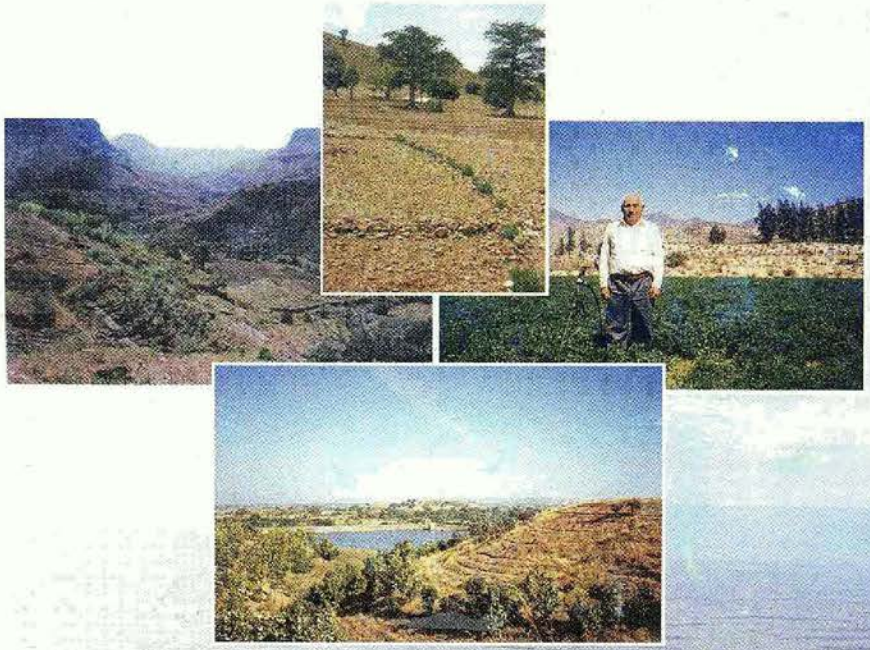
Success Stories

IN THE STRUGGLE AGAINST DESERTIFICATION

A Holistic and Integrated Approach to Environmental Conservation and Sustainable Livelihoods

Volume1 - Case Studies: Evaluation Reports
Volume 2 - Case Studies: Report Summaries



December 2002

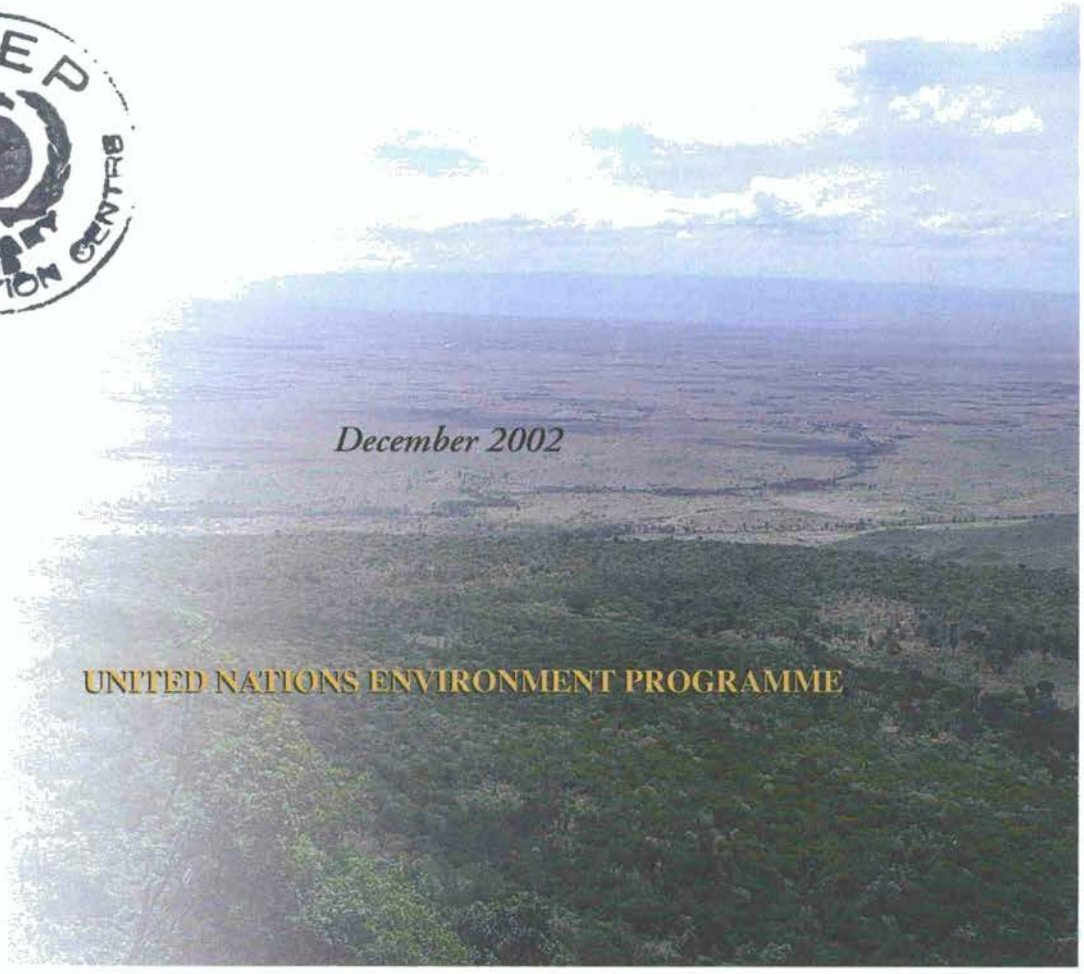
UNITED NATIONS ENVIRONMENT PROGRAMME

Success Stories

IN THE STRUGGLE AGAINST DESERTIFICATION

A Holistic and Integrated Approach to Environmental Conservation and Sustainable Livelihoods

Volume 1 - Case Studies: Evaluation Reports
Volume 2 - Case Studies: Report Summaries



December 2002

UNITED NATIONS ENVIRONMENT PROGRAMME

ISBN Number: 92-807-2278-6

Technical Editing and Case Study Development: Elizabeth Migongo-Bake, with support from Fenke Elskamp

Design and layout: Anthony Mwangi (Consultant) with support from Lucy Cherogony

Photographs: BSGN Photo Archives, UNEP

Foreword

© UNEP

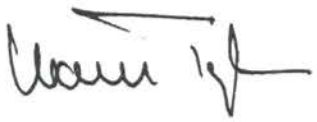
The prevention and mitigation of land degradation and subsequent desertification, through the promotion of sustainable land use and management, is a global challenge. UNEP's initiatives towards medium- to long-term solutions to desertification have been strong from it's outset in the early 1970s, following the General Assembly Resolutions 27/3054 and 29/3337 which vested in UNEP with the primary responsibility for the preparation of the United Nations Conference on Desertification (UNCOD). UNEP contributed significantly to the implementation of the United Nations Plan of Action to Combat Desertification (UNPACD), which subsequently led to the ratification of the United Nations Convention to Combat Desertification (UNCCD). Since then UNEP's role has gradually changed from global co-ordination of UNPACD to supporting the implementation of the UNCCD.

While land degradation control impact continues to be made, mostly at the community level in rural areas (such as the case studies reported here), the recent *Global Environment Outlook 3 (GEO-3)* report shows that there is no clear indication that the rate of land degradation has decreased at global level. The *GEO 3,* launched by UNEP in 2002, estimates that areas affected by desertification range from one-third of the world's surface area to about 50 percent, and people affected from 1 in 6 to 1 in 3. Twenty three per cent of all usable land has been affected by degradation to a degree sufficient to reduce its productivity. More than half of the extremely degraded lands are situated in Africa (5 million hectares out of 9 million). Desertification processes affect 46 per cent of Africa, and 55 per cent of that area is at high or very high risk. In total about 485 million people in Africa are affected.

The main issues related to land in the developing world include increasing degradation and desertification, together with inappropriate and inequitable land tenure systems, which have played a major role in exacerbating degradation. Other widespread problems include a decline in soil fertility, soil contamination, land management and conservation, gender imbalance in land tenure, and conversion of land habitat to agricultural or urban uses. These statistics and facts demonstrate a grave situation in the world as a whole and in Africa in particular. Innovative policies and effective measures must be taken and action programmes existing on paper in many countries must be urgently implemented.

To address the identified key issues in land use management and soil conservation within a development oriented approach poses challenges to all stakeholders and requires integrative solutions across policy, socio-economic, and environment sectors. The UN Millennium Declaration, the UN Millennium Development Goals and the World Summit for Sustainable Development (WSSD) Plan of Implementation recognize the maintained integrity and restoration of land resources as a critical factor in achieving economic and ecological sustainability. Through this publication *Success Stories in the Struggle Against Desertification, Volume 1 - Case Studies* and *Volume 2 - Summaries*, UNEP is hoping to encourage replication of successful initiatives by raising awareness about the approaches and innovations that have applied successfully around the world to manage drylands sustainably, thus enhancing the environment and alleviating poverty.

While each project is unique, and reflects the specific environmental, political and social conditions of its location, there are shared similarities in their emphasis on integrated approaches and solutions based on local action and the integration of people into the efforts to sustainably control land degradation and desertification through better land and water use management. And each success story clearly shows that the efforts have been worth it: increased profits for local communities, a more stable and supportive environment, and the hope for a brighter future. For those readers that will feel inspired by these success stories and will begin their own on sustainable management and use of the drylands- the so-called "bright edges of the earth", then this publication will have achieved its goal. Such impacts will, more importantly, serve to reverse the current grave statistics on land degradation, as reported in GEO3 as well as addressing Agenda 21 and WSSD decisions on sustainable development through the involvement of governments, communities and civil society in the planning and implementation of sustainable dryland initiatives.



Dr. Klaus Töpfer
Executive Director,
UNEP

Preface

For more than 20 years, UNEP has been actively involved in worldwide efforts to combat dryland degradation and until the adoption and entry into force of the UNCCD in 1998, had a special programme, the Desertification Control Programme Activity Centre (DCPAC), promoting and supporting desertification control initiatives globally, regionally and even at national levels through assessment, awareness raising and institutional capacity-building. It was under DCPAC that the Success Stories in Desertification Control Initiative was implemented in 1994.

Although desertification still remains a major environmental problem, impeding dryland development, there are also many projects and community-based initiatives which have successfully addressed these problems. These successes need to be better publicised to show that land degradation and desertification can be controlled, and positive experiences can be replicated. This programme, to define and publicise success stories in desertification control, aims to raise global awareness that land degradation in the drylands can be both prevented and corrected. It would also build community responsibility for the local environment and confidence in local abilities to solve land management problems.

The UNEP success stories initiative is helping to develop capacity through the replication of best practices. It is a global programme coordinated from UNEP headquarters, but implemented in close collaboration with UNEP Regional Offices, NGOs and civil society in the regions. The programme evaluates projects or initiatives that have been submitted to UNEP as success stories in land degradation control. The main criterion for a success story requires that activities directly and substantially contribute to the prevention of dryland degradation or to the reclamation of degraded land, using appropriate resources in a cost-effective manner. A success story addresses not only the biophysical but also the socio-cultural-economic issues in all its developmental stages, thus ensuring long-term sustainability.

More than two hundred submissions from Africa, Asia and Latin America and the Caribbean have been received at UNEP for consideration as success stories since the implementation of the initiative in 1994. An award scheme, *Saving the Drylands,* was also developed alongside this initiative in the form of a certificate to outstanding achievers through an on-site evaluation process by teams of independent experts. This was done in the hope that the recognition of success conveyed through the *Saving the Drylands* award will spur local communities to further action and encourage the replication of promising approaches.

Between 1995 and 1999 UNEP presented the *Saving the Drylands* award to twenty five local projects globally in recognition of their achievements. The certificate awards have been presented during CCD related events (Desertification Conference in Kazakstan (1995), CCD Day in Nairobi (1996), IFAD financially supported the evaluations and award-giving ceremony for its 20th Anniversary, and with UNCCD participation, in Rome (1997), UNCCD COPs in Dakar(1998), UNCCD COP in Recife (1999). Since 2000 more projects have continued to be received at UNEP and those qualifying as success stories have been included in the Success Stories and Best Practices database for dissemination and knowledge sharing. This report dwells on the twenty-five award-winning case studies.

While similar criteria were used in evaluating the success stories, these successes are not always comparable between regions but rather reflect successful impacts in the context of economic, social, political and environmental aspects of a given location. Thus, the socio-economic, political and environmental impacts of the Pakistan's Thal Desert success story are different from those achieved by the Sand Encroachment Control project in the Cele County of China or the Desertification Control Project in Cape Verde. The award giving ceremonies of 1998 to 1999 were at the UNCCD COPs in Dakar, Senegal, and Recife, Brazil,

respectively, with poster and workshop sessions to share and exchange ideas with the global community working and living in the drylands.

The Drylands success stories initiative has since 2001 become integrated into UNEP's new *Best Practices and Success Stories Global Network* (BSGN) that encompasses all ecosystems as well as all environmental sectors under UNEP's mandate, including land degradation control. The network goes beyond in-house UNEP programmes to include inputs from collaborating United Nations agencies, research centres, the private sector, INGOs/NGOs/Community Based Organizations (CBOs) and civil society. This new programme consists of an Internet-accessible website/database that will allow better sharing of information and ideas as well as dialogue on issues related to sustainable environmental protection, management and use. The programme also involves the development of award schemes for outstanding achievers. However, UNEP continues to encourage the submission of dryland development case studies outlining promising practices and lessons, which can be replicated elsewhere under similar environmental and socio-economic conditions.

Information on success stories and associated best practices is also disseminated globally through publications (booklets, posters and brochures, journals) as well as through the UNEP web site (**www.unep.org/desertification/successstories**) to enhance further replication and capacity development.

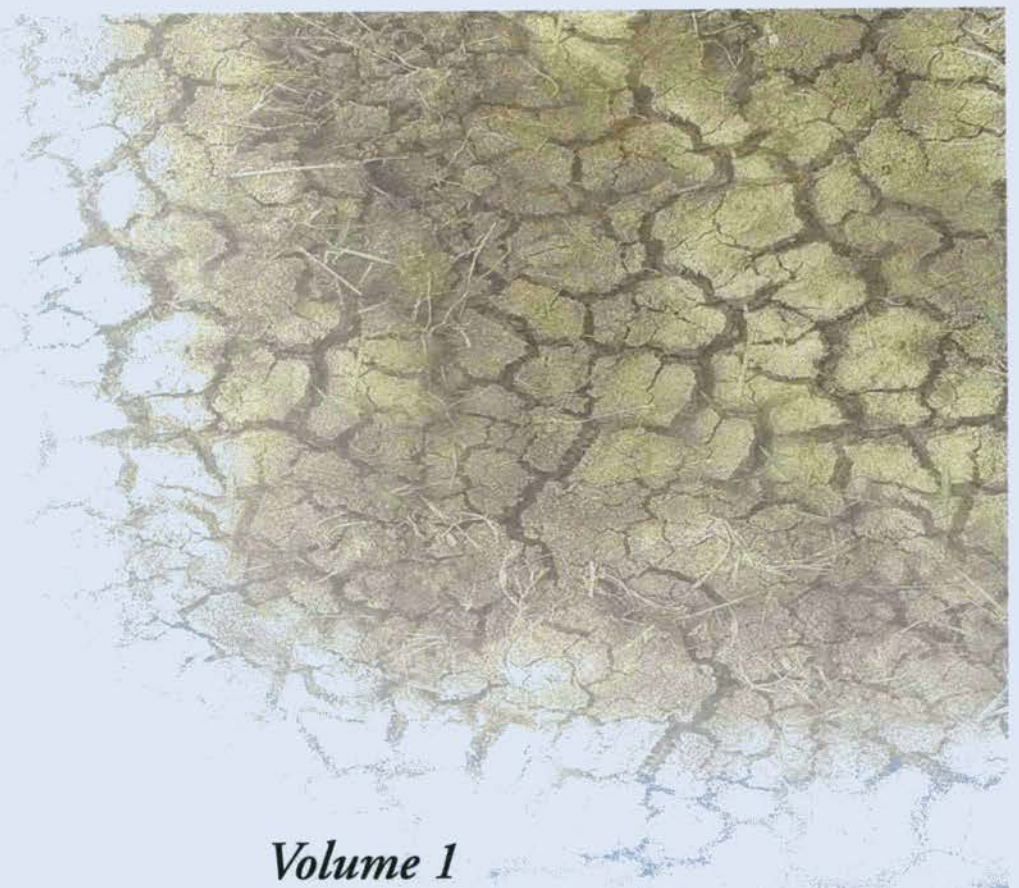
Elizabeth Migongo-Bake, PhD
Co-ordinator, Best Practices & Success Stories Global Network (BSGN)
UNEP

Acknowledgements

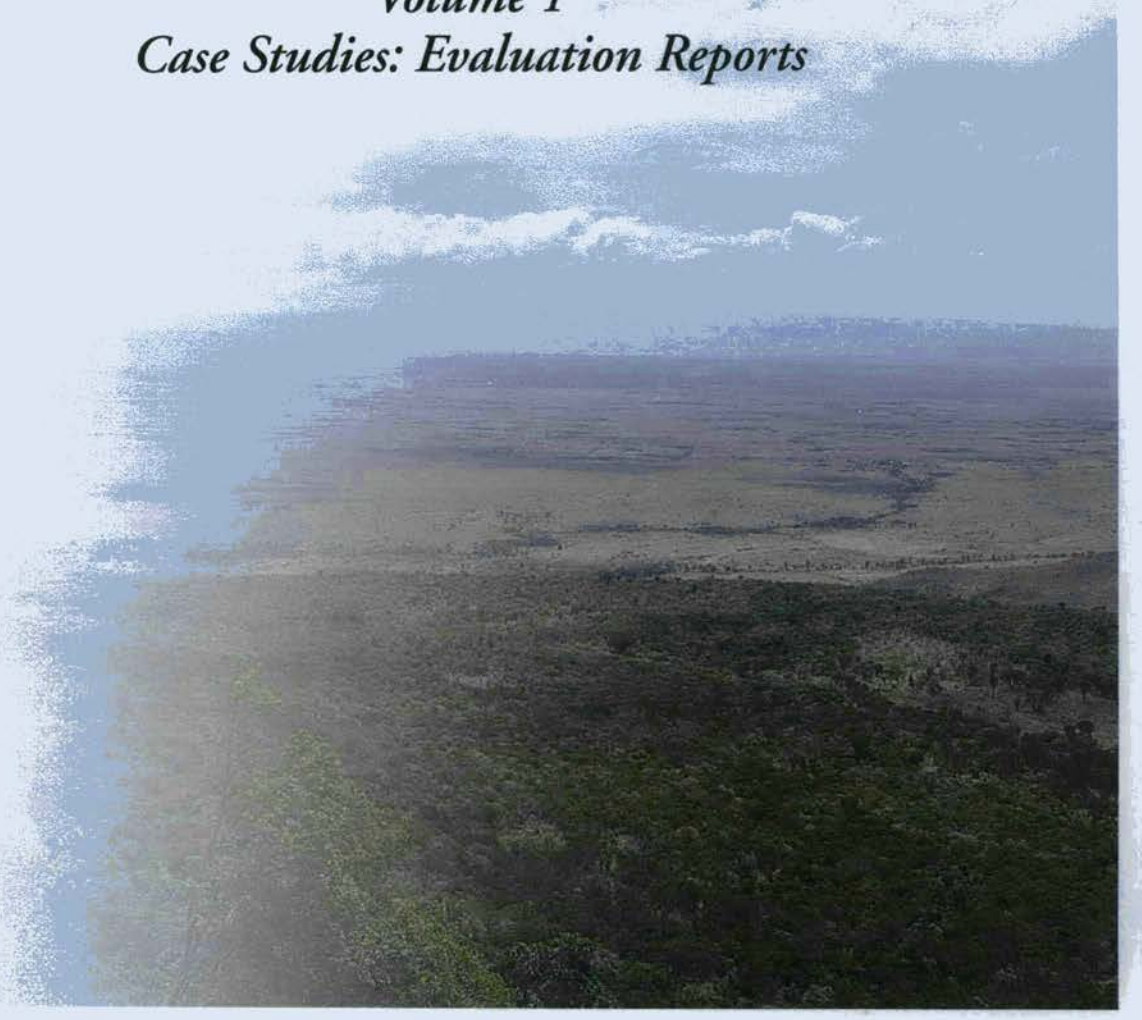
The Success Stories in Land Degradation/desertification Control Initiative of UNEP was the brain child of W. Franklin G. Cardy, the then Director of the former Desertification Control Programme Activity Centre (DC-PAC), who saw to the creation at UNEP of the "Saving the Drylands" award scheme in 1995 to recognize the outstanding achievements made by individuals, groups and governments in the global battle against land degradation in the drylands, the so-called "bright edges of the earth". The initiative looked, through on-site evaluations, at how different projects had been integrated with local people and the local environment, the focus being on appropriate technology instead of high technology, on community empowerment instead of mega projects, and how these approaches and technologies could be replicated in other parts of the world.

More than two hundred projects were submitted to UNEP for evaluation for the award between 1995 and 1999, from UN organizations, including UNDP/UNSO and WMO, as well as International Research Institutions, INGOs, NGOs and CBOs. Their inputs are greatly appreciated, especially those who won the "Saving the Drylands" award and whose initiatives comprise this publication (see Annex 1). Many consultants were hired by UNEP to carry out independent evaluations of the Success Stories and this publication would not have been possible without their reports and contribution to summary papers (see Annex 1). Many thanks and appreciation also go to the several interns from McGill University, Canada (D. Cardy and M. MacKay and Moses Sitati (Kenya)), Tria University Germany (Richard Theis, Wolfgang Schwanghart and Inga Dirks) and Moi University, Kenya (Barnabas Sang) who were involved with the initiative over this period and, in one way or another, contributed to the development of Success Stories materials used for dissemination, including brochures, booklets and posters.

