal) desert range. Some development took place here after the introduction of the new irrigation systems and the village took on the demographics of a small town. As a result, the village area seems to have merged with the town area.

The land here is naturally barren; some of it is irrigated and large parts of it are uncultivable. The land in and around Mitha Tiwana is mostly waterlogged and saline. Indigenous annual crops grown here are mostly channa and gawara (a coarse grain). There is a limited dependence on livestock. Many families have members serving in the army and in neighbouring Joharabad Town in the cotton, jute and sugar mills.

2.2 The Society for Human Empowerment & Rural Development

The Society for Human Empowerment & Rural Development (SHER) at Mitha Tiwana, Khushab, is a local Community Based Organisation (CBO) that was registered initially as the Colonel Mohammad Sher Social Welfare Society. It is named in memory of the late Colonel Mohammad Sher, the grandfather of the present Society President Mohammad Sadiq and well known for his philanthropic activities and personal orientation towards welfare.

The Society was established in 1991 and registered under the Voluntary Social Welfare Agencies Ordinance 1961. It started out with a vocational training centre for women in 1991 and later established a technical training centre for local villagers where they are trained in various crafts. The centre has acquired the traditional *khaddi* (wooden) looms where beautiful multi-coloured hand woven cloth is made and sold off at various exhibitions.

The Society has been working in education, health, environment, social welfare (women, youth, handicapped children) and economic development (income generation through vocational training). Its contribution in the education sector seems to be well known and it has implemented a number of formal and non-formal education projects over the years. The Society is implementing a non-formal education project with through six community mobilisers and with inputs from the Government of Pakistan (GoP), Pakistan Literacy Committee (PLC), the United Nations Children's Fund (UNICEF) and the Japanese International Co-operation Agency (JICA). Another educational project being implemented is a community model schools project funded by the Asian Development Bank (ADB).

In the forestry sector, the Society has executed a Rs 625,000 project, "Forestation in the Suburbs of Mitha Tiwana" funded by the Ministry of Environment under the Pakistan National Conservation Strategy (NCS). The Society also co-ordinates with other local and national NGOs (including the Aurat Foundation) for various training programmes.

2.3 *Eucalyptus* Plantation Project—Revolving Fund for Tree Plantation

2.3.1 Project Rationale and Objectives

As indicated above, the Society had relevant prior experience in environment and forestry related projects and the farming community it aims to serve also wanted to increase its land productivity and income. Therefore, the Society made a request to the United Nations Development Programme (UNDP) for financing a project of *eucalyptus* tree plantation under the UNDP GEF small NGO grants programme. The plantation project was initiated in 1995 and it envisaged a five-year plantation campaign for *eucalyptus* trees. The project approach at the time was the creation of an innovative revolving fund for long rotation crops that would help sustain the project on a long-term basis.

The overall project goals included afforestation, multiple use and sustained yield of the tree, controlling the water level, economic development through establishing trees as a industry and reduction in global warming and other positive environmental impacts.

The aims and objectives of the project as described in the project document include:

- Increasing the forest cover in Mitha Tiwana;
- Providing a sustainable yield of wood over the years;
- Controlling the water table;
- Promoting the economic development of the farmers, and;
- Encouraging wildlife preservation.

The project area defined for the plantation was up to 20 km around the village. The GEF grant amounted to Rs 450,000 with some additional contribution (Rs 75,000 approx.) expected to come from the Society. The proposed activities included the establishment of nurseries by the farmers for producing 25,000 saplings of the *eucalyptus* trees every year with technical assistance and seeds provided by the Society. It was thought that 20 – 25 families, each owning 5 – 25 acres of land, would plant a total of 125,000 trees on a total of 125 acres over five years.

A number of small farmers/peasants were identified by the Society who were willing to plant trees on their land and look after them. The Society held discussions with them and told them about the economic gains that could be had from the tree plantation. It was also agreed that the entire project execution and supervision would be carried out locally through the Society and the group of farmers would be selected by the Society. These farmers were mostly existing members of the Society or their blood relatives.

The people were told that *eucalyptus* is suitable for their waterlogged non-cultivable land, that it would increase land productivity and give higher per acre yields and would also lower the water table and improve the climatic and environmental conditions. For the farmers the benefit was very clear: they were required to incur a one time cost in the plantation of *eucalyptus* trees with money given from the Society and the tree would be ready for harvesting in five to six years time. The project staff reports that they were given technical assistance in planning or site selection and the plantation was done on the land of their choice. The seedlings were obtained from the Forest Department of the provincial government, which also provided some basic information on disease prevention, insecticide use, etc.

2.3.2 What Was Planned—The Project Details

The project envisaged plantation of 25,000 trees each year by the farmers for the first five years to be distributed over two plantation seasons in July-August and February-March. Thus, 125,000 trees were to be planted during a first phase that would mark the completion of the revolving fund cycle. Each farmer was asked to earmark five acres of land and plant 5,000 en bloc trees in this area each year. Five farmers were to be involved each year and trees were to be planted on 25 acres of land, with a total of 125 acres planted with trees at the end of the first phase.

As there would be no income from the trees for at least five years, it was proposed that each farmer would be paid one rupee per surviving plant (Rs 5,000 annually) for the first five years of the project. Subsequently, each farmer would hand over 1,000 of his 5,000 trees to the Society at the end of the first phase. The proceeds from these 1,000 trees were to be reinvested for further plantation during a second phase and the number of trees planted increased to 50,000 per year.

The price of one *eucalyptus* tree was estimated at Rs 100 and for 1,000 trees to be planted in one acre of land, the return after five years was estimated at Rs 100,000, an amount considered to be quite profitable in view of the irrigated and saline land. The entire project was planned in anticipation of a pulp and paper producing factory that was to be operationalised in the near future. The factory had apparently agreed to become a regular buyer of the tree wood from the farmers at a price of Rs 60 (or at least Rs 40, according to some farmers) per maund (approximately 40 kg).

Table 1. Project details at a glance

First Phase (six years)		
Number of trees planted in:	1995	25,000
	1996	25,000
	1997	25,000
	1998	50,000
	1999	50,000
	2000	25,000
Total trees planted		**200,000**
Second Phase (one year)		
Number of trees planted in 2001		25,000
Number of trees sold by the farmers		75,000
Income earned by farmers		550,000
Income earned by the CBO		110,000
Average income per acre		Rs 6,733 approx.
Excess of annual income from *eucalyptus* over other crops		Rs 3,000
Payment made to farmers from revolving fund		Rs 450,000

Source: Project document.

2.3.3 What Actually Happened—Project Results

The GEF grant for the project amounted to Rs 450,000 over a five-year period and payment was disbursed to the farmers as agreed. The UNDP GEF small grants programme assisted the Society in establishing linkages with the Forest Department for technical assistance. In addition, it provided informative literature on the trees of Pakistan and on tree planting.

The project document shows 16 individual farmers who have participated in the tree plantation. As under the agreement, the farmers deposited one-fifth of the sale proceeds from the trees to the Society. Contrary to farmers' expectations that they would find a regular and profitable long-term market for *eucalyptus* in the Faruki pulp and paper mill, the mill was not made operational due to financial constraints and the experiment became a failure. The farmers were forced to sell the wood at a mere Rs 16 – 20 per maund to local buyers for use as fuel wood. However, the people have also attributed other factors and underlying reasons for this failure, including the lack of technical assistance, seed and site selection, local environmental (climatic), social and economic characteristics. A few explanations that are accepted and recognised by the project are as follows:

- Of the 150 acres of land that were brought under cultivation, 100 acres was cultivable land and 50 acres was extremely water logged. Farmers report that the growth of the tree has shown tremendous variation in height and girth etc. in any given patch of land; most of the trees planted in extremely waterlogged land have shown poor growth.

- Other than adverse soil and land conditions, the tree growth has been damaged and/or restricted by the persistent drought, wind storms and wildlife and domesticated livestock. The result was poor wood density and much less weight as anticipated.

- The farmers opine that en bloc plantation and inter tree spacing of about 10 feet each could be likely factors for restricted growth.

- Because of water shortage, the trees could not be watered as adequately and frequently as is required in the first year of plantation.

- The farmers were not given comprehensive guidelines and technical assistance regarding site selection, proper plantation and care methods, disease prevention, etc.

- Lack of knowledge and facilities for proper wood treatment and processing resulting in defective wood. In Pakistan traditional crude methods are employed like placing wood in pond water or steam. This reduces the acceptability and market for *eucalyptus*.