Finally, appreciation and thanks to the Director of the Division of Environmental Policy Implementation, Mr. Donald Kaniaru, who supported and encouraged the publication of these Award-wining land degradation/ desertification control case studies, to especially allow dissemination and awareness-raising to the general public in those parts of the world without access to electronic mass media.



Volume 1
Case Studies: Evaluation Reports



CONTENTS

LATIN AMERICA AND THE CARRIBEANS

Protecting Degraded Dryland Forest

The Collective and Family Woodlands Project in Tiogo Forest Reserve, Burkina Faso

Over the last two decades, Burkina Faso, like other Sahelian countries, has experienced accelerated degradation of its natural resources, and especially forests, as a result of drought and desertification. Faced with rising human population pressure on increasingly fragile land, the Government of Burkina Faso and its development partners launched several programmes to combat the degradation of ecosystems. This project was launched by the Office to Combat Desertification and Drought (UNSO) [formerly the United Nations Sudano-Sahelian Office], in 1984 and taken over in 1994 by communities as UNSO's role ended and the project moved towards self-reliance.

The objective of the project was to conserve natural resources while ensuring that local people, organized in Forest Management Groupings (GGFs, in the French acronym), had continued access to reserved forests in the zone for the sustainable harvest of wood, Burkina Faso's main source of energy. The project covers four locations, including Tiogo Forest Reserve, the case study being reported here. In evaluating the self-reliance phase of the project, the evaluation team confirmed that village GGFs around the Tiogo reserved forest, under the supervision of regional forestry technical services, were actively involved in the preservation of forest resources. Indeed, the self-reliance of wood producers has been maintained without threatening the natural resource base.

Protection of woodland and soil conservation measures

Location and physical background

The Tiogo Forest Reserve is located southwest of Ténado District, Sanguié Province, approximately 15 kilometres from Tenado and 40 km from Koudougou. Reserved by Decree No. 114 of 17 January 1940, it was established as a reserved area covering approximately 46,000 hectares, now reduced to 30,000 ha. The vegetation of Tiogo Forest Reserve is characterized by two main physiognomic types: a predominant tree savanna, occasionally alternating with shrub savanna, and a riparian layer along the Mahoun River and its tributaries that consists of *Pterocarpus santalinoides, Mytrangyna inermis, Vetivera nigritana, Sporobolus pyramidalis* and *Oryza longistaminata*. Also present are various groves of *Tamarindus indica, Capparis corymbosa* and *Cissus quadrangularis*.

Tiogo Forest Reserve has a Sudanian climate with an average annual rainfall of 700-850 millimetres. The dry season is from November to April, and the rainy season from May to October.

Objectives of the self-reliance phase

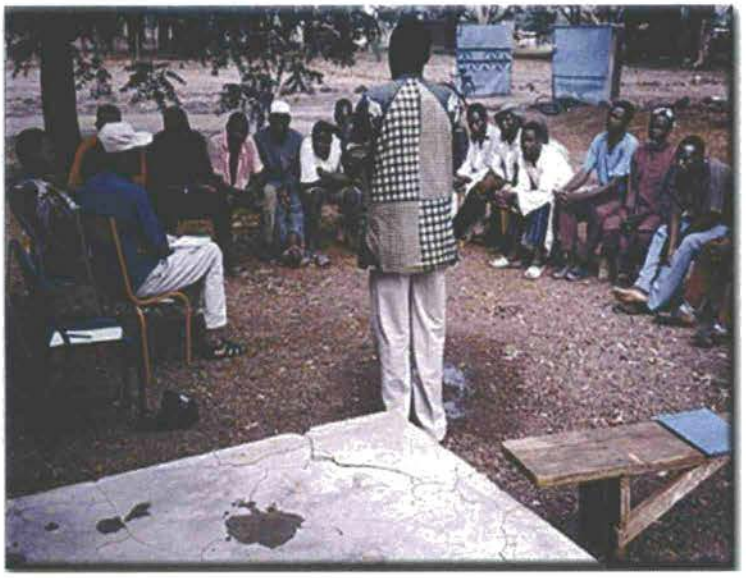
With the withdrawal of the donor, local communities took over the management of the Tiogo Forest Reserve project, with the support of national technical structures under the Office of the Forestry Commission for the Central West Region. The long-term objective of this phase of the project was to protect and regenerate natural resources, especially forests, with a view to improving living conditions in rural areas and increase the production of vegetation.

The first specific objective was to contribute to meeting the needs of populations in terms of fuelwood, building poles and forest products in general through better management of forest resources. The second specific objective was to create a favourable environment for agro-pastoral activities, thus improving soil fertility and increasing productivity.

Evaluation findings

The self-reliance phase of the Tiogo Forest Reserve project pursued the objectives of conservation and sustainable management of resources through the protection and rehabilitation of vegetation cover. This successfully preserved the forest ecosystem, which is especially important considering that rainfall levels throughout the Sahel have declined over the last decade.

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by UNDP/UNSO and local communities with funds from SIDA.



Information meeting in Tenado with GGF members and technical staff

In 1940, the Government of Burkina Faso reaffirmed the status of reserved forests through the Forest Code and the Land Reform Programme (RAF). This took place in an exceptionally political context, marked by the will to embark on three struggles with local communities, namely: protecting against stray animals, stopping bush fires and halting excessive logging in reserved forests. Populations in villages bordering the forest took over the enforcement of regulations on illegal grazing of domestic animals. Unlike other Sahelian regions, herdsmen and farmers arrived at a consensus, avoiding violent conflict. In Négarpoulou, Fulani herdsmen entered into an agreement restricting the presence of animals in the forest to the daytime only; animals must be returned to the village each night. The herdsmen agree that this arrangement is justified because it creates conditions for good regeneration of vegetation, even though they do not participate directly in the activities of the GGF. Villagers are also opposed to clandestine cropping in the forest.

Fire breaks have been established in the forest, but despite these efforts bush fires are yet to be entirely controlled. Stone cordons and small anti-erosion dykes around fields in the main villages are among the most noticeable soil erosion protection measures. These stone cordons were erected by local people with the assistance of NGOs such as Projet de Développement Intégré dans les Provinces du Boulkiemdé et du Sanguié (PDISAB).

Rehabilitating vegetation

Protection and rehabilitation go hand in hand as communities continue to practice the lessons learned during the UNSO phase of the project. GGFs have largely mastered the production of planting materials as well as direct seeding and planting seedlings of forest species. To this must be added a good mastery of harvesting techniques, thus enabling the production of offshoots and inducing good regeneration. In the three villages visited, thousands of eucalyptus and some fruit tree seedlings are produced in pots.

Direct planting, on the other hand, which consists of placing the seedling in a half-moon shaped hole filled with manure, poses problems because these areas are prone to drought and open to bush fires, and because of a general lack of mastery of planting techniques among the population. As a rule, results obtained through direct planting in the Tiogo Forest Reserve are low, and call for a critical reassessment of techniques and the introduction of alternative methods.

Sustainability and replication

Sustainability of the above conservation measures was measured by the following indicators of success:

- Populations accept the status of the reserved forest and relevant restrictions. Sustainability is guaranteed by a lasting complementarity between populations and forests.
- Forest resources are available in sufficient quantity to justify harvests. Farmers have mastered efficient harvesting techniques that contribute to the regeneration of these resources. However, the completion and implementation of a management plan would encourage greater sustainability in the exploitation of resources.
- Herdsmen have reorganized their grazing systems, returning their herds to the villages every night to avoid uncontrolled grazing in the forest reserve.

Local people are actively involved in protecting and rehabilitating the forest. Villagers respect the reserved status of the forest, with all of its constraints and restrictions. The exploitation of wood and other resources is rational, done according to generally well-mastered methods and techniques without a negative impact on the forest resource. The sustainability of this experience, however, could be jeopardized in the long term by the low level of control of bush fires, whose adverse effects on the regeneration process are acknowledged by all concerned. Better mastery of direct planting techniques would also help in the reforestation process.

The prospects of replicating this project are encouraging, as costs are low and conservation and regeneration techniques are

Wood ready for transportation to market

relatively simple. Villagers have reported considerable improvements in their standard of living. Similarly, women have seen the time devoted to fetching wood reduced with the adoption of improved stoves. A return to the old, unsustainable ways is unlikely because, as one villager in Ténado says, "once you taste something good, you just do not stop wanting it." Two neighbouring villages, Tielivele and Poa, have now joined the programme because they were impressed with the achievements they witnessed in Negarpoulou.

Social capital

The village woodlots programme has introduced profound changes in the interplay between populations and resources in the Tiogo reserved forest, effectively ending a long process of degradation. The Government's role in the regulation and organization of forest resources has stabilized the interaction of various groups of forest users (contractors, foresters, *dolo* brewers, retailers, rural and urban households) and made distribution of access more equitable.

Improved stoves or 'dolo' fabrication

Overall, the experience gained in the framework of theTiogo Forest project can be summarized as follows:

- There are visible changes in perceptions and attitudes towards forest use and management. Communities are aware of the need to conserve forest resources because of their economic value as well as their other uses, such as traditional medicines.
- New methods for seedling production, planting and resource harvesting have continued long after after withdrawal of donor support. Linear erosion control, through the establishment of small anti-erosion dykes (stone cordons) has been implemented through new training sessions. The most significant aspect lies in the fact that these training sessions took place during the self-reliance phase, which suggests that there is awareness of the interplay in the various factors influencing the degradation of resources (linear erosion and degradation of the canopy, for example).
- It is clear that the introduction of improved stoves has had a positive impact on women's daily workload. The use of improved stoves reduces the consumption of fuelwood, and thus the amount of time spent by women in fetching it. The time saved can be dedicated to other activities. The impact of improved stoves is also appreciated by contractors, who speak of a "falling off of hassle," that is, less pressure from clients. Similarly, *dolo* brewers view this situation as a means of substantially reducing their energy bill. The manufacture of improved stoves is also an employment-generating activity for both men and women.
- Capacity-building in organization and negotiation was brought to the forefront with a conflict that arose over the price of wood. Reports on activities concerning the management site in Tiogo area point out a persistent claim by GGFs for an increase in the price of the cubic metre of wood, which had been set by the Government in 1985. To put an end to this claim, negotiations were initiated during GGF general assemblies with national and regional authorities. Unable to reach a satisfactory solution, GGFs decided to stop selling wood to contractors in April 1998, which prompted the central authorities to request direct negotiations between foresters and contractors. For lack of agreement on the price of the cubic metre at CFA 2,500, as demanded by foresters, the Government set the new price at CFA 2,200. The idea of pursuing and defending their own interests has taken root among foresters, even if their claims were met only partially. They are aware of their strength, which may contribute to changing relationships with the Government and contractors.
- Intra-community relationships have benefited from better organization of forest areas and activities. The typical case is the reorganization of pastoral practices in the agreement between herdsmen and farmers. A sentiment of accountability *vis-à-vis* the resources of the Tiogo reserved forest encourages the local communities to fight illegal exploitation and the destruction of the forest resource by outsiders.
- Community investments facilitated by revolving funds have evolved with the withdrawal of donor support. Achievements include: the rehabilitation of schools and roads and the construction of culverts and village maternity centres.

Conclusions

The improved management scheme of Tiogo reserved forest reveals several positive points:

- Local income is generated through the sale of green wood and fuelwood, following a well-organized programme of clearly defined allocation of resources.
- These sales are directly profitable to GGF members and indirectly benefit non-members, who enjoy better infrastructure financed with income accruing from sustainable forest resource management.

- The harvesting and sale of wood have generated jobs and put a brake on rural exodus.
- The adoption of improved stoves by rural households, especially women, allows considerable savings in terms of energy and time.
- Foresters have learned to negotiate with the Government and other partners and better defend their interests.
- Sustainable harvesting methods have facilitated the regeneration of tree species.
- New villages have joined the programme because of its overall positive results. Certain aspects likely to jeopardize the outstanding outcomes of this experience, such as the lack of a management plan that would enable better planning in the utilization of forest resources, as well as offset discouragement from problems connected to the producer price policy, have,however, been noted. Despite these considerations, the management programme of Tiogo reserved forest can be considered a success in desertification control.

References

Chantier d'Aménagement de Tiogo (1998). Rapports trimestriels d'activité Mars 1997, Juin 1997 et Mars 1998.

Guinko Sita, Zoungrana I., Zoungrana Y.C., Boussim I.J., Belem M., Diallo A. et Sawadogo, L. (1991). Etude agrostologique de la forêt classée de Tiogo, Province du Sanguié - Projet Boulkiemde - Sanguié. Bois Collectif Villageois.

Projet UNSO / DES / BKF / 89 / X04 Bois Collectifs et Familiaux - Boulkiemde - Sanguié (1991). Rapport d'activités 1989 - 1990 et Programme Prévisonnel 1990 - 1991.

Projet UNSO / DES / BKF / 89 / X04 Bois Collectifs et Familiaux - Boulkiemde - Sanguié (1993). Rapport d'activités 1991 - 1992 et Programme Prévisionnel 1992 - 1993.

Projet UNSO / DES / BKF / 89 / X04 Bois Collectifs et Familiaux - Boulkiemde - Sanguié (1994). Rapport d'activités 1992 - 1993 et Programme Prévisionnel 1993 - 1994.

Projet BKF/ 89 / 011 Aménagement des forêts Naturelles pur la sauvegarde de l'Environement et la production de bois (1993). Procédures d'Administration financière - Chantiers d'aménagement des Forêts.

Quattara T.N. (1997). Chantier d'Aménagement de Tiogo - Programme prévisionnel d'Activités 1998.

Societé Africaine d'Etudes et de Développement (SAED) (1984): Enquête socio-économique sur « Bois Collectifs et Familiaux » de la Forêt Classé de Tiogo.

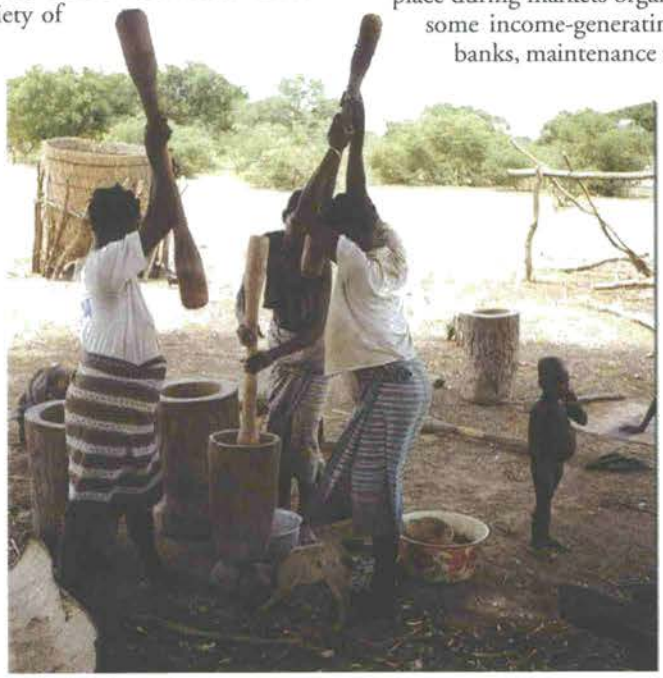
Enriching Soils Naturally

The Zabré Women Agro-Ecological Project on Education, Training and Food Security, Burkina Faso

Established in 1987 by the Association of Zabré Women, better known as the Pag La Yiri (PLY) Women's Association, to work for the improvement of agricultural productivity through better management of soils, this project involved the preparation and intensive use of compost and manure on peanut, millet, soybean and vegetable fields, as well as water erosion control through the construction of bunds and stone cordons.

Through the use of organic fertilizers, the women were able to improve the soil structure and fertility of their gardens, resulting in a significant increase in agricultural productivity. These results were met with so much enthusiasm that many more women joined the association, along with other new actors such as men and herdsmen who contributed to making the compost. Local incomes have increased considerably, thus allowing farmers, and the women in particular, to achieve better living and working conditions.

Beginning with this success, PLY's activities have now diversified to include a variety of other projects: improving mother and child health, processing fruit and vegetables, establishing cereal banks, initiating a savings and loan scheme, and even managing a filling station. Though these new activities may appear to compete with the original agro-ecological project, they are in fact complementary and indispensable to the improvement of working conditions and to the association's greater financial autonomy.



Pulling together: Zabré women pound grain

PLY carries out activities in three provinces of Burkina Faso: Boulgou, Yatenga and Zoundwéogo. The organic fertilizer and green manure project initiated by this association is carried out in the various administrative units (départements) in these three provinces. This report, however, deals only with the Département de Zabré, located 185 kilometres north of Ouagadougou, in the Sudanian Sahel part of the country. The climate here alternates between a long dry season from November to May and a rainy monsoon season from June to October. Rainfall varies between 5.8 millimetres in March to 204.4mm in September; the annual average from 1993 to 1997 was 883mm.

According to the latest census (1985), there were 84,274 inhabitants in the Département de Zabré (PQD, September 1997). With an annual population growth rate of approximately 2.8 per cent, the current population is estimated at 100,000 residents, most of whom are very young (60% are under 20). The average density is relatively high (56/ km^2).

The economic activities of the area are dominated primarily by agriculture and traditional sedentary and nomadic cattle rearing. There are many constraints to efficient agricultural production, among them a lack of fallow periods, very low organic matter content, and difficulty in accessing credit for inputs such as chemical fertilizers. Pastoralists are faced with rustling and animal health problems.

Commercial activities are embryonic; the bulk of trade takes place during markets organized every three days. There are some income-generating projects (millet mills, cereals banks, maintenance units, etc.) as well as a number of governmental and non-governmental development support services.

To begin the composting project, the association requested and obtained training sessions in agro-ecology at the Pierre Rhabi Centre in Gorom-Gorom, northern Burkina Faso. The training initially involved 25 women from various villages in the zone, and focused on techniques for making and using compost.

The long-term objective of the project was to control land degradation resulting from drought and poverty, and to improve the living conditions of local communities, especially women. Specific objectives were to restore the fertility of soils through organic improvement techniques, since chemical fertilizers are inaccessible to farmers; to control land erosion through simple techniques; and to promote income-generating activities to improve the living conditions of the communities in general, but especially the economic status of women.

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by Centre Ecologique Albert Schweitzer, Switzerland, and Zabre women groups, with funds from private Swiss foundations and New Planet.

The evaluation of the composting project reveals many positive aspects, including the following:

- *Soil fertility improvement*: The uninterrupted use of soils not only has adverse effects on yields but also provokes accelerated degradation of land, making it prone to wind and water erosion. Composting has contributed not only to increasing soil fertility and yields (a twofold increase in most cases), but also to the opening of agriculture of lands previously deemed sterile.

- *Measures for the protection and restoration of soils, and the reduction of water erosion*: Excessive deforestation and mismanagement of soils have encouraged erosion. The addition of compost to the soil to improve fertility cannot, therefore, have any benefit if it is not accompanied by measures aimed at preventing the erosion of added improvements.

- *Training of trainers in water and soil conservation*: The construction of bunds and stone cordons has now been mastered by both men and women, enabling the recovery of degraded lands and hillsides.

- *Seedlings for agroforestry*: These activities are easily noticeable in vegetable gardens, where trees are mixed with other crops.

- *Improving agricultural yields*: The application of organic fertilizers (compost, manure) and green manure have increased yields significantly.

Diversification and sustainability

Five women were responsible for the establishment of PLY in 1975. Today, the association brings together 11,000 members (women and men), through 703 grass-root groups in 200 villages. Composting activities started with a group of 25 women who received the initial training. From this group the activities were spread to more than 8,000 other farmers. Organic matter is the only source of fertilizer used in communal and individual peanut and cereal fields and vegetable gardens.

From initiatives aimed at improving agricultural productivity and food security, PLY's activities have become much more diversified, with the main objective of removing constraints to more active participation of women in the local development process. New projects include mother and child health (family planning, better nutrition), primary health care and village pharmacies. In general, however, the new activities are designed to support traditional subsistence, including processing of agricultural products, the production of shea butter, natural insecticide (from neem trees) and soap, weaving, the sale of drinks, and the management of a filling station.

These activities may appear to have no connection with farming, but members are nevertheless unanimous in recognizing that diversification is indispensable and complementary to agriculture, their main activity. For example, misola flour for children suffering from malnutrition is made from peanut, soy and millet cultivated in individual or community fields, and income drawn from the refreshment stall and the filling station are invested in agricultural activities. The diversification process has yielded several key benefits:

Vegetation and stones are used to build anti-erosion dykes

- Improvement of living conditions for women and the entire community, from increased incomes.
- Literacy classes and training in management techniques and agriculture create more awareness and participation.
- Better awareness of excessive dependence on external funding, and a quest for financial autonomy in the medium to long term through the development of income-generating activities, such as the conservation and processing of agricultural products and the management of the filling station and refreshment stall.
- Education in savings and credit.
- Further decentralization of decision-making.
- Less social conflict.

The achievements of the agro-ecological project are judged as excellent by most observers. The significant increase in yields and in the quality of production resulted, however, in the arrival of new actors, i. e. men and herdsmen who now refuse to let women collect dung for compost-making. Despite the income they could generate from the sale of dung, the price for a cart having increased from CFA 250 to CFA 500, they refuse to sell it, preferring to maintain their compost and manure pits and to spread the manure in their own fields.

Replicability

The growth in association membership, eventually bringing together as many as 11,000 active members in the project, is solid evidence of the replicability of the project. The Savings and Credit Co-operative (COOPEC) launched in 1990 with 23 members, boasted 390 members in 1998.

Agriculture remains the main land use/income-earning activity, either in vegetable gardens or in individual and community cereal and peanut fields. The diversification of activities takes into account not only the complementarity between activities, but also their financial profitability. Replication has been made possible by the use of simple techniques and forms of organization; the training of trainers in basic literacy and post-literacy and basic French; the use of locally available and inexpensive inputs; sound organization and an increased sense of responsibility; and the exchange of experiences with organizations in other regions.

Social Capital

Before the establishment of PLY, interventions in rural areas fell mainly under the responsibility of the Government, through pastoral promotion centres, and regional departments of environment and forestry).

The launching of PLY's endeavours in 1975 triggered the establishment of many associations, all of which are striving for self-improvement in the rural areas.

The impact of the agro-ecological project as the first activity of PLY cannot be dissociated from the impact of the association itself, especially regarding the status of women. To better understand the qualitative changes that have occurred, it is necessary to recall that the condition of rural women depends to a large extent on their status in society. In the PLY zone of intervention, 'they have the status of wives, mothers and workers. They are encouraged to have as many children as possible' (PQD, September 1997). 'Tedious and multiple domestic chores leave no time for women to participate in literacy, education and training activities intended for them' (PQD, op. cit.). In general, women have no say when it comes to making decisions concerning family life or managing crop production from family fields, even though they have to bear the brunt of most expenses, including education, child support and school fees.

The following conclusions can be drawn:

- Female members of the association are generally more open-minded than non-members, and have a higher economic and educational standing. They are more confident, can express themselves better in public and have a more positive image of themselves. Today in Zabré, it is impossible to make important decisions without the participation of women.
- The impact of PLY is remarkable at a variety of levels, including food security (with the creation of cereal and vegetable banks) in a zone where there was a critical production gap, sometimes resulting in food shortages and malnutrition; literacy in national languages; agricultural equipment; the struggle against environmental degradation, and the improvement of soils cultivated using newly popularized organic fertilizer production techniques.
- With 11,000 members, PLY is the most important women's organization in Burkina Faso. It is a powerful means of lobbying in the struggle for more equity and social justice.
- The elevation of women's aspirations has increased their capacity to take up challenges, a major factor contributing to development.
- Thanks to PLY, many women now have much greater access to knowledge (literacy, practical training), which frees them from ignorance, poverty and domination by men.

In many respects, the experience of PLY has generated substantial direct or indirect benefits. Among the direct benefits:

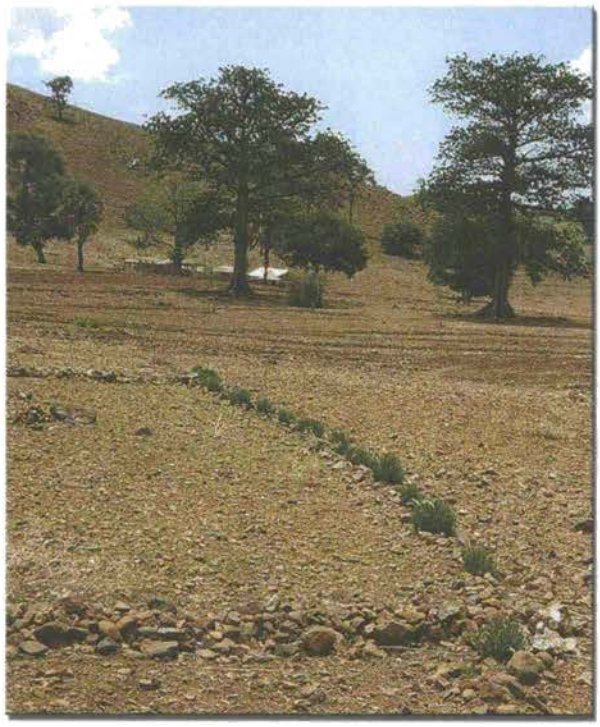
- Actions undertaken in the framework of PLY activities that started with the agro-ecological project (awareness raising, literacy, education and training) have allowed women in this region of Burkina Faso to gain more political, financial and socio-cultural power.
- There is now far more regular income for women who were busy previously only for part of the year with rainfed crops, from which they drew little profit because of the critical decline in soil fertility and frequent drought. This income is generated mainly through the sale of vegetables and cereals, whose yields have notably improved with compost and manure. Where they hardly obtained five millet bags from previously exhausted lands, they now obtain up to nine bags of much better quality grain. With the diversification of activities, income is also generated through the sale of beverages and gasoline.
- Savings made possible from this income give them access to small loans for the acquisition of agricultural equipment or for commercial operations. PLY has set up a modern and flexible savings and credit system, for which the membership fee is CFA 500, with an annual contribution of CFA 600. A membership share in the Savings and Credit Co-operative (COOPEC) is CFA 2,500 and all members can obtain a loan of up to CFA 50,000. Established in 1990 with 23 members, the cooperative today has 390 members and ready cash reserves of CFA 11 million.
- New jobs: Socio-economic units are generally managed by women (this is the case with the village pharmacy in Zabré). All the activities that are closely connected to agro-ecology, such as the processing and conservation of fruits and vegetables, the preparation of natural insecticide (from neem trees and tobacco) or of flour for children suffering from malnutrition, are the responsibility of persons paid by the association. Literacy and training in management and basic French have become conditions for access to these jobs. One also notes the participation of female organizers in the agro-ecological project (12 such organizers were recruited directly by the association). In addition, there are female trainers in literacy and in basic French, a secretary, a communication officer, a driver, a guard, nursery attendants and a coordinator in Ouagadougou with limited support personnel.
- Infrastructure: PLY has built a school for girls, the objective of which is not only to fill the gap in girls' schooling but also to propagate the basic tenets of PLY.
- Marked improvements in living conditions and child and mother health.

- Improvement in the status of women and better understanding by men of the complementary role played by women and, consequently, better relationships within families;
- Better management of funds for the public school. Indeed, misappropriation of funds contributed by parents was previously the rule; since the establishment of the Savings and Credit Co-operative (COOPEC), the school has its own savings account.

Apart from the use of compost for the regeneration of lands and erosion control, the commitment of PLY women to natural resource and environmental protection is evident through their reforestation programmes and the production of seedlings, the popularization of improved stoves to offset deforestation (the association uses solar driers to process fruits and vegetables) as well as education and sensitization on environmental issues in the region in general, and within the association in particular.

The main objective of the Zabré women agro-ecological project was to enhance soil fertility in order to increase agricultural productivity and improve food security. In this process, needs assessment led to the organization of a number of other activities with a view to diversifying and generating income likely to improve general living conditions and, in particular, to create future opportunities for financial autonomy.

These activities have not overshadowed the imperatives of environmental preservation, which still have a proud place in the association's programmes, through intensified use of compost to abate land degradation, soil protection and restoration through anti-erosion control (construction of bunds and stone cordons), agro-forestry (production of seedlings and reforestation), and environmental education. Although some achievements remain to be strengthened, especially those relating to the regeneration of vegetation, the project is nonetheless a success in the struggle against land degradation and desertification.



Compost pit and anti-erosion dykes in Pakoungou.

References

Diallo, O.F. (1994). Rapport annuel et de Programmation des activités.

Diallo, O.F. (1995). Rapport annuel et de Programmation des activités.

Diallo, O.F. (1996). Rapport annuel et de Programmation des activités.

Kabore, V. (1994). le Projet Agro-écologique des Femmes de Zabré, AE Echanges SA / DDA-CEAS -Rapport d'évaluation.

Traore, D. et al. (undated). Auto-évaluation Assistée de l'Association Pag-La-Yiri. Rapport Final.

Traore, D. et Nignan, M.S (1997). Programme Quadriennal de Développement 1998-2001 de l'Association PLY.

Back from the Brink

Desertification Control Through an Integrated River Basin Management Approach to Soil and Water Conservation, São João Baptista Valley, Cape Verde

Located approximately 20 kilometres from Praia, the capital city of Cape Verde on the island of Santiago, São João Baptista Valley is one of the most arid, isolated and poorest areas in the Cape Verde Islands. The upper reaches of the valley extend to 1,300m above sea level (Pico d'Antonia, the highest volcanic mountain on the island), while the lower valley drops to sea level over a distance of approximately 14 km. The river basin is located in the rain shadow of the island of Santiago's central volcanic mountain range.

Trickle irrigation for vegetable production

Under the auspices of UNSO, projects to combat desertification in the São João Baptista Valley have been carried out for many years. From 1976 UNSO provided special funds that enabled sporadic and uncoordinated construction of flood and erosion control dams and slope stabilization structures. After a massive flood event in the valley in 1984, which caused loss of life, widespread erosion and destruction or damage to all pre-existing flood and erosion control structures, UNSO funded a major two phase project in the valley which lasted for eleven years, ending in 1995. Any activities that continue in the valley are a result of initiatives of valley residents, responses from Government departments, or from Cape Verde NGOs. There were three phases of the original project.

The overall goal of the first phase of the project (1985-1989) was to control all forms of erosion, increase the amount of flat or low-slope land suitable for cultivation, and increase groundwater infiltration rates. Specific goals for Phase I were: to implement an integrated and coordinated approach to river basin management; to construct multi-purpose structures to control flooding, reduce soil erosion and to increase rainwater infiltration and groundwater recharge; to reforest plateaus and slopes (to stabilize slopes and reduce soil erosion by water and wind); and to improve local incomes. The approved budget for the project was US$ 1,056,013, funded through UNSO with support from the Government of Norway and in-kind contributions from the Republic of Cape Verde.

The second phase (1990-1995) employed the same set of goals and added two more: to increase the participation of local residents in all aspects of the project, and to improve the socio-economic condition of the residents of the valley. The adoption of a participatory approach in mid-1992 meant that local residents were afforded the opportunity to identify their priorities, resulting in a significant re-orientation of the project and the emergence of a detailed set of sub-objectives, namely: a primary focus on improving the supply of water for irrigation and the development of a more diversified cash crop agriculture; strengthening of other forms of income generation; development and improvement of existing infrastructure, and the establishment of local organizations to support these initiatives after the termination of the project.

Members of the newly established organizations continue working to meet their priorities in the post-project period. Some national agencies have moved in to continue support to some of the project's initiatives.

Environmental problems in the valley

The long-term problem which the sequence of projects, under the title 'Battle against Desertification in the São João Baptista Valley, Cape Verde', addressed is two-fold – a problem of aridity and of water erosion. Mean annual rainfall in the valley ranges from a high of 667 mm at Curralinho (sub-humid zone) to a low of 78 mm at Chao d'Ingreja (arid zone). Periodic droughts extend over several years, during which no rain at all may fall in the arid zone (20% of the valley area) and semi-arid zone (60%) and very little in the sub-humid zone (20%). There are high evapotranspiration rates throughout the year.

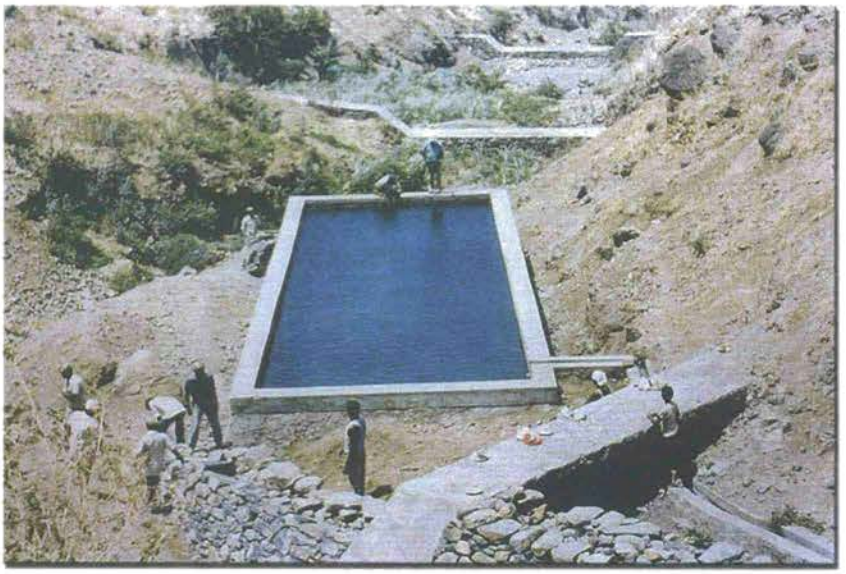
Torrential rainfall from occasional summer thunderstorms, leading to rapid runoff from steep slopes, causes massive erosion. Coupled with overgrazing and occasional catastrophic flooding, this means that natural vegetation is sparse or nonexistent. Rain-fed agriculture is impossible in the arid zone and unreliable in the semi-arid and sub-humid zones. Irrigation is possible only where there are natural springs, as in the upper river basin, or

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by UNDP/UNSO and local communities with funds from the Norwegian Government.

where irrigation works have been constructed.

Economic problems

The major economic problem for the inhabitants of the valley is the paucity of natural resources relative to the valley's population. While soil fertility is not a significant problem in the valley, since soils are derived from young mineral-rich volcanic materials, there is little flat land, or sloping but stable land, available for cultivation. The valley population was estimated to be 1,901 in 1980 and had grown by 34.4% (annual growth rate about 2.5%) to 2,555 in 1990. Just over 50% of the valley population is under the age of 16. As a consequence the natural resources of the valley are insufficient to maintain the population even at the most basic subsistence level.



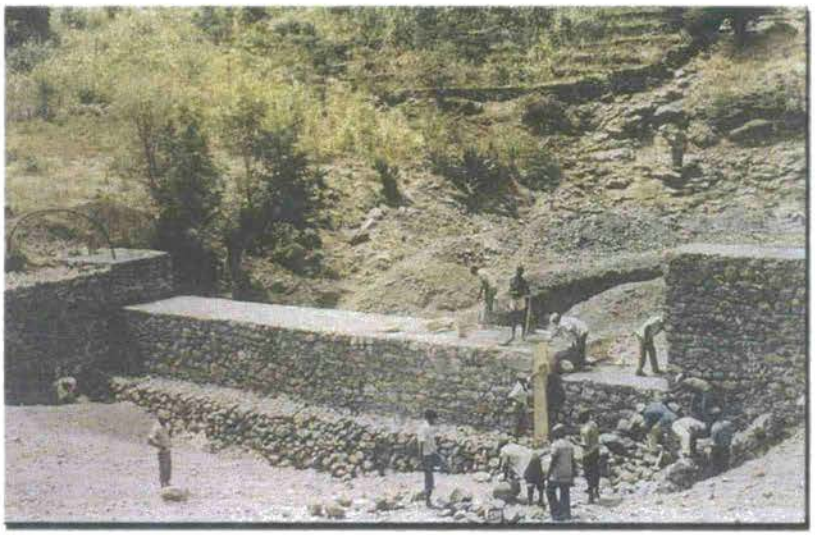
Construction of a catchment channel, reservoir and erosion control masonry

There is a lack of sufficient moisture for rainfed agriculture (primarily the cultivation of maize and beans) throughout the river basin, and especially in the arid and semi-arid zones in the central and lower part of the river basin where rain is insufficient to produce crops more than one year in five. Year-round productive arable land (which means irrigated land) in all zones is almost non-existent, and there is very little forage (edible low-growing herbaceous plants, trees and bushes) available for livestock (primarily goats and cattle), which are the primary form of agriculture in the arid and semi-arid zones. There is also very little and sparsely distributed wood for domestic use or sale.

Household incomes are supplemented by remittances sent by family members who have emigrated from the valley, and by income earned from manual labour on public works programmes (the Cape Verde system known as FAIMO), when such work is locally available. According to project data (survey 1992), 61% of household income comes from manual labour on public works, 13% from remittances from individuals who have migrated, 4% from livestock, 1% from crops and 21% from other unspecified sources. Of 442 households surveyed in the valley, 21.5% practice no arable agriculture, 28% subsist on rainfed agriculture, 46.4% depend on a combination of rain-fed and irrigated agriculture, and 4.1% carry on arable farming on irrigated land only. Households or individuals who are able to generate some surpluses from livestock husbandry, wood or agricultural products face the difficulty of marketing very small quantities of products, transporting products to markets in Praia, and of obtaining even the smallest amounts of credit to replenish supplies of seeds or livestock.

Social, administrative and organizational problems

The environmental and economic problems of the valley are compounded by a very dispersed settlement pattern (many of the villages are scattered clusters of houses rather than tight nucleated settlements), and the fact that there is virtually no public or community infrastructure and very few services in the valley. Prior to the São João Baptista project, the road into the valley from the nearest town of Cidade Velha was impassable for much of the year, and did not extend much beyond Belem, half-way up the valley. There were no schools, health posts, or public telephones, though each of the major settlements had a church. There was no effective local public administration to bring improvements in infrastructure or services. Prior to the São João Baptista project, there were no local organizations, associations or cooperatives of any kind. Organizations were forbidden during the Portuguese colonial period, and after independence in 1975, the Government continued to be highly centralized. Efforts by the Government to form cooperatives or other community associations were resisted by a population for whom the household or set of related families was, and still is, the primary social reference group.



Construction of a major flood control dam and valley bank protection walls

Problems unique to women

Women in the valley experience particular difficulties. For example, 45% of households are headed by women. Male-headed households are two times more likely than female-headed households to have access to irrigated land. When women are hired on the FAIMO, they generally carry out the least skilled (and often heaviest) tasks at the lowest pay rates. Since water is so scarce, women often have to walk long distances up and down steep hillsides to fetch water for domestic use, several times a day.

Community members build an irrigation channel

Environmental outputs and impacts

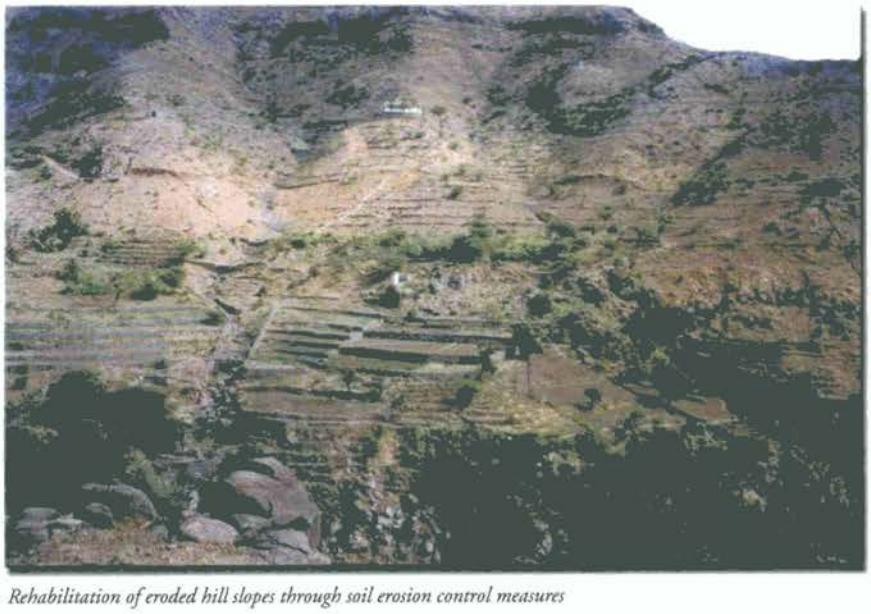
The São João Baptista Valley Project focused almost exclusively on implementing erosion control measures for the first seven and a half years of the two-phase project, utilizing immediately available materials (basalt rock and stones - only cement and some sand had to be brought in) and local low-cost manual labour on all construction sites. Targets were met for the construction of flood control and erosion control structures and ground water infiltration measures, including: one major and 25 minor masonry flood control dams in valley bottoms and on tributaries; 243 new major and minor rainwater catchment dams and gully erosion structures and 119 reconstructed; many hundreds of metres of dry stone and earth retaining walls on valley slopes; many hundreds of dry stone halfmoon structures on valley slopes; 858ha reforested and 95.5ha replanted and used for firewood and fodder for livestock; and 5.3 km of new road constructed.

Irrigation works did not become a project priority until late 1992, when valley residents participated in needs and priorities identification. The project nevertheless made considerable contributions to increasing the quantity and reliability of water, both for irrigation, domestic use and the use of livestock, largely because local residents worked harder and were better on paid projects, and also contributed their labour voluntarily for several irrigation projects when they felt that the projects were of some direct benefit to themselves and their families. As a result, the project completed:

- Seven km of reinforced irrigation channels, benefiting 245 households;
- Five large reservoirs, benefiting 47 households;
- Twenty-four small reservoirs, benefiting 24 households;
- Twenty-one wells, benefiting 21 households; and
- Six family cisterns, benefiting 6 households.

Working with newly formed local irrigation associations and groups, the project also assisted in the acquisition of 13 motorised pumps, and tubing for the installation of a drip irrigation system. The project also:

- Adopted and successfully implemented an integrated physical and biological approach to river basin flood and erosion control, which is now a model for other similar projects;
- Sought out and utilized multi-purpose flood and erosion control measures that not only reduced erosion, but also increased the amount of cultivable land and contributed to increased groundwater recharge and soil moisture retention, again a model for similar projects;
- Adopted an approach to river basin management in which erosion control measures were implemented from the headwaters of the basin and sub-basins progressively downstream, and from the upper valley slopes to the lower slopes (with two notable exceptions, construction of a major erosion control dam in the valley bottom mid-way down the valley in Phase I, and in the last two



Rehabilitation of eroded hill slopes through soil erosion control measures

years of Phase II, construction of irrigation works of high priority to local residents), which has been adopted as a guiding principle at the national level.