- Absence of a market for the *eucalyptus* tree and lack of acceptance on part of people. There have been many rumours and newspaper articles on the ill effects of the tree during the project duration alleging that the tree destroys land, lowers productivity and that it is an alien invasive species imported from foreign lands and that even birds don't make their nests in a *eucalyptus*. This has further reinforced people's biases.

As a combined effect of the above factors the only use of the tree in Mitha Tiwana was for fuel purposes and for inner planks, shuttering in construction and use in brick kilns, etc. This has discouraged the farmers: the supply far exceeded the demand for the tree wood and the profits diminished accordingly to a point where all farmers have reported losses. Of the money lent to the farmers, only Rs 110,000 has been returned to the Society to-date. Of the total harvested, only two farmers have recycled the plantation and it is said that farmers are no longer interested in taking the *eucalyptus* plantation any further. They have done their own cost-benefit calculations and concluded that they are better off growing their traditional crops. The UNDP GEF small grants programme has also advised them to introduce other species instead of *eucalyptus* and suggested that they try planting the *Zizyphus* and *siris* species and provided them with literature on these species.

2.4 Some Future Plans and Directions

2.4.1 At the Project Level

The Society feels that it has now had considerable experience in tree plantation and is well placed to take up similar projects with an expanded scope and duration. Moreover, it also feels that due to the experience it is well equipped to deal with any difficulties and problems arising in the future. The project staff is of the view that they would be interested in extending the project but with a few modifications that are deemed necessary for the revival of the lost interest of the farmers' community in *eucalyptus* trees. This includes proper guidance on the plantation methods and related aspects and increased incentive for the farmers up to minimum of four to five rupees. They also suggest an increase in the tree spacing during plantation and the introduction of another tree variety along with *eucalyptus* for motivating people.

The Society also wishes to benefit from the research and experiences of IWASRI and other specialised institutions and experts working in the field. It feels that the market for *eucalyptus* could be increased considerably if local people are facilitated in acquiring training in wood treatment and processing techniques as well as marketing techniques and linkages.

2.4.2 At the Farmers' Level

In view of the limited market and low returns that the farmers got from their trees they seem to have lost interest in *eucalyptus* plantations and the preferred tree for the locals is now kikar and sheesham that can easily fetch up to Rs 40 to 60 per maund. According to their estimate a compensation of one rupee as the opportunity cost of land and effort is not adequate. The only incentive to these farmers lies in short rotation crops that can get them high returns and *eucalyptus* is a medium to long term crop. However, although they have not had a good experience this time round they opine that with the provision of better planning, technical assistance and incentives they would be willing to reinvest in *eucalyptus* trees. They express a keen interest in accessing training opportunities for farmers, carpenters etc. and in acquiring additional knowledge regarding the benefits of the tree.

2.4.3 At the National Level

Screening trials have already been conducted in Pakistan for *eucalyptus* and Pakistan's tropical provenance favoured as a climatic zone for the tree. Sufficient information on the basis of empirical research already exists on the many uses of the *eucalyptus* tree and its ecological and economic benefits have been documented. Despite this the fact remains that with a few exceptions a real and profitable market for *eucalyptus* does not exist in Pakistan. Both the consumers and the producers are inhibited by various market factors and there are wide gaps in knowledge and awareness at all levels. Unless the wood quality is made suitable for the end users and effective marketing made available the tree will not be a success with the farmers and the wood purchasers and thus its real value will never get materialised.

Described below are a few options that could be worth further consideration and pursuit, including those for Mitha Tiwana:

- It is essential that awareness and objective information regarding the ecological and economic benefits of the tree are disseminated widely to farmers, foresters, land-use planners, development and area development practitioners.

- A simple measurement system needs to be put in place that can provide reliable insights towards the tree plantation and care methods and an early warning system for different climatic and land types to assess likely impacts and growth inhibiting factors. The growth and wood properties of the *eucalyptus* tree species are not known in general although various studies have been made to understand the makeup of the tree.

- There is a great need to investigate the suitability and harmful effects of *E.camaldulensis*, its utilisation in different products and wood treatment and stabilisation methods that can make it suitable for producing high quality products.

- Proper wood drying and seasoning techniques should be promoted and disseminated widely so that a good quality lumber and sawn wood is obtained. Various dimensional changes can occur in *eucalyptus* wood due to moisture content and shrinkage, swelling or other damage is common. Proper seasoning can reduce these changes, protects wood and increases its strength for further use. Other common approaches include freezing and boiling pre-seasoning treatments, external coatings and stabilisation techniques, resin impregnation, sucrose etc. are used to increase wood stability.