Sustainability of project initiatives depends in large part on the successful establishment of systems to continue to maintain, and even expand, initiatives taken by the project. For example, DEGASP has located a field office in the valley at São João Baptista and, with four field staff, offers technical and agricultural extension support, and the National Forest Service has a system of guardians to protect against over-grazing and over-cutting of reforested areas, although residents say they do cut wood without permission on occasion.

Economic outputs and impacts

During the first phase of the project and the first half of the second phase, the project's economic goal was to generate employment and increase incomes through the use of local labour on all construction projects. In any one year, upwards of 250 people were employed for nine months (the summer months being the planting season) on a daily basis, earning between US$ 2.00 and US$ 4.50, depending on their skills. Both men and women were employed on the project, although men generally occupied better positions, and earned proportionately more. Individual gains from employment with the project were small, but they undoubtedly made an important contribution to household incomes. While this level of employment is not sustainable, some employment through the FAIMO system continues to be available to local residents, for work on major repair of erosion control works and on road reconstruction.

Reforestation measures carried out by the project (and by other projects in the valley) have increased the total quantity and accessibility of wood for domestic use and for sale, although residents still comment on the scarcity of wood, the distance they have to travel to obtain it, and bemoan the fact that they do not have free access to much of the reforested land held by the state and absentee landowners. The quantity and accessibility of fodder and forage for livestock has similarly increased, both for local use and for exchange or sale, although the National Forest Service imposes restrictions on use, in large part to protect the plantations from overgrazing.

The project increased the amount of arable and irrigated land, both through siltation of fine material behind dams, and through construction of irrigation works. In the last two years of the project it worked directly with farmers, encouraging them, through the use of demonstration plots and data on the higher productivity and marketability of a wide variety of crops new to the valley (carrots, onions, tomatoes), to shift from growing sugarcane to higher value crops, including sweet potatoes, manioc, and, most particularly, vegetables (which increased from 0 ha in 1990 to 3.2 ha in 1995). As a result, the area occupied by sugarcane, which is used primarily for the production of rum, has declined slightly, and farmers are continuing to shift to higher value and more marketable crops, particularly vegetables. The local diet is traditionally based on maize and beans. While most vegetable crops are sold outside the valley, to Praia or beyond, there is some prospect that local diets may improve over the long term, with a greater variety of vegetables in the diet.

The project worked with women in several of the villages to increase their production of small livestock (chickens and pigs) by providing them with starter stock, assistance with preparing chicken houses and pig pens, information on rearing, and assistance with marketing. In the short term this contributed to improved incomes for the women who participated. However, without technical and marketing assistance from the project, most of the women have not been able to continue rearing improved small livestock, and express their disappointment that the supports are no longer there.

Positive and sustainable economic outcomes include: the gradual adoption of horticulture and higher value market garden crops now supported by the extension work and field office of DEGASP; farmer-to-farmer demonstration of the income-generating value of market gardening; expansion of the amount of terraced and irrigated land (albeit on a very small scale); a gradual increase in the amount of irrigated land, now that the communal and individual water sources are more reliable due to improved infiltration and higher ground water tables); and cultivation of the tiny areas of new soil accumulating behind catchment dams.

Social outputs and impacts

In Phase II, the project adopted a genuinely participatory approach to local needs and priorities, as well as the promotion and support of community organizations, with several important consequences. For example:

- Participation of local residents in identifying individual and collective priorities, which resulted in more emphasis on irrigation systems (irrigation channels, community and individual reservoirs, community and individual wells, motorised and wind-driven pumps);
- Establishment of a more flexible approach to the organization of labour gangs (more flexible hours and work closer to place of residence), which resulted in greater productivity and higher quality work;
- Establishment of several community-level organizations, including two formally organized irrigation associations and five informal irrigation groups in valley communities;
- Establishment of work contracts for the irrigation associations to provide labour for locally identified irrigation priorities;
- Provision by association members of voluntary labour for locally identified priority works;
- Establishment of an agricultural producer cooperative for the purchase of agricultural inputs and the sale of produce;
- An attempt to establish women's organizations that would work to meet the needs of women in valley communities;
- An attempt to establish a small-scale credit system, or *Caisse*.

The participatory approach adopted by the project in its final two years enabled local residents, particularly men, to define and achieve some of their individual and collective priorities. They were able to see and be proud of what they could achieve,

understand that they can work to achieve these goals, and insist that agencies respond. Also, the project achieved considerable success in establishing functional irrigation and agricultural producer associations.

The project was less successful in working with women, who had no prior experience with formal or even informal organizations. A small livestock project with valley women met with limited success and was not sustainable after the technical, financial and marketing assistance that the project provided was no longer in place. Long-term and consistent programmes, rather than sporadic initiatives through individual projects, are required to assist women to meet their needs.

Similarly, although the small scale and micro-credit was quickly identified as a priority when the project began working directly with farmers, the project was not successful in finding a system to offer small-scale credit to valley residents. This continues to be a critical need for valley residents who wish to expand sale of agricultural products, but need some capitalize to do so.

Replicability

One of the strengths of the project is the extent to which the lessons are being heeded and acted on at the national level by key Government agencies, such as DEGASP and INIDA. The major contribution of the project at the international level was the demonstration that a holistic approach, combining biophysical, socio-economic and participatory objectives, is feasible, and has the potential to achieve significant success across all three areas. The São João Baptista Project is, indeed, a success story in the fight against desertification, and has contributed significantly to the lives and livelihood of residents.

References

Document Informatif sur les Changements Envisagés et des Possibilités Socio-économique de la Participation Populaire en Vue de la Phase III du Project (1994). Project de la Lutte Contre la Désertification dans la Vallée São João Baptista, Ministère de la Pêche, Agriculture et Animation Rurale, Direction Générale de l'AgriculturŒe, Sylviculture et Elevage, UNSO/CV1/90/XO1, July.

Englebrecht, A.K. (1995). Document du Project (Ist Ebauche), Project de Développment Rural Intégré et Participatif dans la Vallée de São João Baptista, Cap Vert, June 1995 Englebrecht, A.K., Rapport de Fin d'Affection, (Juillet 1994-Juin 1995), Project de la Lutte Contre la Dé sertification dans la Vallée de São João Baptista, Phase II, UNSO/CV1/90/XO1.

Haagsma, Ben (1994). Report on a Short Consultancy to the São João Baptista Valley Project, Cape Verde, UNSO/CV1/90/XO1.

Konate, Yaya (1995). Rapport de Fin d'Affection, Project de la Lutte Contre la Désertification dans la Vallée São João Baptista, PhaseII, UNSO/CV1/90/XO1.

Rapport d'Evaluation Participative (1995). Programme de la Lutte Contre la Désertification dans la Vallée São João Baptista, Phase II, 1995 UNSO/CV1/90/XO1, December 1995.

Rapport de Fin du Project (1997). Project de la Lutte Contre la Désertification dans la Vallée São João Baptista - Phase II, Bureau des Nations Unies Pour la Zone Soudano-Sahélienne et Ministère de l'Agriculture, Alimenta tion et Environnement.

Schéma Directeur d'Aménagement de la Vallée de São João Baptista (1985). Bureau de Service du PNUD, UNSO.

Schema Directeur d'Amenagement de la Vallée de São João Baptista - Ile de Santiago (1993). Actualisations de 1992, 1993 Programme de la Lutte Contre la Desertification dans la Vallée de São João Baptista, Phase II, Bureau de Services du PNUD, UNSO/ CV1/90/XO1.

Queens of Drama and Development

The Suntaa-Nuntaa Rural Women Project on Sustainable Livelihoods, Environment protection and Development, Upper West, Ghana

The UW region is located in the Sudanian climatic zone, relatively well drained in general but, in the past ten years, subjected to significant rainfall variations, which, combined with human pressure on vegetation and soils, constitute a serious threat to the environment.

The activities carried out by the NGO Suntaa-Nuntaa are part of a desertification control initiative in the administrative Upper West Region (UWR) of Ghana, established in 1983 to bridge the economic gap suffered in thisregion. In the local language, Suntaa-Nuntaa means "Help one another, Love one another." The project was set up in 1990 to fight the degradation of resources in the UWR, working primarily with rural women. Faced with heavy domestic and farm duties, women are still confined to secondary status in this highly male-dominated society. Suntaa-Nuntaa's programmes are very diverse, covering agriculture, tree planting, bush fire control, fodder banks for cattle, improved livestock farming and drama for development.

Drama group acting out a scene of conflict over tree planting

Suntaa-Nuntaa's approach is both demonstrative and participatory. The NGO runs an experimental farm in UW and maintains a staff of extensionists well versed in agroforestry and community development. Between 1994 and 1998, women's groups mushroomed in all the districts of the region, geared to improving natural resource management in village lands. Drama for development plays a vital part in raising women's awareness, giving them space to express themselves and find solutions to the problems caused by the degradation of the natural environment.

This very effective and replicable approach is inspired by traditional values of sharing and individual and collective solidarity - *chena* and *susu* - which have produced very original forms of organization. Although certain aspects of Suntaa-Nuntaa's actions in the field need to be strengthened, by promoting new attitudes towards natural environment,its use and protection, Suntaa-Nuntaa has made headway in controlling land degradation and combating desertification.

In 1983, the government of Ghana decided to separate the Upper West Region from the Upper Region in an attempt to bridge the gap in development between the lagging Upper West area and the rest of the country. With Wa as its regional capital, the youngest administrative region of Ghana is bordered to the north and west by Burkina Faso, and to the east and south by the Upper East and Northern regions respectively.

The UW R is one of the least developed regions in Ghana. Almost 90% of the population depends on agriculture, producing mainly subsistence crops. The combination of high dependency on agriculture, erratic rainfall and dwindling vegetative cover has resulted in a high level of poverty.

The common agricultural practice in these areas is fallow farming, leaving cultivated land to regain its natural vegetative cover for a period, thereby maintaining soil fertility and structure. Due to the rapid rate in population growth, however, the fallow periods have been reduced, resulting in soil degradation and a decrease in food production.

Suntaa-Nuntaa focuses mainly on a collective approach to problem solving in the rural north of Ghana to help the local communities fight hunger, poverty and ignorance. Special emphasis is placed on agroforestry and income-generating activities for women. Traditionally in the region, women are often regarded as an unimportant group, and are seldom involved in loca leadership and decision-making roles. By 1998, the time this project was evaluated as a success story, there were 89 women's groups in Upper West Ghana, planting trees, maintaining fodder banks, rearing cattle, trading and conducting drama for development programmes.

Environmental protection and improvement

One of the most significant activities of Suntaa-Nuntaa is environmental protection through reforestation. The promotion of trees for fuel energy (99% of domestic fuel energy comes from biomass sources), land conservation and safeguarding

UNEP's "Saving the Drylands" award winner, 1999. This project was implemented by the Ghanaian NGO Suntaa-Nuntaa – "help one another, love one another" in Dagaari language, with funds from Bread for the World, UNDP PHD.

Bee hives carrying short messages

natural plant formations is a significant element in the Suntaa-Nuntaa approach. *Cassia siamea* and *Leucaena leucocephala,* two soil fertility-improving tree species were systematically distributed and planted, in association with cash crops such as melons, vegetables or fruits following the rules of good agroforestry practices. Packaging for tree seedlings was made, as far as possible, from local clay to avoid using plastic packaging, which is more costly and non-biodegradable. Pottery made by local craftsmen was also used to contain seedlings, which were planted without removing the packaging. The clay containers act as small water reservoirs in this semi-dry environment, supporting the seedlings' growth until they are well established.

In this savanna area where fires are recurrent and often devastating, bush fire control practices are also geared towards environmental protection. Fires are almost always related to human activities (slash and burn, hunting, honey gathering, end-of-year festivities, etc.). Drama performances by the groups provide an opportunity to carry clear, precise and focused messages to effectively control bush fires.

Suntaa-Nuntaa also encourages the practice of fodder banks,consisting of *Leucaena leucocephala* plantations managed by women's groups on village lands. These are protected by a fence and very closely monitored by the groups with expert advice from extentionists. Fodder banks combine agroforestry (tree planting and cash crops) with livestock management.

Theatre for Development

Suntaa-Nuntaa introduced popular drama to convey useful messages in the promotion of sustainable development. Popular drama is a practice drawn from the theory of Participatory Learning in Action, developed by Paulo Freire, a Brazilian adult education specialist, based on the idea that people get involved first and foremost in the issues that directly affect their daily lives.

Drama performances are given by grassroots communities in order to convey messages related to environmental and resource management. They are inspired by problems encountered by women's groups in daily life and follow rather strict rules of organization, monitored by leaders accepted by the members. Drama performances are often followed by discussions within the community, facilitated by Suntaa-Nuntaa agents, to identify the major issues raised and solutions suggested.

Drama groups are a vital element in the Suntaa-Nuntaa approach, providing significant leverage to motivate groups to get better organized to manage environmental and development problems and solve conflicts. It also makes it possible to maintain a conducive atmosphere for creativity and inspiration.

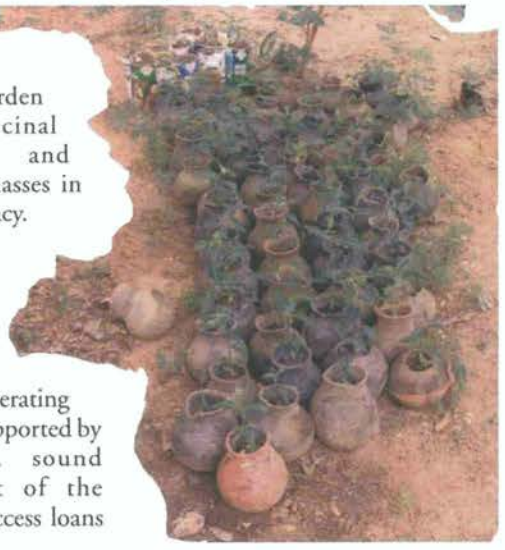
Creating income-generating innovations

Diversification of Suntaa-Nuntaa programmes is aimed at creating new sources of income for the groups. The approach is based in certain cases on traditional inter-village solidarity networks or "chena", which foster sharing to create harmony within communities. Suntaa-Nuntaa has set up an experimental farm at its headquarters in Wa, providing training in:

- Honey production: Beehives are built and provided to the communities, after explanations on their use. Short messages on the utility and use of the product are printed on the beehives.
- Poultry keeping: The raising of chickens and guinea fowls is encouraged through the supply of improved breeds, including white-feathered poultry to meet the demand for ritual ceremonies.
- Raising Sahelian goats: In the programme to improve local goat breeds characterized by their small size and low meat production, Suntaa-Nuntaa provides, free of charge, the better endowed Sahelian breed. Through the principle of *chena,* beneficiaries then pledge to provide free goats to other groups in order to extend the circle of production of the improved breeds. The same principle is applied in the breeding of rabbits and pigs.
- Loan schemes: With support from the Presbyterian Hunger Project, a Canadian NGO, Suntaa-Nuntaa initiated a loan system for women's groups to foster the emergence of a Local Economic Trade System (LETS) based on exchange. The initial loan is set at 300,000 cedi (about US$120) with an interest rate of 20%. This loan may be increased if the group proves capable of repaying the initial loan. Loans have been taken to set up pesticide production projects from Neem leaves, compost projects, a botanical garden of medicinal plants and evening classes in adult literacy.

Sustainability

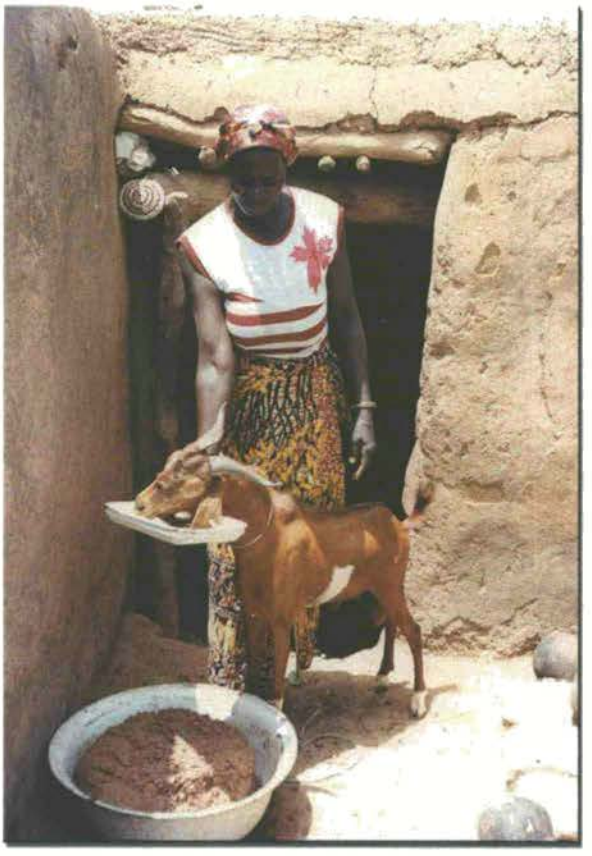
The introduction of income-generating activities is supported by training in sound management of the income. To access loans



Community production of tree seedlings

to starting of LETS-type economic activities, the groups established direct relations with financial institutions without Suntaa-Nuntaa's intervention. They keep management and accounts books with the assistance of a secretary or the staff of the lending institution. Sustainability in these type of activities is related both to the new capacity to create wealth, even at a modest level, and the acquisition of management skills.

Of all of Suntaa-Nuntaa's activities, drama for development seems the most productive. Its impact is very visible among young girls and boys, who are often precocious actors. Remarkable creativity in the oral nature of this literary genre, in a society based on oral tradition, is reflected in the actors' abilities to adapt to the background and the moment, as well as the rich repertoire of songs created - sometimes on the spot - on the theme of desertification control. Drama also creates a virtual space for expression which suffers no male censorship, where all problems can be addressed and solved. Drama is low cost and accessible to everyone, providing an opportunity to express talents and ideas without running the risk of being restricted by social conditions (poverty, caste, age, etc.).



The Sahelian goat - an improved breed

Replicability

A number of indicators show the replicability of Suntaa-Nuntaa's activities, not only in the Upper West Region but also in the other regions of Ghana faced with the same process of environmental degradation. Up to 1994, Suntaa-Nuntaa had no active group. Only a few informal groups related to schools or churches and a few villages had been approached through awareness campaigns. By 1995, five districts were covered and over 493 grassroots communities and villages contacted. Among these, 25 groups were chosen to start innovative activities. 25 new groups were to be added in 1996, 50 in 1997 and 14 in 1998. Eighteen other groups and 49 individual farmers expressed the wish to be integrate into the system. In the 3 districts where Suntaa-Nuntaa operates (Wa, Nadowli and Lawra), 76 active groups were identified. In the two other districts of the region (Sissala and Jirapa), Suntaa-Nuntaa works mostly with support from focal points. About 43 new groups were to be set up soon after.

Apprenticeship and training through demonstration were given priority by the NGO, especially on the experimental farm, where women selected by their groups came to seek technical skills in agroforestry and livestock farming. Demonstrations were carried out in the same way for the establishment of fodder banks and the production of drama.

A tree planting plot and the nursery of the Community Development Institute in Wa receives young girls from the various districts of the region, and the experiences they are involved in are likely to be replicated in all other localities facing the same problems. Through the solidarity chain of the *chena*, groups also pledge to replicate their initiatives.

The low costs of these projects in time and in money also increase replicability. An example is the use of clay pots in tree planting, which provide the advantage of not polluting the environment and can be used more than once.

Social capital

Before the inception of Suntaa-Nuntaa and its intervention in the Wa region, organizations working in development and state bodies had tried to group women in community associations to help them better manage issues related to environmental degradation and deforestation, with little success. To better understand the qualitative changes brought about by the Suntaa-Nuntaa approach, one should first consider women's status within a polygamous, highly male-dominated society where women are exclusively recognized for their role as wives, mothers and workers. Besides having to carry out all the housework in addition to their work in the fields, they require their husbands' authorization for any participation in non-household or non-agricultural activities, and are excluded from all decision-making, including decisions that directly affect them.

The 100 women's groups working with Suntaa-Nuntaa are relatively well structured, with a chairperson, a secretary and a treasurer. Their organization is based on strong solidarity, which can be seen through the system of collective fields, social aid through contributions from members, the principle of *chena* and operation rules adopted by common consent (fines in case of absenteeism from activities, etc).

Peace and social cohesion: Conflicts and misunderstandings are among the major hindrances to women's emancipation and to the success of collective actions. According to the interviewees, Suntaa-Nuntaa has managed to restore peace and social cohesion, without which there can be no sustainable development.

Acquired skills and income: Thanks to Suntaa-Nuntaa, women have acquired technical skills in the area of environmental protection, as well as knowledge of the food, medicinal and soil fertility improvement by use of non-indigenous plant species. The skills acquired also relate to livestock production and the art of drama, through which the bulk of the message is conveyed. The loans provided by Suntaa-Nuntaa and greater mastery of techniques enabled women to not only increase the income generated from their traditional activities (brewing of local *pito* beer, production of shea butter and charcoal) but also to diversify their sources of income through the development of livestock production (improvement of local goats through crossbreeding with Sahelian goats, poultry, pigs) and honey production.

Self-reliance: Women are still far from dealing with men on an equal footing and shaking the social order. However, the confidence and financial independence which they have gradually gained through new income-generating activities enable them to no longer fully depend on their husbands. This is no doubt a step towards a certain form of emancipation.

In addition to this sense of self-reliance, the women now feel that they are socially recognized by their husbands. Drama activities were once seen as somewhat degrading but also as competition to field work; hence the husbands' reluctance. Nowadays, drama groups are seen as fora for raising awareness and releasing initiative and creativity, giving women a new social status.

Institutional development

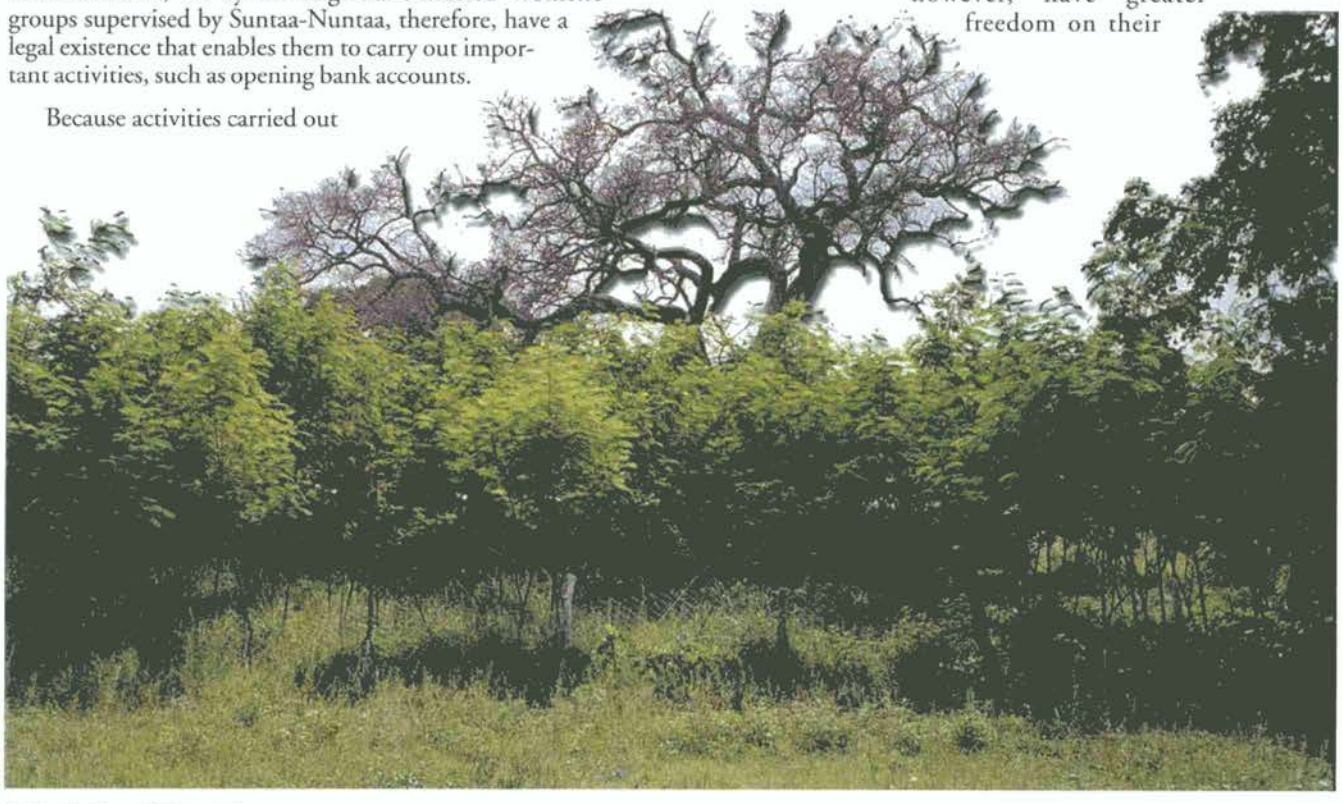
Suntaa-Nuntaa was born in 1990, fostered by government's decentralization policy in the late 1980s and the decision to turn the Upper West Region into a fully-fledged administrative region. It carries out its activities under the authority of the local administration, led by the Regional Minister. Women's groups supervised by Suntaa-Nuntaa, therefore, have a legal existence that enables them to carry out important activities, such as opening bank accounts.

Because activities carried out by Suntaa-Nuntaa mainly centre on agroforestry, fighting deforestation, and the rearing of smallstock, the Ministry of Agriculture (MOFA), the Environmental Protection Agency (EPA) and the Forest Service are its major partners. Support from these bodies is mainly focused on training extensionists and other areas related to agricultural and livestock production; for instance the improvement of West African Dwarf goats and sheep by using Sahel breeds. These projects are in line with governmental priorities in the region - fighting the growing pressure on natural resources and endemic poverty.

While decentralization harnesses grassroots energies and initiatives and facilitates the implementation of participatory approaches, other constraints such as women's access to land are still limiting the impact of Suntaa-Nuntaa's actions. For example, the administration and management of land in Ghana is governed by the Administration of Land Act of 1962, with the fundamental principal that land belongs to the community or group. Therefore, land tenure is still highly influenced by customary law and traditional chiefs.

Within the community, women have little social recognition other than their status as wives, mothers and workers, as mentioned earlier. Their activities in the area of agricultural production in general and tree planting in particular are thus highly important. They are limited by a very rigid land tenure system, which gives them no right either to the land or what it produces. Women may be married out of the family or clan and thus may own no land, since land is common and indivisible property.

In principle, women cultivate the land with their husbands, their husband's other wives (if any) and their children. In certain ethnic groups such as the Dagaaba, they are formally banned from planting trees or reaping fruits (even if they planted them) without authorization from their husbands. Wala women, however, have greater freedom on their



Fodder banks establishement by women groups

husbands' land, but the produce of this land belongs to the whole family. Despite these many restrictions, it is women who take the initiative of finding the seedlings for tree planting in the fields, which they get from NGOs such as Suntaa-Nuntaa, the MOFA or other bodies such as the Cotton Development Company.

Positive changes seem to have begun since organizations like Suntaa-Nuntaa took the initiative of grouping women around development and environmental protection activities. Through the groups and their activities, women now have safe access to plots of land, though often marginal, which are allocated to them by the chief. Interviews and reports show that chiefs are increasingly encouraging women to plant trees and meeting their requests for land; according to others, the involvement and support provided by development and government agencies to women are among the causes of the new attitude adopted by the chiefs.

Lessons learned

- Desertification control should be adapted to the conditions of stakeholders: Suntaa-Nuntaa has managed to mobilize women by adopting frameworks that respect local social values (gender relations, social structures) and based on the principles of social life (*chena*, *susu*, etc.)
- Drama for development is a strong lever for mobilizing and sensitizing populations through precise messages that are accessible locally, and have great potential to modify behaviour blamed for desert encroachment.
- State disengagement and the process of decentralization may be opportunities and not constraints in the development of local initiatives to fight environmental degradation. However, these initiatives should be supported by organizations specializing in community development.

Suntaa-Nuntaa's ultimate purpose is to provide local populations, and particularly women, with income-generating agricultural activities and environmental protection activities capable of freeing them from poverty, ignorance and suffering in order to significantly improve their living conditions. To achieve this goal, the NGO chose, in addition to initiatives such as tree planting, the demonstration and implementation of cropping techniques, to put particular emphasis on activities likely to change the attitudes and behaviour that lead to natural resources degradation.

Certain aspects of Suntaa-Nuntaa's intervention needed to be strengthened, for instance, physical achievements in the field of tree planting and systems of bush fire prevention and control, which seem to be major concerns. However, by getting involved in the fight for the adoption of new behaviour *vis-à-vis* a local environment which is still relatively healthy compared to the neighbouring Sahelian areas strongly marked by desert encroachment, Suntaa-Nuntaa has no doubt banked on a better, more sustainable future.

References

AYEE, J. R. A. (1998). A decade of Decentralization Reforms in Ghana, 1988-1998 Paper presented at the Project Workshop on « Policies and Practices Supporting Sustainable Development in sub-Saharan Africa, Scandinavian Seminar College, November 9-11, 1998

Cockerton, L. and Fanaroff, D. (1996). Suntaa-Nuntaa Rural Development Program. The Study of 10 Women's Groups in the Upper West Region of Ghana.

Kasanga, K. (1996). The Role of Chiefs and Tendamba in Land Administration in Northern Ghana. Paper presented at a Seminar on Decentralization and Land Administration in Northern Ghana.

Kasanga, K. (1997). Land Resource Management for Agricultural Development. Paper presented at the Programme of Public Lectures and Symposia, 17th-21st november, 1997 Ghana Academy of Art and Sciences, 38 th Anniversary, The Britsih Council, Accra.

Loggah, R. and Horbach, B. (undated). Suntaa-Nuntaa Rural Development Program. Project proposal for Women Mean Business Project.

Pocknell, S. (1995). Women Agro-forestry in Upper West Region, Ghana. Research Report.

Suntaa-Nuntaa Rural Development Programme (1996, 1997, 1998, 1999). Series of reports.

Water for Development

The Wei Wei Integrated Development Project, Kerio Valley, Sigor, Kenya

The Wei Wei Integrated Development Project (WWIDP) was started in 1987 in Sigor, West Pokot District, under a development co-operation agreement between the Government of Kenya (GoK) and the Italian Development Co-operation. The planned outputs of the project were: the construction of intake weir on the Wei Wei river, with a maximum intake flow of 1.2 m^3 per second; an underground steel and PVC pipeline network that would distribute water through gravity fed sprinkler irrigation units; reclamation of over 700 ha of degraded agricultural land; the establishment of a 50 ha pilot farm; the development and allocation of 540 1-ha plots; and the construction of a service centre to provide workshop, storage and office facilities.

Phase one of the project was implemented over the period 1987-90, and involved construction of the intake weir 9km away from the project site, land clearing and reclamation, laying the irrigation pipe network and establishment of the pilot farm. Water is carried by a 1m diameter pipe from the intake point to the project farm on the valley floor.

This gravity-fed system supplies irrigation water 24 hours a day, 365 days a year to the valley floor, which had been only marginally productive because of water scarcity. Now crop yields have dramatically improved. A total of 275 ha out of a target of 700ha of badly degraded land have been reclaimed. A total of 225 plots on the valley floor have been allocated to farmers, each with a hydrant fed from an underground pipe network equipped with galvanised steel irrigation laterals, raisers and sprinklers. The plots were levelled at a slight slope to allow adequate drainage into natural channels on the valley floor.

Integrating the old and the new in water-harvesting technologies

Nursery for fruit and indigenous tree seedlings

Since irrigation water delivered by sprinklers can be adversely affected by wind, the project established windbreaks between every 4 plots, and natural vegetation was maintained on the perimeter of each plot. Tree species used as windbreaks include Leucaena, eucalyptus and neem (*Azadiracta indica*). The project distributed vertiver grass for planting across most water channels as a means to reduce the speed of water and its erosive capacity (see below right). The grass has been widely adopted, planted on the edges of plots, along water courses, gullies and traditional irrigation furrows.

The project has also successfully established orchards and woodlots around the 50 ha pilot farm. Farmers have planted fruit trees - mangoes, pawpaws, lemons, avocados and oranges - on their homesteads, both for produce and to rehabilitate abandoned watercourses. The neem tree, which is well known

UNEP's "Saving the Drylands" award winner, 1999. The project was a co-operation venture between the Government of Kenya and the Italian Development Co-operation. It was planned and implemented by Lodagri (an Italian contracting and project management firm) and the Kerio Valley Development Authority.

Increased traditional food (sorghum) production through irrigation

in the area, is found on almost every homestead. This tree is particularly important as an insecticide; its active extracts are used against pests like caterpillars, grasshoppers, leafhoppers and beetles.

In all the activities carried out in the project area to date there is no evidence of any significant effort to promote the use of natural fertilizers for soil improvement, apart from the distribution of some Leucaena trees, which are used for soil fertility improvement in agroforestry systems. But the project does encourage farmers to practice crop rotation by planting legumes - green grams, cowpeas and okra - after cereals. These crops help in nitrogen fixation, especially if the plant residues are also used for mulching. However, legume crop residues are mainly used as animal feed, and thus the benefits of crop rotation are not being fully realised.

Benefits to the community: The project has been effective in providing training to farmers on subjects such as vertiver grass planting and management for erosion control, nursery establishment and management, and tree planting and care. In addition the project provided training to farmers on tillage practices that enhance soil conservation, crop rotation and agroforestry practices and farm management.

Irrigation water is now available 24 hours a day, allowing farmers to grow and harvest crops twice a year. Benefits to agricultural Pokot people are also being shared with pastoral Pokots, who have access to crop residues and water for their livestock. Pastoralists are also guaranteed adequate food to buy in years of poor harvest. The rejuvenation of agriculture on the valley floors has withdrawn pressure to cultivate on the hill slopes, and once degraded hills are slowly regenerating. Some farmers reported positive climatic changes in the area due to biodiversity regeneration. There is an unmistakable total sense of ownership of natural resources amongst the farmers, which is critical for sustainability. The gravity-fed irrigation requires no energy. In fact, if desired the water could be used to generate electricity, as an additional benefit.

Sustainability: The technology needs no external inputs; maintenance costs for the irrigation system are minimal and there is no wastage due to seepage and evaporation. All these aspects strengthen the sustainability of the innovations. The uninterrupted availability of water on the valley floor has brought confidence to farmers, who have now moved away from the old practice of shifting agriculture.

Socio-economic benefits

Crop yields, earnings and food security: Prior to the project, crop yields among the Pokot people who lived here were low. Production was entirely for subsistence, and in years of drought, food scarcity was pervasive. The Pokot's response to this problem was to move into other districts in search of food, or even across the border into neighbouring Uganda. The project has completely transformed the lives of the Pokot in the project area. Crop yields have increased from about 0.5t/ha for maize and sorghum to a mean of 3.5t/ha and 4t/ha respectively. New crops, including okra, cowpeas and green grams, have been introduced into the local farming system.

Farmers have realized consistently improved yields on these crops over the last 12 years. Farmers now have contracts with three seed companies, Kenya Seed, Western Seed and East Africa Seed Company, who buy maize and sorghum at KShs 30/kg and KShs 18/kg respectively at the farm gate. These prices are at least 250 percent higher than those offered by food companies. On average, farmers realize a net annual income of KShs 40,000 each year.

Employment and incomes: The WWIDP has made a significant contribution to employment and income generation in West Pokot district. During the implementation of civil works

in 1987-88, at least 300 people were employed on the project. At an average daily wage of KShs 25 per person per day during that period and assuming a 200-day working year, at least KShs 3m was injected into the local economy. Since the start of the second phase in 1991, the Kerio Valley Development Authority has had at least 50 staff employed on the project each year, which helps to stimulate commercial activity in Sigor and other parts of the district.

Due to the increased demand for labour on farmers' plots, each farmer currently hires at least 120 man-days of labour per year, at KShs 45 per day, or KShs 1.5m in total each year. There is no doubt that this significant income has helped to uplift living standards in an area that was once very poor and marginalized.

Expansion of commercial activities and access to education: Increased employment and incomes have stimulated the development of commercial transactions. A thriving and rapidly expanding market has developed at Sigor. The population of Sigor division has grown from a mere 40,000 at the start of the project to nearly 200,000, which has in turn stimulated the expansion of commerce and the development of education and health facilities.

Community members at a sorghum harvest from irrigated land

Before the project, there were only two primary schools in Sigor, and enrolment of children in schools was as low as 30%. Now there are six primary schools and two secondary schools here. Enrolment has increased to an average of 70%. There is no doubt that increased access to education by local children will, in the near future, create a good pool of qualified people who will be able to spearhead local development initiatives.

Community participation and empowerment through institutional capacity-buiding: Local people were consulted and involved in the implementation of the project right from the beginning. A distinct strength of the project is that it built on local indigenous knowledge and farming practices. Pokot people living in the project area were already accustomed to growing crops using the traditional furrow irrigation system. The project recognised this, and it has improved the irrigation system through the construction of a modern gravity-fed pipeline that conveys water to all the 275 ha so far developed at minimum cost and water loss. Farmers use pipes and sprinklers for irrigation on each plot and water is supplied at a pressure of 3.5 bars at the plot hydrant.

A plot allocation committee was created at the beginning of the project to ensure fairness in the allocation process. The committee consists of the executive committee of the Wei Wei Farmers Association (WWFA), the local councillor and local traditional leaders.

The WWFA was created in 1991 by project beneficiaries to promote farming activities in the area. It consists of a General Aassembly, an Executive Committee and a Board of Directors. The General Assembly is the supreme organ of the association and consists of all 225 plot holders. It meets at least once every two years to elect members of the board and the executive committee. The project area has been divided into 8 blocks and each block is represented by at least two people. At present there are 18 block representatives.The Board of Directors, made up of block representatives and members of the executive committee, is responsible for discussing and finding solutions to all problems faced by farmers, such as pest control, seasonal budgets, crop rotation and soil fertility management. Any expenditure from the WWFA account that exceeds KShs 10,000 has to be approved by the board of directors. Board meetings are held as and when necessary.

The Executive Committee consists of five members: the chairperson, vice chairperson, secretary, vice secretary and treasurer. To ensure the future sustainability of project activities and benefits without external support, the WWFA constitution provides for employment of three staff, an accountant, a plumber and an agronomist, to run the affairs of the association. The executive committee is responsible for recruitment and supervision of the three staff members. It has the authority to approve and make expenditures not exceeding KShs 10,000. The committee meets every month.

Adoption of innovations: Innovations introduced by the project are being widely adopted by communities involved in the project, as well as beyond the project area. Farmers involved in the project have taken the initiative to clear extra pieces of land adjacent to their plots to expand the land available for irrigation and crop production. Many households not involved in the project have also cleared pieces of land next to the project, in order to hire pipes and sprinklers to draw water from project farmers. While this could potentially create conflict in the future, so far this practice has helped to enhance the sense of communal ownership and the need to bring all interested households into the project. With strong sense of communal ownership in place, it will be very difficult for outsiders to interfere with the project. It also means that sustainability of project benefits will be guaranteed. The availability of tree seedlings from the project's nursery has encouraged farmers to plant fruit trees around their homesteads. Trees that provide wind shields are also planted around homesteads and fields. Growing of vertiver grass to control gully erosion is now widely practiced both within and outside the project area.

Cost-effectiveness: Project costs during phase one are estimated at approximately US$ 7 million. The major costs during this phase were for the construction of the weir and pipe that conveys water to the valley floor, construction of the irrigation pipe network, land reclamation and development, and farm machinery and equipment. Since the completion of phase one, no major

capital investment has been made by the project. The irrigation system is gravity-fed and requires minimum maintenance. Cost-benefit analysis shows that the benefits created by the project far exceed the costs incurred. When costs and benefits for the period 1987-99 are compared, the project's internal rate of return is 24%, an impressive result.

Strengthening social capital: Increased economic prosperity now enjoyed in the Sigor area has helped to enhance family cohesion. A growing and thriving market for food crops, chicken, goats, sheep, cattle and fruits has developed at Sigor centre.

The WWFA has developed into a viable and strong organization that articulates and promotes the interests of its members. It holds regular meetings with seed buying companies to negotiate for better prices for its members. It has a written constitution which continues to be updated regularly to reflect the changing needs of farmers and project development. It is anticipated that once modern management practices are fully inculcated into the culture of the Pokot farmers, they will also filter into the management of the affairs of the wider community.

Vertiver grass planted on farm borders to control erosion and provide fodder.

Replication

At the local level, communities have been actively involved in replication of project activities as already described above. Not much has taken place, however, in other parts of the district and other parts of the country. A dam project on the Turkwel river was built with funding from the French government to generate electricity and also provide gravity-fed irrigation along the same principles as the WWIDP. To date, the dam only generates electricity and no irrigation activities have been implemented. It appears that funding is the key constraint, but the interest to develop a gravity-fed irrigation scheme exists.

Replication of the WWIDP has also been carried out by KVDA in the Arrol irrigation scheme in Marakwet district. A furrow has been developed to feed water into a reservoir. Water is gravity-fed from the reservoir to irrigate land using sprinkler irrigation. The project was started in 1991 and each farmer was allocated one acre of land. The main crops grown by farmers on the project are green gram, cow peas and okra. KVDA and the Italian Development Co-operation jointly provided funding for the project. The Sondu Miriu dam project in Nyanza province was initially designed to generate electricity and later to provide water for irrigation following the design of the WWIDP.

Despite the few examples of attempts to replicate the WWIDP, the project is highly replicable. Although initial investment costs may be high, these are far outweighed by the benefits the project creates. The project can therefore be replicated not only locally and in other parts of Kenya but in other countries.

Government support and political commitment: The government has demonstrated its commitment to make the project sustainable by creating a joint management structure that involves KVDA, Italian Development Co-operation and the WWFA. After completion of phase three of the project, the Italian Development Co-operation will pull out, leaving the management of the project in the hands of KVDA and the WWFA. KVDA operates 50 ha on the project and is therefore destined to remain an active participant on the project for a long time into the future. The 50 ha produce a gross annual income of at least KShs12m, nearly three times the annual salary and wage bill of KVDA staff. It is therefore plausible to expect KVDA to continue to operate the farm and work closely with the WWFA to sustain benefits to the farmers.

The project has direct linkages with the Office of the President and the Ministry of Foreign Affairs, so it has a direct influence on government policy and practices in agriculture.