- Revival of sick units or non-operational pulp manufacturing mills in Pakistan including the Faruki Pulp Mill Private Limited established at Mangowa, Gujrat that was expected to utilise solely *eucalyptus* wood for paper pulp but could not take off due to financial constraints. *Eucalyptus* has one of the best paper making properties and a medium sized plant has a capacity of using 800 tonnes of green wood all year every day. Exploring and operationalising other smaller units for utilisation of *eucalyptus* wood in chipping wood supply and packaging material. Packages (Pvt.) Limited at Lahore has a small unit that is already producing one of the best tissue papers from *eucalyptus*. This can reduce the high pulp import costs for Pakistan. High quality pulp for paper can be produced at nearly one-third the cost in Pakistan.

- Environmental legislation is being drafted to look at the effluents problem caused by the pulp and paper industries and a number of them have been closed down for non-compliance with the effluent standards to meet their requirements. Influencing legislation on the use of less toxic fuel can have a positive impact; the straw, weeds and coarse grasses used presently are more condensed and have a high content of silica (e.g. wheat straw) that can insulate the machinery with deposits and lead to inefficient functioning and excessive effluents.

- Training of farmers and local area carpenters in wood cutting, drying techniques and seasoning processes etc. for utilisation of wood in making high quality furniture. There is a fully functioning furniture making factory in village Salooki Chattha of Wazirabad.

- Possible markets for the use of *eucalyptus* that already exist should be looked into and developed further. There are chipboard factories in Sheikhupura and Raiwand (near Lahore) and a *eucalyptus* oil extraction unit in Shorkot (the cost of the standard oil extraction equipment is approximately Rs 100,000). Another factory that is running profitably is the Chenab Particle Board, Ali Pur Chattha, Wazirabad, that purchases the tree wood at Rs 60 per maund for the production of good quality chip board.

- All future programmes and strategies should consider this as a major industrial wood resource. Both the farmers and the wood users need to be given proper incentives along with an assurance of a long-term sustainable wood market so that import substitution can take place for economic as well as environmental progress.

③ SUPPORTING *EUCALYPTUS*

3.1 About IWASRI

The International Waterlogging and Salinity Research Institute (IWASRI) is the lead executing agency established under the Ministry of Water and Power for the multi-funded (AusAID, UNDP, GoP) bio saline farming systems project entitled the "Pakistan Community Development Project for Rehabilitation of Saline and Waterlogged Land" in Punjab. The institute is working primarily as a research organisation to conduct and consolidate research on the issue of waterlogging and salinity and disseminate economically and technologically feasible solutions to practitioners and researchers within Pakistan and abroad.

The IWASRI project is aimed at poverty reduction and livelihood's improvement through promoting the use of sustainable biological systems (salt tolerant vegetation) to increase the household income of the small farmers. Using a participatory decision making process the project establishes salt land user groups (SLUGs) and women interest groups (WIGs) for land reclamation and rehabilitation technologies derived from a participatory applied on-farm trial program. Interventions include establishment of nurseries, small enterprises, demonstration plots of salt tolerant vegetation, adult literacy programmes, micro-credit programmes and linkages to extension services on saline agriculture, forestry and marketing, capacity building of local agencies and NGOs.

Irrigated agriculture practices, lack of drainage and waste management facilities have created a severe waterlogging and salinity problem in the country with the result that an estimated 16 million acres of agricultural land in Pakistan has been lost to this menace. A majority of the farmers do not possess adequate knowledge in alternative farming techniques and options available to them and as a result the land is made barren and unproductive. The IWASRI project has encouraged adoption of low-cost, biological approaches to the problem through introducing a variety of salt- and waterlogging-tolerant plants, in particular, *Eucalyptus camaldulensis* on marginal lands; a tree known to help lower the water table significantly. Other salt tolerant fruit trees include falsa, jaman, bair, guava and date palms. The project is trying to identify and improve the market and marketing of the various products acquired from this tree including pulp and paper production, furniture, charcoal production, oil extraction, bio-energy production etc. through research, farm demonstrations, linkages and through world wide expertise available in the field.

3.2 The IWASRI Perspective and Findings

According to experts at IWASRI, *eucalyptus* can play a key role to land rehabilitation in Pakistan. In Pakistan, *eucalyptus* is planted on farm lands under social forestry and farm forestry programmes in the form of small compact blocks or multiple rows along field boundaries. But slow market uptake has discouraged farmers to plant these trees. Pakistan has more than 6.2 million hectares of saline and waterlogged lands suitable for plantation of *eucalyptus* trees. IWASRI has made persistent efforts in raising awareness regarding the tree and promotes the tree use on all marginal lands. A number of workshops and seminars have been organised by the Institute which brought together a large number of stakeholders to identify existing constraints and chalk out future strategies for effective utilisation and marketing of *eucalyptus* tree.

IWASRI works as a salinity research institute and it advocates the practicality of trying to live with the waterlogging and salinity problems by introducing and demonstrating bio-saline agricultural practices. Very compact spacing of plants, trees and a mix variety of crops e.g. bean and fodder crops often present a problem and *eucalyptus* is a good option to mitigate this situation. Salts are leached down with water and the horizontal roots of the *eucalyptus* tree can spread up to 3–5 meters and can lessen this effect. The optimal spacing recommend for the tree is 6x4 meters. The average height of *eucalyptus* trees in Pakistan is between 7 – 10 meters and it has the resistant characteristics to survive in most of the saline and waterlogged lands in Pakistan. The evaporation effect of the tree enables it to pull out up to 70 litres of water in a day and it thus acts like a natural drain. With the return of the wet cycle the waterlogging situation will worsen, therefore planting deep-rooted trees like the *eucalyptus* is essential.

According to IWASRI, some of the benefits that can be obtained from *eucalyptus* and are specific to Pakistan include the following:

- Depending on the size of the tree, age, spacing and wood density, the market for *eucalyptus* wood can be segmented into end uses like timber, poles, pulpwood, fuel wood, charcoal and chipboard. Although it does not have a market in the pulp industry yet, the fibre is ideal for making good quality paper. The wood of the *eucalyptus* tree is not preferred for use in furniture; a common use is during construction as shuttering and replacement of the T-iron.

- Use in low cost housing and as insulation material; shavings of the tree soaked in water and dried, mixed with cement powder and compressed can produce good quality boards.

- Oil extraction for medicinal purposes; use in the cosmetics and pharmaceutical industry. Oil can be easily extracted through a simple steam distillation process. The leaves can yield oil up to 0.70 percent with 60 percent cineole content.

- Use as diesel oil for steel mills; charcoal distillates from *eucalyptus* burnt in furnace are low in sulphur content and good for the machinery.

- Electricity generation on a small scale in turbines through gasifying wood in a bio-furnace.

- Debarking of the tree is easily done manually and tannin, a potential end use product can be obtained from the bark.

- The flowers of the tree can be a good source of nectar for the honey bee.

- Planted in the right location, *eucalyptus* has a positive impact on the environment; one mature tree uses up to 1.5 pounds of carbon dioxide to produce one pound of wood and in exchange discharges up to one pound of oxygen into the atmosphere (Hussain, 1997).

- This species sprouts after cutting (coppicing) which saves farmers having to replant for two or three 8-year rotations[1].

[1] Joint Satiana Pilot Project. Developing a Marketing Strategy for Wood Produced by Farmers on Saline and Waterlogged Land in the Punjab Province. United Nations Development Programme, Australian Agency for International Development. August 1998.

- It has high potential as future fibre for pulp and paper. The bleached *eucalyptus* chemical pulp produces good printing and writing papers and tissue paper. The pulp and paper industry is so far the most profitable and viable option for utilisation of *eucalyptus* wood in Pakistan. The pulp industry at present has excessive reliance on non-wood raw materials including wheat straw, grasses, bargrasse and cotton linter that produces low-grade paper. The properties of the *eucalyptus* fibre lead to excellent formation in sheet, good bulk, furnish, stiffness and opacity.

The current per capita consumption of paper-board in Pakistan is only 3.5 kg, as compared to over 200 kg in developed countries. This is expected to rise sharply and create tremendous potential for future growth. The benefits[1] of replacing straw feeding with *eucalyptus* chip feeding are many, including the following:

- The *eucalyptus* pulp improves machine runnability and the quality of paper-board and it may also reduce the percentage of imported long fibre pulp.

- *Eucalyptus* is not a seasonal crop like straw and is available throughout the year.