Influence on land use policy: The project has demonstrated to the government that more investment needs to be directed to the promotion of irrigated agriculture in arid and semi-arid lands (ASAL). For example, studies show that at least 200 ha of land are required by one household in Turkana district to be able to attain the level of productivity and food self-sufficiency now enjoyed by households involved in the WWIDP. In other ASAL areas, the mean land required has been estimated at 100 ha per household.

Lessons learned

Balancing economic and environmental benefits: It is well known that rural communities usually cause damage to the environment out of basic necessity. Communities get motivated to participate in a project if there are some tangible benefits to be derived from such participation. Project beneficiaries in Sigor have realised major socio-economic benefits and this has encouraged them to get fully involved in the project. Environmental conservation came as a secondary benefit and has, therefore, been readily accepted. If conservation of the environment had been emphasized as the primary objective right from the beginning, project's results could have been completely different from what they are today.

Building on indigenous knowledge and practices: An important lesson is that projects that build on indigenous knowledge and practices stand a better chance of success. The WWIDP recognized that local people had a long tradition of growing crops using irrigation, and intervened to improve irrigation. If the project had been introduced in an area with no irrigation tradition, the impact of the project might not have been as phenomenal.

Taking advantage of local conditions: The Project took advantage of the fast flowing Wei Wei river and the slope in the river valley to introduce a gravity-fed system borowed and modified from a local traditional innovation. The system supplies water to farmers for irrigation 24 hours a day and 365 days a year. It requires little or no maintenance costs, a distinct strength for the system.

The WWIDP is an extremely innovative and successful project that has created immense biophysical, economic and social benefits for both project beneficiaries and the local community. The project is sustainable and the technological innovations introduced in the project area can be readily replicated not only in other districts of Kenya but even in other countries. Recognition of its success and support at the national level has influenced policy for sustainable development and poverty alleviation in similar arid and semi-arid areas in kenya.

References

Clarfield, Geoffrey W. (1993). "Traditional and Modern Natural Resources Management Among Pokot Farmers: A community and project appraisal".

Damiani, Stefano (undated) "Wei Wei Integrated Development Project: Irrigation Training Manual".

Government of Kenya, (1999), National Poverty Eradication Plan, 1999-2015, Nairobi, February.

Hogg, Richard (1984), "Pokot Traditional Irrigation and Its Future".

Lodagri SpA (1993), "Wei Wei Integrated Development Project: Socio-anthropological survey report on the Sigor Farmers Community: Results and Recommendations of a Participatory Rural Appraisal".

Lodagri SpA and KVDA (1995). "The Wei Wei Integrated Development Project: Progress Report".

Ministry of Planning and National Development (1999). Economic Survey, Nairobi, May 1999.

Planital S.r.l., (1984). "Sigor Agricultural Development Project Proposal for Irrigated Crop Production and Poultry Complex.

Rambaldi Giacomo (1987). Wei Wei Integrated Development Project: Behaviour of different food crops under furrow irrigation at Sigor", Technical report No. 1.

Rambaldi Giacomo (1988). "Wei Wei Integrated Development Project: Behaviour of different crops under spinkler irrigation", Lodagri SpA and KVDA Technical Report No.3.

Rambaldi, Giacomo (1992). "Small-scale Irrigation in Remote Areas: An approach to marketing as contribution to successful project implementation", paper presented at workshop on " Experiences and Perspectives on Horticultural Smallholder Irrigation Schemes in Kenya".

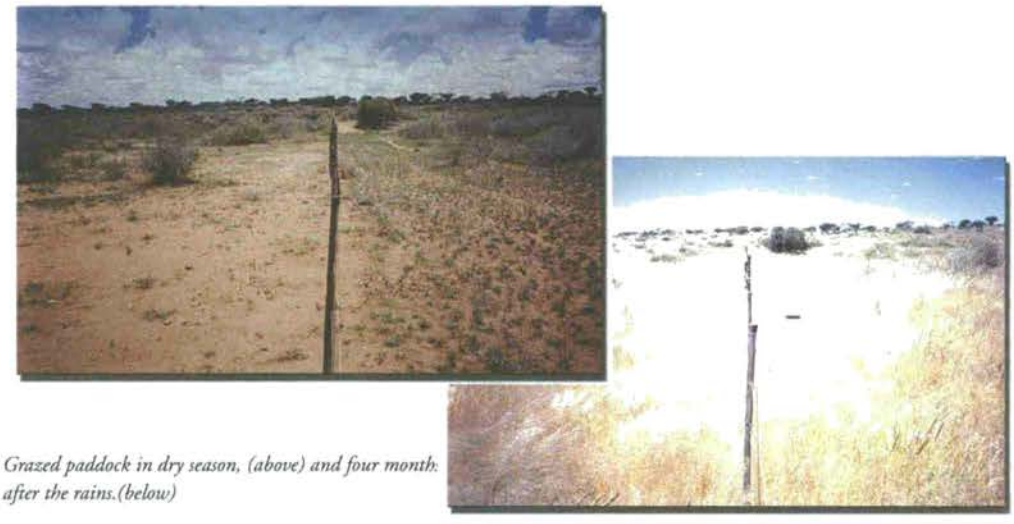
Rambaldi Giacomo (1993), Wei Wei Integrated Development Project, Activity Reports, 1987-93.

Rambaldi Giacomo (1995). Wei Wei Integrated Development Project: Training, Research and Consolidation Programme".

Dryland Ranching Made Sustainable

A Holistic Approach to Land Management, Sonnleiten Ranch, Namibia

The remarkable Sonnleiten Ranch lies roughly 40 kilometres east of Windhoek, on the dry eastern slopes of the low mountains of central Namibia. For many years this 11,600 acre ranch was managed in the traditional fashion. Large numbers of cattle were kept in paddocks over long periods, resulting in heavy brush encroachment and soil erosion, deteriorated vegetation and a compacted, crusty soil surface that discouraged the establishment of vegetation.



Grazed paddock in dry season, (above) and four months after the rains.(below)

When Argo Rust took over Sonnleiten's management from his father in 1967, the condition of the ranch had seriously deteriorated, and the family was heavily in debt. Government extension officers recommended that he clear the property of brush, but Rust was unable to raise the necessary capital investment, and for the first few years the ranch sank further into the red.

At the beginning of his tenure Argo Rust knew very little about ranching, but he was thirsty for answers and determined to succeed. In 1969 he learned about an approach to dryland management called Holistic Resource Management (HRM), described in a book of the same title by Allan Savory, and slowly began to introduce this unique process of decision-making and management into his entire operation, changing fundamentally the way he managed all aspects of the ranch.

Over the years, by making gradual, continuous changes following Savory's advice, he has eliminated the ranch's debt, improved range conditions, enlarged his herd, and turned what seemed to be a hopeless exercise into a profitable enterprise.

The history of Sonnleiten

Sonnleiten is not alone in the challenges it faces. Nearly 70% of Namibia's 1.4 million people (1991) live in rural areas and depend on some form of agriculture, though much of the country is dry. The climate around Sonnleiten is arid and semi-arid, with average annual rainfall of 350 mm and extremely high rates of evapotranspiration. Rainfall is variable, serious droughts common. There is only one rainy season from December to March. There are no permanent water courses on the property; water is supplied by bore holes.

When Argo Rust took over Sonnleiten's management in 1967 he commissioned a broad assessment of the ranch's situation and potential to determine where he stood. Argo's father H.E. Rust had farmed Sonnleiten for many years, grazing 300 head of mainly Simmental cattle. He received awards for his breeding practices, managing the ranch in the four camp system - separating bulls, cows and heifers. Following the traditional system, he rotated his cattle between 21 paddocks throughout the year, with highly concentrated grazing on each paddock.

But after years of this concentrated grazing system, several negative effects began to appear and then to worsen. General plant cover diminished, as did the number plant species. Soil capping created a compact crust that reduced seed germination with the onset of rains, and this in turn led in turn to reduced rainwater infiltration, increased runoff, soil erosion and severe gullying. Cattle production fell, parasite problems became chronic, and bush encroached on productive pasture.

H.E. Rust tried to counter these problems by reducing the size of his herd to reduce pressure on his pasture, but this only resulted in further degradation of the range as soil capping increased, with a consequent reduction in seed germination and infiltration of rainwater. The farm went into debt, and looked as if it might fail.When Argo Rust took over he had no funds to invest in improving the property, and Sonnleiten went further into debt. Then in 1969 he discovered HRM, and Sonnleiten started on the long road to recovery.

UNEP's "Saving the Drylands" award winner. 1995. This private ranch project was implemented by the owners, Argo Rust family, with personal funds.

The Holistic approach

Holistic Range Management is based on four fundamental principles: that the passage of animals over ground has a healing, regenerating effect; that dry environments require their soil surface to be disturbed by animal trampling so that decomposition of old plant material is accelerated; that overgrazing does not occur if the vegetation is grazed once and animals are moved and allowed to return only after the grass has completely regrown; and that the entire ecological system is interrelated, and must be treated as a whole.

Following these basic principles, Rust gradually divided and fenced the ranch into 90 fenced, wagon wheel shaped paddocks, each with its own access to a watering point. He then began to circulate his herd every 2 - 3 days from paddock to paddock.

The herd was kept together, no longer separated into bulls, cows, and heifers as in the past. Breeding continued year round, and he increased the size of his herd, in keeping with HRM practice.

He introduced indigenous African Nguni cattle into his herd and began to cross breed. Nguni tend to group up to protect against predators, which contributes to chipping paddock soil and thus improves seed germination. The herd was kept on a "fast rotation" of 2-3 days, reducing grazing pressure and leaving more grass after each grazing cycle.

Major achievements of the approach:

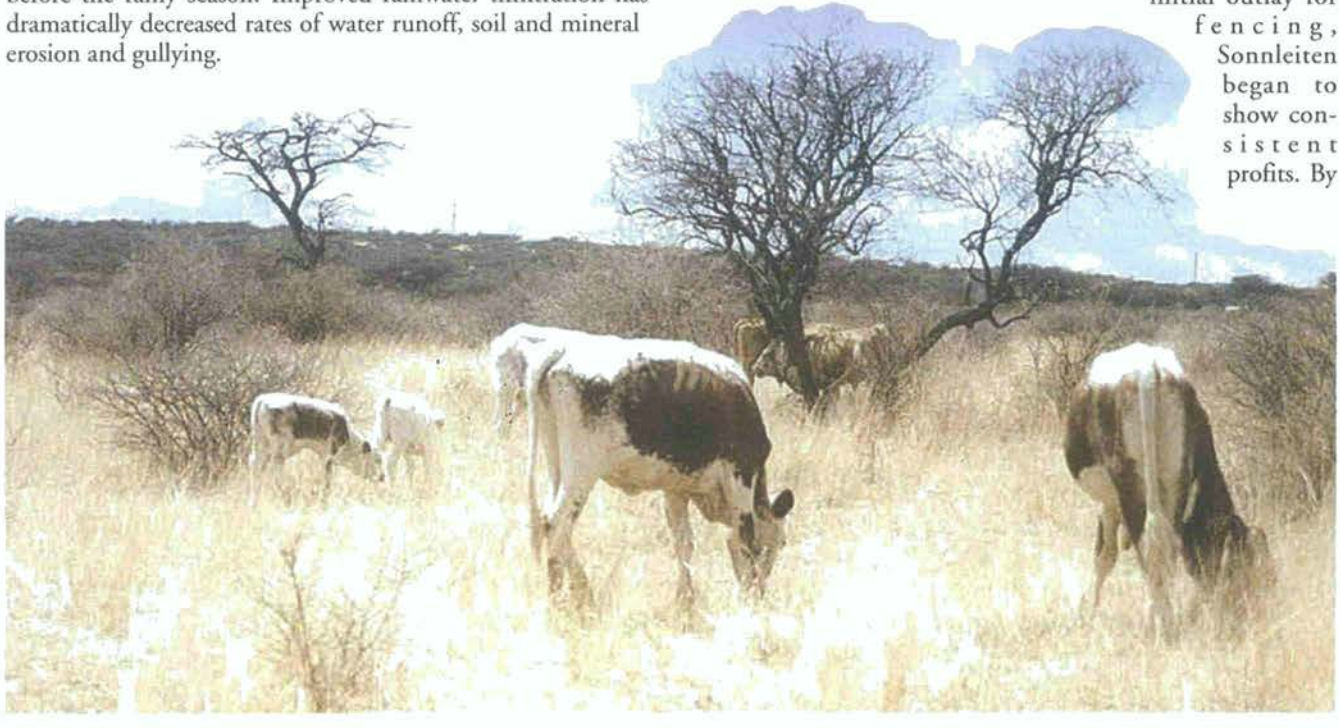
Soil health: Quick rotations resulted in a more even distribution of cattle across the paddocks, scattering manure over a wider area and generally improving the soil's organic matter content.Rust reported improved grass seed germination and water infiltration as a result of the herd chipping the soil surface. To prevent compacted soils, he places a salt lick near vulnerable areas for one to two days to attract cattle to work the soil surface before the rainy season. Improved rainwater infiltration has dramatically decreased rates of water runoff, soil and mineral erosion and gullying.

Animal health: Cattle were no longer grazed on fouled ground, and the quick rotations helped to control parasite problems, as cattle moved on to the next paddock before parasites completed their life cycle and so died for lack of a host.

Biodiversity: A larger proportion of the paddock now remains under vegetative cover as a result of lighter grazing pressure, which encourages the seeding and germination of larger numbers of each grass and forb species. Wherever heavy rains cause gullying, dead trees and brush are placed in the depressions to encourage restabilisation and sediment build up. Grass species on the property increased from 30 in 1967 to 65 in 1994, and all have increased in abundance and vigour. The excellent pasture perennial *Cenchrus ciliaris* has extended its range considerably, and savannah-type trees and shrubs are scattered over the entire property. Rust maintains an herbarium for the farm, with 53 species of grasses and 29 species of forbs. He has made no introductions of new species, nor done any seeding of degraded paddocks. Rust has taken no steps to discourage wild animals from his property. Kudus and warthogs come into the paddocks after the cattle have been rotated. Jackals and leopards have been observed in the area, and there has been an increase in the number and abundance of bird and insect species. The ranch's overall biodiversity has improved under the new management system. Rust feels that the ranch is being managed in harmony with nature. After 1969 he deliberately eliminated the use of all agricultural chemicals from his operation. He has abandoned de-worming of his stock, as the chemicals discourage beetles, earthworms and other organisms that recycle manure. Neither does he spray for ticks - these are now eaten by birds. Rust refers to the need to manage the property in a socially, economically and ecologically sound manner, one of the basic principles of HRM.

Sound economics

The benefits are far more than just environmental. After the initial outlay for fencing, Sonnleiten began to show consistent profits. By



Nguni cattle on Sonnleiten

1995, the time of this reporting, the herd had increased from 300 to 700 head, and despite a severe drought from 1981 to 1984, the ranch netted an average income roughly four times the average of similar ranches in the region. Throughout the time he managed the farm, Argo Rust neither asked for nor received government subsidies for drought relief.

The Sonnleiten system of management requires significant initial capital outlay for paddock fencing. It also requires comparatively intensive management. These factors tended to discourage some ranchers, but Rust reported that since the system had been established, he had actually had much more leisure time. Neither was capital outlay for fencing a major problem. In some cases, to save money, thorny bush was cut and used as fencing material before a permanent fence could be established.

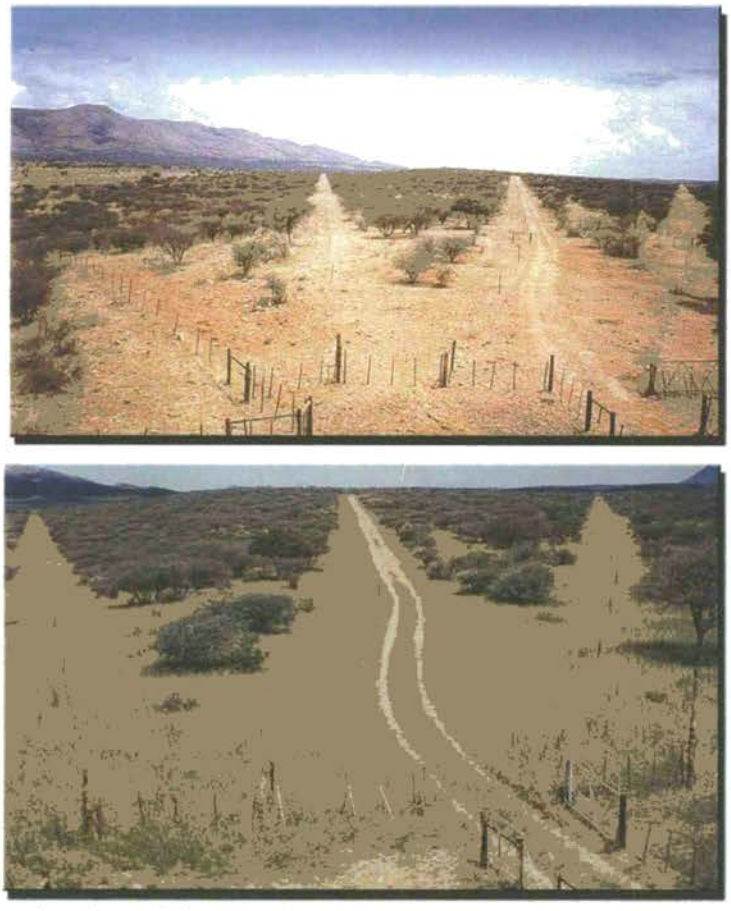
The total capital cost of Rust's 250km of fencing was nearly N$458,000, roughly equivalent to the value of about 300 steers at 1994 prices, but this cost was spread over many years, and proceeded only as increased productivity provided the funds to cover subsequent stages. Each fencing phase had a two-year repayment period based on the farm's output, making it possible to complete the fencing from ranch-generated funds over a period of 15 years.

Water for this intensive grazing system is provided by reticulating water from existing boreholes, distributed at the hub of the wagon wheel paddock system, and therefore required no extra investment. Labour costs rose, as Rust increased his permanent labour force from 2 staff to 7 in order to manage increased stock numbers and maintain the farm's extensive water systems and fences. Production more than covered this increase, however, and new jobs were an extremely welcome development in a country where rising unemployment was a worrying economic and social problem.

Though farmers, and livestock ranchers in particular, are often unwilling to change long-held habits and customs, Sonnleiten's economic success should encourage adoption among even the most conservative of ranchers.

Returns on investment in improvements and equipment were impressive; The innovations on the ranch made it possible for Sonnleiten to carry 50% more stock than other similar ranches. Lower veterinary costs on Sonnleiten could be attributed to the ranch's improved ecological health. Though the cost of improvements and equipment per hectare were 22-38% higher than other ranches, net farm income per hectare was reported as being 200-1,000% higher.

On average, there was a five year pay-back period on fencing, water and equipment purchased and installed on the ranch. The ranch carried no debt at the time of this reporting in 1995. Through applying the holistic approach to manage his ranch, Rust's leisure time increased, and he was able to educate his two children and fund their capital base in farming, giving each of them 250 head of cattle to begin their own ranching operations.



Before (above) and after (below) the rains

Replication

Asa result of its striking turnaround, Sonnleiten became well known in Namibia. The ranch has become a favoured attraction for farmers, Government officials, and students from neighbouring Neudamm Agricultural College, the Polytechnic and Windhoek University.

Through the growing publicity surrounding Sonnleiten's success, and the promotion of the approach by member farmers of the Namibia Centre for Holistic Resource Management (NCHRM), Rust's innovations were being replicated at varying levels on 28 other ranches around the country, covering a total of 400,000 hectares of rangeland.

In 1985, NCHRM started offering short courses in HRM. Because NCHRM members are mostly active farmers, there is little time for active promotion of the methods used, except on farm days; the main NCHRM policy was to let others come and see the approach for themselves. A new HRM centre was also opened in neighbouring Harare, Zimbabwe, staffed by three specialists.

Rust's innovations are technically adaptable to private dryland commercial ranches. Problems would arise if new boreholes needed to be drilled and reticulated, and lower cost fencing options should also be explored, particularly considering uncertain beef markets. Even with increased capital costs,

however, Sonnleiten did improve its carrying capacity, despite the fact that rainfall had been far less than normal for much of this time, and net returns per hectare remained well above the average for similar ranches.

Sustainability

At the time of this study, 1995, there were roughly 4,000 commercial farmers in Namibia, occupying about 45% of the land, and nearly 140,000 subsistence farmers on communal lands, covering another 41%, but both agricultural productivity and potential countrywide had been declining at an alarming rate. Bush encroachment was common in communal areas. Soil capping was a major problem in the centre of the country. Rapid desertification is turning the arid southern and western grasslands into desert. In the 1950s, Namibia maintained 3.7 million head of cattle and 5.7 million sheep and goats, but in recent years the population peaked at 1.8 million head of cattle and 4.3 million sheep and goats.

Uncertainties over land tenure only compound the problem. Wealthier indigenous Namibians were fencing off large tracts of land in communal areas in the hope that they would be allowed to keep these areas as land changed from communal to freehold tenure. Since they were still using grazing resources in unfenced communal areas, some areas were becoming heavily overgrazed, and the large majority of livestock holders were being squeezed onto less grazing land.

Communal land is administered by chiefs, who have no legal right to stop people from using or misusing it. Equally, the people using the land have no collective legal rights to communal land and resources. Short-term drought relief in communal areas, in the form of food aid, restocking credit and borehole development, led to overgrazing around waterpoints. Commercial farmers were being given subsidies on a per head basis, a policy that promoted overstocking.