- In wood pulping, chemical recovery process is possible and the technology known whereas the straw pulping has silica associated problems. A modern wood based market chemical pulp mill will recover over 95 percent of its pulping chemicals, produce all the thermal and electrical energy required for its operation and its liquid effluent has little environmental impact.

- The major problem facing the pulp and paper industry at present is that with wheat straw based raw materials it cannot meet the environmental regulations for disposal of liquid effluent. With a wood based mill they could easily meet these requirements. Wood pulping is environmentally friendly and compliance with the Environmental Protection Agency (EPA) and the National Environmental Quality Standards (NEQS) is possible.

- The capital cost for establishing wood based puling is high but the cost of chemicals, fuel and power is negligible due to the chemical and heat recovery. Whereas, in a straw-pulping process chemical, fuel and power constitute 55 percent of the cost of pulp production.

- With just one moderate sized *eucalyptus* chemical pulp mill, the wood requirement would be approximately 1,600 tonnes per day or 16,000 trees per day for 350 days of the year. For a sustainable supply this would require 160,000 acres of planted trees.

- The pink gum resin of the *eucalyptus* tree can produce beautiful timber for high quality furniture if properly treated and conditioned then the quality is comparable with that of sheesham. It has three popular rotations at age five when it can be used for pulp production, at 10 years for poles and at 15-16 years for high quality timber for furniture.

In short, the hope at IWASRI is that *eucalyptus* will find an appropriate niche in the landscape of Pakistan, and that farmers here will find a market sooner rather than later.

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[1] Workshop Proceedings on *Eucalyptus*: Future Fibre for Pulp and Paper Manufacture in Pakistan. Pakistan Community Development Project for Rehabilitation of Saline and Waterlogged Land. December 2000.

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Annex I

Terms of Reference for the Research Team

Nature of the proposed activity

The proposed activity is based on the premise that there are living examples of civic governance in Pakistan that can be readily adopted by others in similar socio-economic settings and within the resources available to a community. A related premise is that relevant examples need to be documented and evaluated to guide other communities as well as to caution them against the mistakes made by others. Based on the first premise, the examples selected for the proposed activity are four GEF-supported projects, namely, (a) Conservation of Biological Diversity with Community Development, Torghar, Balochistan (b) Eco-tourism and the preservation of the Indus Dolphin in Taunsa, Punjab, (c) Smokeless Stove Project of Escorts Foundation in District Kasur, Punjab, and (d) Revolving Fund for Tree Plantation in Mitha Tiwana, District Khushab, Punjab. Based on the second premise, the proposed case studies are intended to be both inspirational and evaluative in nature and will:

- Demonstrate successful, or potentially successful, strategies for mobilising communities, protecting wildlife and conserving natural resources in diverse socio-economic settings.
- Help develop priorities and strategies for addressing environmental problems.
- Support research and data gathering.
- Support exchanges of experience among CBOs and their local, national and international partners.
- Develop material that can be used for guiding and evaluating GEF-assisted and similar projects.
- Motivate partnerships between communities and relevant authorities at various levels.

In broad terms, the proposed activity will document and evaluate:

- The way local pioneers identified a challenge and provided the spark to facilitate change, the values they promoted, and how others view them and their values.
- How these local pioneers established partnerships with UNDP, local authorities and international organisations for obtaining technical and financial assistance.
- The new institutional arrangements (including norms and conventions and arrangements for cost- and benefit-sharing) established in the process of change and the human and financial contributions made by local communities as a result.
- The results achieved by and the future prospects (including sustainability) of the initiative, and the lessons learned from it, including the potential for replication.

In pursuit of the scope of work outlined above, the research team will:

1. Review project documents including proposals, evaluations and in-house records.

2. Interview key implementers, advisors and facilitators including UNDP staff to obtain history.

3. Conduct field visits and beneficiary interviews, including interviews with women and poor households, in the four locations. Local people and organisations will be treated as one set of evaluators of the projects. Women beneficiaries of the projects will be interviewed by female members of the research team.

4. Prepare a report including (i) a short history of the project, (ii) description of the partnerships, local institutional arrangements including those for cost- and benefit-sharing, and project achievements, and (iii) assessment of future prospects and potential for replication. The evaluative content of the report will include, as much as possible, the kind of description and analysis that is generally provided in an evaluation report.

With the assistance of RSPN, UNDP will be responsible for disseminating the case studies to the relevant audience.