While HRM cannot address the larger problems of land tenure and short-sighted policies, the remarkable rehabilitation of degraded land on Sonnleiten proved that ranch productivity and stock numbers can be increased while improving dryland ecological health. The ranch provides an inspiring example of economically and environmentally sustainable rangeland management that could be adopted countrywide to solve many of Namibia's pressing desertification challenges. Commercial potential has already been well established. In communal areas, with more clearly defined land tenure systems, stronger community organization, intensive training in Holistic Range Management could reverse the fortunes of the majority of poor farmers, and bring hope for the future of Namibia's threatened drylands.

References

Savory, Allan (1988). Holistic Resource Management. Island Press, Washington, D.C., U.S.A. 564 pp.

Desert Research Foundation of Namibia (1994). Proceedings of Namibia,s National Workshop to Combat Desertification. July 4 -7, 1994. Ministry of Environment and Tourism and the Ministry of Agriculture, Water, and Development, Windhoek. 214 pp.

Duffy, P.J.B. (Ed.) (1986). Initial Assessment Guide. Federal Environmental Assessment Review Office, Ottawa, Canada. 36 pp.

Ministry of Finance, Namibia (1994). Economic Review, 1994.

Ministry of Agriculture (undated). Water and Rural Development and the Desert Ecological Research Unit of Namibia. A Preliminary Assessment of the Economic Impact of Desertification in Namibia.

Namibia Center for Holistic Resource Management, Various News Updates.

Development Cooperation, Namibia (1993). 1991-1992 Report. December, 1993.

World Bank, Public Expenditure Review (undated). Namibia.

Halting Encroaching Sands

Sand Encroachment Control and Agropastoral Development Mauritania

In 1980, the Mauritanian government, in conjunction with the United Nations Sudano-Sahelian Office (UNSO), organized a national seminar to develop specific strategies to combat desertification. Of the possible solutions discussed, sand encroachment control was deemed the most appropriate, and this formed the basis for Mauritania's national desertification control master plan.

Three phases of the Sand Encroachment Control Project were carried out between 1983 and1997, with the ultimate goal of reestablishing the ecological balance of the country.

Mauritania belongs to a geographical area called the Sahara, where for over 3,000 years the process of desertification has slowly advanced between the Atlas Mountains and the Guinean Plateau. Arid and semi-arid dryland forest progressively gives way to the Sahelian savanna on one side and a sea of sand on the other.

Green belt of trees protecting a village from encroaching sands

This process began some 10,000-12,000 years ago, due to climate changes in the wind cycles of the Azores. The once fertile Sahara, which supported nomadic pastoralism, agriculture, trade, towns and cities, gradually saw its population abandon their settlements ahead of encroaching desert sands. This process accelerated dramatically in the 1970s, during a long period of drought.

The disappearance of vegetative cover that had stabilised the sand dunes now set them in dramatic motion, and as waves of traveling sand threatened settlements on a massive scale, the Mauritanian government moved to act.

The objectives of this project were:

- To step up sand encroachment control measures and reduce pressure on the environment.
- To improve the living conditions of the rural population in order to curb the exodus to large urban centres.
- To strengthen rural organisations to increase self-reliance and sustainable land management.
- To replicate viable activities.

The project zones involved Adrar Assaba, Brakna, Guidimakha, Hodh Chargui, Hod El Gharbi, Tagant and Trarza.

The project used three main approaches, one curative, one preventative, and one promotional:

1. The curative approach sought to transform the sea of sand dunes into productive agricultural and pastoral grazing lands.
2. The preventative approach sought to develop safeguards against sand encroachment and the deterioration of natural resources, and to reverse the process of desertification.
3. The promotional approach was designed to encourage the participation of local people from the beginning of the project, ensuring sustainability by creating economic opportunities far beyond sand dune stabilization.

Achievements

Through document reviews and extensive field visits, it was determined that the stabilization of sand dunes was successful in more than 80 sites, benefiting at least 40,000 people directly, and bringing indirect benefits to an additional 100,000-200,000 people.

Villages and palm tree oases that before the project were in danger of obliteration by the encroaching sands have now been made safe and habitable. Sections of road that were blocked by sand have been made passable, and threatened agricultural and pasture lands have been made productive. Though the achievements have been considerable, however, there were shortfalls in certain areas, and much still remains to be done. The following section details the project's progress in three villages: Tigenti, Male and Maghta Lahjar.

UNEP's "Saving the Drylands" award winner, 1997. This project was implemented by UNDP/UNSO and local communities with funds from DANIDA, UNDP/UNSO, WFP and Mauritania Government.

Tigenti

Despite the considerable efforts of the project team and the local people, sand encroachment remains a problem in some areas of Tigenti, and maintaining productive traditional agro-sylvo-pastoral livelihoods is still proving quite difficult.

Sand dune fixation started in Tigenti in 1987 with the construction of windbreak using *Euphorbia Balsanifera. Prosopis spp* was planted inside the windbreaks in temporary nurseries. Windbreaks were established according to wind direction, generally north-northeast, in an L shape. This technique, fully mastered by the project team, has yielded positive results. Large surface areas have been covered, dunes have been stabilized and the population feels more secure.

Women and children watering a community garden

The project team, in consultation with local people, marked out and planted 'closed areas' where there was significant growth of *Calotropis procera*, the first species to colonize the dunes, as well as some natural regeneration of *Panicum turgidum* and Acacia.

With the dunes secured, villagers planted market garden crops, but have been hampered by a lack of water and good quality seed. Fodder production was also still quite low. Small scale developments to remedy these problems are currently underway with the establishment of a dairy group, a poultry raising group, and a system for the promotion and development of market gardening crops.

Male

At the start of the project, major developments in Male were initiated by the government, but currently all activities are planned and carried out with extensive local participation. A green belt of *Prosopis* was planted to protect both the town and hillside dams, as well as to provide wood products. Sale of the wood by the local management committee has had a major effect on local attitudes; sand dunes that were previously a threat to the village's survival are now a productive source of income.

The availability of water for agriculture also poses problems in Male, with unpredictable fluctuations in the yield of traditional wells. Downstream from the dam, farmers manage to cultivate market garden crops and sorghum, but cropping could be diversified considerably with the development of an irrigation scheme.

An area of 360 ha has been demarcated, fenced and divided into two separate management units for dairy and non-dairy livestock, and fodder plantations have provided considerable yields. The village rangeland management committee president reported that significant savings were realized during a recent drought, as no fodder needed to be purchased from outside the village. Building on this success, a dairy farm is now being planned for another area of the village.

Maghta Lahjar

Dune fixation work started here in 1984 because of a major imminent threat of sand encroachment. Maghta Lahjar was actually slated for evacuation in 1983, but project heads opposed the plan to abandon the village and committed themselves to stabilizing the sand dunes in six months. This extraordinary challenge was met, strengthening the credibility of the project throughout the region.

Heavy machinery was first used to clear areas for *Prosopis* spp windbreaks. While this was an expensive process, it did enable the green belt to be established quickly. The windbreak now extends as greenbelt for 15 km, with a width of between 100 and 115 metres. The village is now fully protected, prompting the management committee president to exclaim, "If Egypt is a gift of the Nile, Maghta Lahjar is a gift of the green belt."

Since 1993 the management committee has been selectively logging parts of the green belt to generate income, which is then reinvested in protection of existing windbreaks and in the establishment of new tree nurseries.

Conclusions

In general terms the project has achieved its objectives, largely overcoming technical shortcomings regarding dune fixation noted in earlier evaluations. It has been implemented in an appropriate manner, through the motivation and close participation of a local population that is now much more secure on its own land and clearly sees very tangible benefits of dune stabilization. The project is progressing successfully toward the preparation of an integrated regional development scheme, and

deserves to be brought to the attention of the wider international community as an example of local communities' capacity to transform desert into forest.

References

Danida (1991). Project Evaluation report. January 1991.

FAO. F. Costa (1995). Management of the Mechanic workshop.

FAO. Mohamemed Taïeb Selmi (1992). Project: Development of Mahta Lajar Bracka protection area: Agro pastoral valorization Premvasp.

FAO. Barattya (undated). Technique Report: Exploration stages of development and management of pastures.

FAO. Sel Mi M. Taïeb (1992). Mission Report: support environment research.

FAO. Araki (1995). Elaboration of a reforesting national program.

FAO Mohammed Taïeb Salim and Hajej Mohammed Salim (1992). Report of mission Development of Magta Lahjar protection area.

FAO. B. Sawadogo Sawadogo (1993). Practicability of saving/credit group.

FAO. Jeans Gozsche Larsen (1994). Final Project report for period from 30/12/92 to 31/03/94.

FAO. Dah Ould Salihi (1995). Yearly Project activity report.

Windbreaks transform the desert

Greening Through Social Forestry

The Community Afforestation Project in Kano and Jigawa States, Nigeria

In response to rapid deforestation and desert encroachment, a World Bank and Nigerian Government-funded Afforestation Project (AP) was implemented in Northern Nigeria from 1988 to 1996. Using an integrated, multi-dimensional approach, the establishment of shelterbelts, windbreaks, woodlots, orchards and nurseries was combined with social forestry, which involved awareness-raising campaigns, school forestry programmes, forestry extension services and a fuelwood conservation programme to address the environmental and socio-economic problems in the region. Although twelve states participated in the project, Kano and Jigawa States were the most successful in achieving the desertification control objectives. Using lessons learned from the early years of project implementation, the AP modified its operations to increase community participation in decision-making and implementation and to develop programmes to address the role of women in afforestation efforts. Afforestation activities have continued without external funding and have a high potential for sustainability.

An individual's neem woodlot

Kano and Jigawa States cover a combined area of 43,000 km^2 in the Sudan savanna vegetation zone of Northern Nigeria. The area is characterized by a long hot/dry season and a short rainy season of 90 to 110 days, with an average rainfall of 300 to 650 mm. Periodic droughts have been experienced over the past century, including severe droughts from1972- 1974 and from 1983-1985.

The total population of the project area in 1991 was 8.5 million, with an annual growth rate of approximately 2.8%. GNP per capita in 1993 was $1,000. Approximately 96% of the population are ethnic Hausa or Fulani, and the predominant religion is Islam. The culture of the region is characterized by polygamous marriages and distinct gender roles, with severe restrictions on the activities of women, who tend to marry at a young age. Literacy rates are roughly 60% for men and 40% for women. Approximately 80% of the population are farmers, who traditionally use shifting agriculture and bush burning to produce the main economic crops in the region: millet, sorghum, cowpeas and groundnuts.

The problem

In Northern Nigeria there is widespread land degradation, mainly attributed to deforestation. Increasing agricultural intensity and livestock overgrazing, combined with increasing demands for fuelwood, have led to a rate of deforestation estimated to be 3.5%, one of the highest in the world. For example, from 1978 to 1992, in Jigawa State, the area of land used for intensive agriculture increased from 36.8% to 69% and undisturbed forest decreased from approximately 1.1% to 0.1%. Livestock densities are high, the majority owned by the nomadic Fulani, who retain large herds for security.

Soils in the region are ferruginous tropical soils, generally of poor structure and low fertility. The hot and dry climate bakes the bare, unvegetated soils, especially during the dry season. Coupled with high evaporation rates, the soil becomes powdery and easily blown away by the wind. Thus, in the absence of vegetation, wind and water erosion on exposed soils have had extremely detrimental effects, limiting plant growth and productivity. In the far northern areas, increasing sand dune formation is evident.

Until the early 1980s, the forestry sector in Nigeria had been a low government priority, comprising only 2.4% of Federal budgets. There was an inadequate national forest policy and improper forestry management strategies, as manifested in over-exploitation of forest resources and lack of inventory to ensure sustained yield. Forest revenue systems were outdated, tending to treat forest resources as free commodities, and State forestry departments had not been managing forest reserves systematically.

The Afforestation Project (AP) was one of three main components of Forestry II, a World Bank and Federal Government of Nigeria (FGN) funded project implemented in Nigeria from 1986 to 1996. The main objectives were to stabilize soil conditions in arid regions, to develop forest reserves and plantations in Southern Nigeria, and to strengthen project management through policy development and institutional strengthening. Forestry II followed Forestry I (1980-1986),

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by the Nigerian Government (FORMECU) and local communities with funds from the World Bank, the government and project States.

which focused on plantation development in South-Central Nigeria and infrastructure development and institutional support for the Federal and State forestry departments.

The Forestry Management and Evaluation Coordinating Unit (FORMECU) was established in 1987 to oversee Forestry II. Simultaneously, the Afforestation Programme Coordinating Unit (APCU) was established to manage the Afforestation Project directly in all northern states, and State Coordinating Units were established to implement the field programmes, working in collaboration with local governments.

The Kano State Afforestation Programme (KNAP) was established in 1988. The Jigawa State Afforestation Programme (JIGAP) was established in 1991, after Kano was divided into two States: Kano and Jigawa. JIGAP took on the activities in the newly formed States that were formerly managed by KNAP. Although the overall AfforestationProject was judged a success for achieving or exceeding its targets, Kano and Jigawa States were considered to have been the most successful of all 12 states, particularly with regard to desertification control.

Stabilization of sand by allowing indigenous Acacia species regeneration

Achievements

The project used an integrated, a multidimensional approach to achieve its environmental and socio-economic objectives. The main biophysical strategies of seedling production and shelterbelt establishment were combined with social forestry to ensure the sustainability of the interventions. Training was also provided for project staff to strengthen project implementation and management. After the mid-term review, the project recognized the need for a more bottom-up approach and increased community participation in project planning and implementation.

Biophysical innovations: The main innovation used to control desertification was the planting of shelterbelts, long rows of trees aligned to break the impact of prevailing winds. At least 541 km of shelterbelts were successfully established in the two states. In Northern Nigeria, belts were aligned in a northeast/southwest direction to break the most damaging of winds, which occur in April-May at the start of the rainy season. The main objectives were: (1) to provide a source of fuelwood; (2) to provide a source of poles for building; (3) to prevent desert encroachment by stabilizing soils and reducing winds; (4) to increase crop productivity; and (5) to make marginal lands more arable. The most common species used were the fast growing introduced species Neem (*Azadirachta indica*) and Eucalyptus (*Eucalyptus spp*).

Windbreaks are similar to shelterbelts, but with fewer rows of trees, so the land area affected is smaller. Windbreaks were adopted by the project where establishment of shelterbelts was resisted by farmers, due to scarcity of arable land.

Woodlots were established by the project, farmers' associations, schools and private individuals to increase the supply of wood for fuel and construction and to increase income by selling the products of the woodlots. They were generally 0.5 to 1.0 acre in size, with mostly Eucalyptus, Neem and Cassia species planted. Often, farmers were able to intercrop in the early stages of tree establishment and growth.

Orchards were developed to generate revenue through the sale of fruit and nuts, as well as for better nutrition. The species most commonly planted include guava (*Psidium guajava*), mango (*Mangifera indica*), moringa (*Moringa oleifera*) and banana (*Musa spp*). Other species planted were cashew (*Anacardium occidentale*), custard apple (*Anona muricata*) and citrus (*Citrus spp*).

Natural regeneration sites were designed through farmer awareness to encourage the establishment and growth of indigenous, multi-purpose tree species. This has resulted in reclamation of land and increased production of food, medicines and fuelwood. Roadside plantings were established by schools and communities to stabilize soils, provide fuelwood and poles, serve as windbreaks and provide shade. Nurseries were established to serve as sources of seedlings for the shelterbelts, woodlots and orchards. They continue to be either operated individually, communally or by the project, and the benefits accruing from production and sales are distributed accordingly.

Social forestry: Social forestry efforts focused on the participation of contact farmers, who were provided with incentives such as fencing materials, training and/or cash payment for surviving seedlings, in exchange for their participation in mobilizing other farmers ('target farmers') to participate in the afforestation efforts. Through agroforestry extension services, farmers were encouraged to plant trees or allow tree regeneration on farms. Another area of focus was the School Programme, which included the support of Young Foresters Clubs, establishment of school woodlots, orchards and nurseries, afforestation training and competitions. Public awareness-raising about the project was accomplished through the production and distribution of various extension materials on afforestation.

Following a mid-term review in 1991, a community-based organization (CBO) programme and a Women in Forestry (WIF) programme were developed and implemented. The CBO programme shifted the focus of implementation from the Government to local community organizations, especially farmers' self-help organizations. The WIF used female extension officers,

and subsequently contact women, to mobilize women to establish orchards and woodlots, and to build and use fuel-efficient woodstoves.

Research, studies and policy analysis: Research was undertaken on a small scale to inform project implementation. Examples of research conducted include field trials of various species for regeneration and seed supply capability, and a Neem disease project on the Scale insect. In addition, over 20 studies were reported on by Forestry II (including a household energy study), and policies relevant to the forestry sector were reviewed and improved, or recommendations were made for improvement.

Impacts

A high level of success was achieved by both States. Original targets were closely met and additional activities contributed to the sustainability of the afforestation efforts. The project had a positive impact on both the biophysical and socio-economic environment. Afforestation targets were achieved through shelterbelts and woodlots. Increased crop yields were experienced on farms protected by shelterbelts and windbreaks and through the integration of agroforestry in the woodlots. A high level of awareness developed among policy makers, school teachers and students and the rural population, about deforestation, desert encroachment and the need for fuelwood conservation. Increased income was realized from orchards and woodlots. The supply of fuelwood has increased because of the woodlots and shelterbelts. In addition, improved nutrition and health was reported by participating schools and families through increased consumption of fruit.

Social capital: In terms of social capital, the project built on existing economic and social systems, including traditional government, and strengthened community-based organizations, including farmers' self-help associations. Participating farmers have been empowered to establish and manage their own afforestation projects, which have proved to be a source of income and employment generation. At the State level, training and professional development have built the capacity of the Afforestation Units to effectively plan, implement and evaluate further afforestation activities. Integration with other relevant sectors has been established, most notably through the Unified Agriculture Extension Services (UAES) and through the school programme, which has linked Forestry with Health and Education. Among other benefits, this integration has improved small farmer access to credit and contributed to the cost-effectiveness of the afforestation achievements.

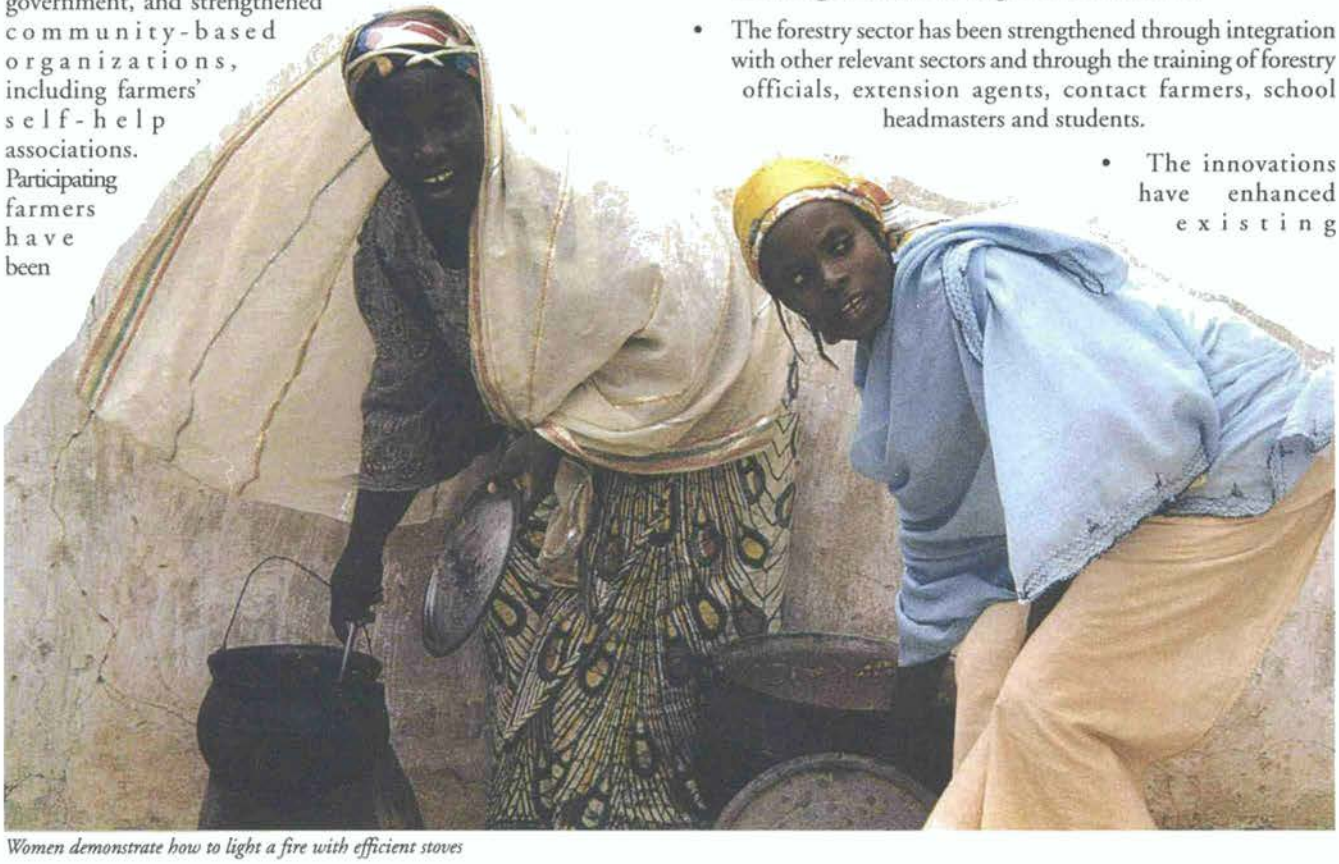
Gender and environment: Gender was not a focus in the original design of the project (in the early 1980s) and participation of women was mainly limited to members of Young Foresters Clubs at girls' schools. However, in recognition of the importance of women in afforestation, the project was later modified to mobilize women to produce and use fuel-efficient stoves and establish their own orchards and woodlots. These activities have been a source of empowerment for participating women and have high potential for replication.

Sustainability and replicability

The sustainability of the afforestation activities is assured for a number of reasons:

There is an increasing level of awareness of desertification and the benefits of afforestation among policy makers and the general population in the region.

- There is a strong commitment to afforestation among policy makers and leaders at the Federal, State, local government and village levels, including traditional leaders.
- The forestry sector has been strengthened through integration with other relevant sectors and through the training of forestry officials, extension agents, contact farmers, school headmasters and students.
- The innovations have enhanced existing



Women demonstrate how to light a fire with efficient stoves

economic activities, such as farming, fuelwood production, and pottery (for fuel-efficient stoves), which are implemented through existing social institutions.

- The project has also recognized and built on indigenous environmental knowledge in the adaptation and use of agroforestry techniques, and through this has encouraged the regeneration and use of indigenous tree species.
- Sustainability is evident in the reported diffusion of the innovations from contact farmers to other farmers.

Potential constraints to sustainability:

- The seasonal shortages of water, a basic need that is a priority above all else. The need for water has impeded reforestation efforts in some areas.
- Although the benefits of shelterbelts established by the project have been successfully demonstrated to farmers, sustainability of further shelterbelt establishment is not assured due to the large area of land required and an increasing demand for farmland due to high population growth rates.
- Project innovations would be replicable in other arid regions of the world where there are similar soil types, vegetation, land-use and social structures. It is anticipated that there would be a high degree of replicability throughout arid zones in Africa, given the similarity of land use and social structures along the East-West Sudan Savannah belt.
- Replicability of shelterbelts in particular would depend on government commitment and funding for shelterbelt establishment and the participation of local communities in the early stages of planning.

Lessons learned

During project implementation, both States demonstrated a keen interest in self-evaluation and were able to apply the lessons learned at mid-term to modify and improve the project, particularly in terms of community participation and the participation of women.

One of the key lessons learned was that it is important to identify and involve stakeholders in planning and implementation in order to create a sense of ownership and to ensure support for the implementation and sustainability of afforestation efforts. While there was limited community participation in the design of the project, there was an emphasis on encouraging beneficiaries to participate in planning and implementation following the mid-term review. Related to this was the realization that providing cash and material incentives for participation are not effective in ensuring lasting farmer support of afforestation activities.

References

APCU (1989). (Afforestation Programme Coordinating Unit, Kano) Afforestation Programme Co-ordination Unit, Kano. World Bank Aide-Memoir. Compiled by the Monitoring and Evaluation Department.

APCU (1985). (Afforestation Programme Coordinating Unit, Kano). Assessment of Survival and Growth Rates of Shelterbelts, Woodlots and Roadside Planting of Afforestation Project (1988-1993).

APCU (1988-1996). (Afforestation Programme Coordinating Unit, Kano). Status Report.

APCU (1996). (Afforestation Programme Coordinating Unit, Kano). Study Report on the Simulation of Improved Wood-cutting Stoves.

APCU (1996). (Afforestation Programme Coordinating Unit, Kano). Impact Assessment of Afforestation Component of Foresty II: World Bank Assisted Project, Final Report.

APCU (1997). (Afforestation Programme Coordinating Unit, Kano). Report of the proceedings of the Policy Makers'/NGO National Dialogue.

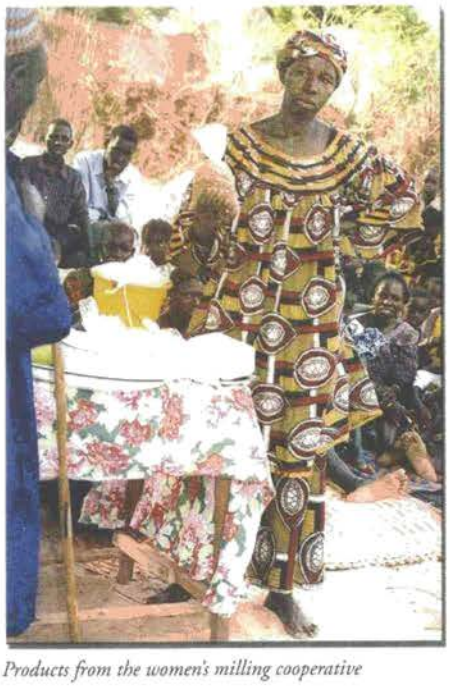
Restoring Hope

Environmental Protection and Rehabilitation in Louga, Northern Senegal

The Louga region, in the north Sahelian zone of Senegal, suffered extensive desertification during the early 1970s largely as a result of drought, demographic changes and modifications in land use practices. The local population, largely subsistence farmers and herders from two major ethnic groups, the Wolof and the Peulh, have used indigenous agroforestry techniques for centuries to produce abundant food supplies from sandy dryland soils. But their way of life was severely affected by a harsh and prolonged drought that began in 1973, resulting in loss of livestock, enhanced wind erosion of soils, and an increase in male migration to urban centres in search of other work. This case study outlines a community-based project to rehabilitate the area's ecology and economy.

Agricultural land prone to erosion after harvest

Annual precipitation in the Louga region was already low and irregular, but the annual average total of 600-800 mm prior to the drought of 1974 has since fallen sharply to 200-300mm a year. Water supply has always been a problem in this dryland area, but the drought made this perennial resource shortage more acute.



Products from the women's milling cooperative

The initial impact of the drought was loss of livestock through dehydration and starvation, which, in turn, threatened the long-term food security system of the pastoralist/nomadic population. Farmers lost food, organic fertilizer from animal dung and significant income. Decreasing rainfall also forced a change in land use. Yields from traditional *tokeur* plots, small areas of cropland protected by local trees and shrubs, declined with the onset of drought, and many were replaced by monoculture cropping of peanuts and millet. Poor yields per hectare of these crops resulted in a reduction of fallow and rotation periods in an effort to boost output. Trees throughout the region were cleared to make way for additional farmland and to meet firewood needs, which led to enhanced wind erosion and accelerated land degradation.

The onset of drought also had a major impact on the demography of the Louga region. Much of the economically active male population left the area in search of work in the cities or abroad. The number of households being headed by single women shot up; at the height of the drought, nearly 60% of the women left behind with children had to assume duties as temporary household heads.

The environmental restoration and protection project for the Louga region was initiated in 1985 by World Vision International (WVI), a Christian NGO. The overall objective was the sustainable improvement of living conditions for the rural population of this degraded agrosylvipastoral environment through water supply, access to back-up services like education, and increased agricultural production through better land use and soil conservation. The approach was based on the principle that a regular supply of basic needs and income earning opportunities is the basis for household food security, and this security is the necessary foundation for any attempts to address the problems of environmental degradation.

UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by World Vision International (WVI) and local communities with funds from WVI.

Using the Participatory Rural Appraisal Method, WVI staff held discussions with villagers in more than 17 villages that served as pilots for the project, adopting an approach designed to help people recognize resources within themselves and their communities. It was a deliberate "bottom-up" approach, aiming to stimulate community involvement and support as well as accountability within the community. It emphasized the following:

- A grassroots approach, revitalising and building on existing traditional knowledge;
- Respect for the social context of any intervention, group and individual endeavour;
- Social mobilization and an increase in individual awareness of sustainability;
- Adaptation of innovations to the needs of the population;
- A partnership relationship within communities; and
- Eventual withdrawal of outside advisors, as a means to achieve self-sufficiency.

Community afforestation initiative, with Prosopis juliflora

The design of the WVI project was closely in line with national policy on desertification, environmental protection and conservation. The Government of Senegal's VIII Socio-Economic Development Plan (PDES) 1989-1995 included the following rural development objectives:

- To achieve food security;
- To promote traditional crops and professionally introduce new ones;
- To combat desertification;
- To encourage environmental protection and soil conservation in order to ensure sustainable management of natural resources;
- To improve living conditions in rural areas.

Within the framework of its "*Plan de Développement Economique et Social*" (PDES), the country launched two important development policy documents: *Une Nouvelle Politique Agricole* (New Agricultural Policy Document), 1993, and the Forestry Action Plan Document, 1994. Both policy documents advocate an integrated approach towards agricultural and rural development, which emphasize:

- Improvement of the institutional framework;
- Sustainable use and management of forestry and other natural resources;
- Restoration and conservation of soil fertility, through the promotion of agro-forestry and agrosylvipastoral farming systems;
- Training programmes on protection and conservation of the environment;
- Promotion of participatory approaches with beneficiaries using their own know-how;
- Training for improvement of the living conditions of certain groups (e.g. women and youth) through income-generating activities.

National development policies advocate combating desertification in the whole country, and in the Sahelian zone in particular. Senegal ratified the Convention to Combat Desertification in June 1994 in Paris and remains an active member of the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS).

The WVI project maintained a close relationship with the Ministry of Water and Forestry, Hydrology Department, the office that surveys all borehole activities, and there was close collaboration with the Institut Sénégalais de Recherche Agricole (ISRA), the International Institute for Tropical Agriculture (IITA) and the University of California, United States in the introduction of two improved varieties of cowpeas (*Niêbe*).

Sand encroachment

Clearing ground for school construction

Innovations

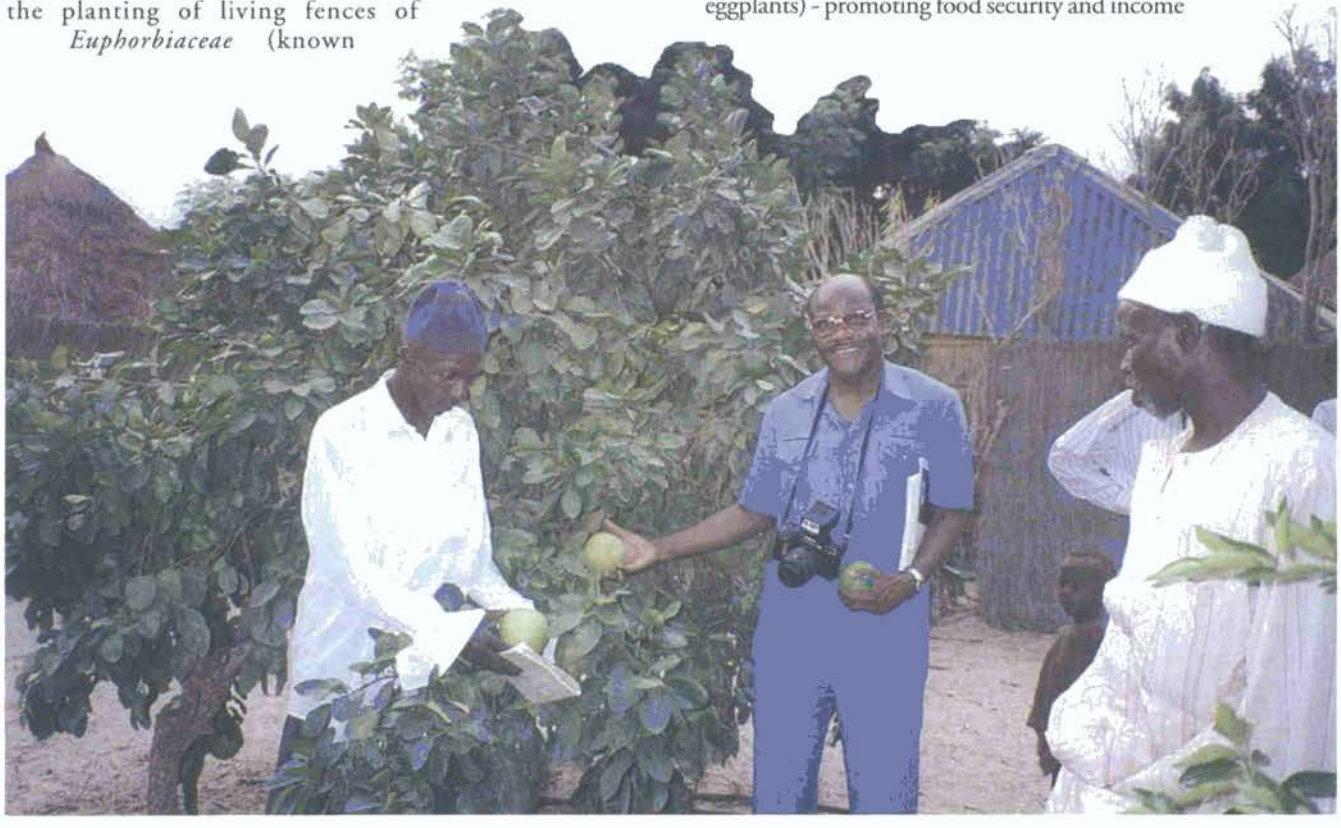
Water availability: Initial studies showed that the shortage of water was one of the most basic problems in the Louga region. In collaboration with the Hydrology Department, a total of 458 boreholes had been drilled since 1987 for settlements with more than 250 people, and supplied with manual or wind-driven pumps. Village water committees, comprising both men and women, were first established to raise the necessary funds: 150,000 CFA (US$ 300). Monitoring of the water table in the region indicated that the new wells were extracting groundwater at a sustainable rate.

Afforestation and natural generation: Villagers throughout the project area had successfully revived the old system of *Tokeur*, the planting of living fences of *Euphorbiaceae* (known locally as *salans*) to provide zero-grazing enclosures of about 15 m^2 in which crops are cultivated. *Salans* both protect the *tokeurs* from straying animals and against wind erosion. Planting within the *tokeurs* was carefully planned to rehabilitate the soil. A couple of seasons of manioc, a basic food crop with a low phosphate requirement, were followed by potatoes and cowpeas. As the soil quality improved, crops such as millet and tomatoes were planted. This relatively intensive cropping system reduced the need for tree clearance on surrounding lands for agricultural extension. Fodder crops were also grown in the *tokeurs*, reducing grazing pressure on surrounding pastures.

A vital part of the strategy for soil conservation was the introduction of *kad* trees (*Acacia albida*) and leguminous crops like cowpeas, as well as the revitalization of traditional methods like euphorbia fencing. As a result of the project's activities, several species had been re-established for the first time in ten years: Kel (*Grewia bicolor*), Baobab (*Adansonia digitata*), Ngigis Mborin, Mbep (*Sterculia setigera*), and Bér (*Sclerocarya birréa*). Tree planting and nurseries were managed by women and children, and in some cases by school classes. These activities were labour-intensive and did not yield high incomes, but villagers. subsequently enjoyed the benefits of many shade trees.

Throughout the Louga region, the project led to the establishment of ten village horticultural nurseries, five nurseries for fruit trees, and 133 agroforestry nurseries. The overall outcome of the agrosylvipastoralism and soil conservation activities are summarized below.

Cropping outside the tokeurs: In the fields surrounding the project villages, a wide range of crops was produced - mainly cowpeas, peanuts, cassava and vegetables (potatoes, tomatoes, eggplants) - promoting food security and income



Fruit production at the village level

generation at the village level. Cowpea cultivation has proved to be particularly successful. The crop provided a good ground cover that protected soil against erosion. The project also successfully introduce a high-yielding cowpea variety. Cowpea, processed into couscous, provided an additional basic food to supplement the traditional staple, millet-based couscous. The possibilities of exporting surplus cowpea production to the Republic of South Africa were being negotiated with private traders.

Economic empowerment through revolving funds: In 1993, when the above schemes to combat the basic problems of water supply and crop production had been established, a revolving fund scheme was established to enable villagers to run their own income-generating schemes. Loans were made over periods of three to six months to groups who pay interest on the money at 3% below bank rates. These groups, in turn, repaid their loans to other groups or individuals.

The revolving fund scheme proved to be a great success, with repayment rates to date of 100%. Borrowers used the funds for a variety of schemes, including zero-grazing fattening of livestock, the provision of food processing equipment for women's groups and the introduction of more efficient stoves.

Livestock fattening schemes using fodder grown in *tokeurs* were implemented both collectively and by individuals for young bulls, sheep and goats. Women tended to concentrate on sheep and goat rearing, while men specialized in bulls. In one example, in the village of Par Cissé, a men's group with 10 bulls made a profit of 150,000 CFA (US$ 300), or 15,000 CFA (US$ 30) per person, after just four months. This figure included income generated from the sale of 7.5 tons of manure to gardeners and nursery managers. Millet mills generated the highest levels of income for groups who have invested in food processing.

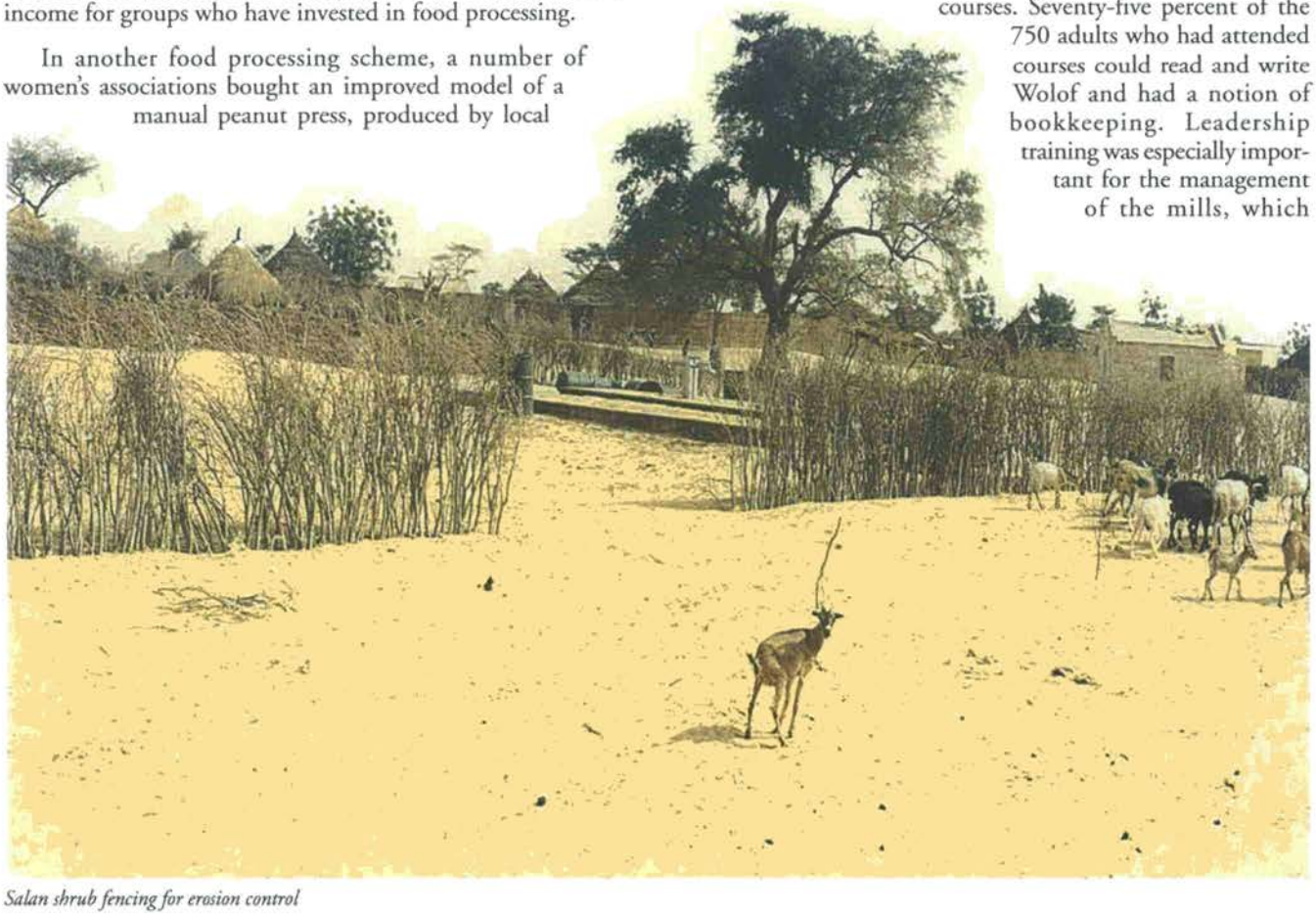
In another food processing scheme, a number of women's associations bought an improved model of a manual peanut press, produced by local village blacksmiths, for 75,000 CFA. These communally-owned presses yielded high returns. The processing costs were half a franc per litre of oil pressed, while one litre of oil could be sold for 335 CFA and more. The annual salary of a family unit was 70,000 CFA (1992). The average family unit (11 or more members) produced 1,000 kg of peanuts per year at 70 CFA per kg. They consumed at least 78 litres of peanut oil, i.e. worth 26,130 CFA. A family unit in this region consisted of one male head of household, his wives and the children eating from one cooking pot. If all the harvest was processed into oil, i.e. 242 litres, and the cake and husks are sold or used as animal feed, the net revenue could be as high as 80,000 CFA. The widespread acceptance of the new peanut oil presses, and high demand among women for more machines, indicated the project's success in dissemination of this appropriate technology.

The improved fuel-saving stoves were much appreciated by the women who made them; they claimed that the stoves used only 25% of the wood used in normal stoves. However, the design of the new stoves needed further improvement, since most needed some form of repair after three to five years, and few women took responsibility in undertaking these repairs.

Education and training

Between 1990 and 1995, 19 education centres had been established, and 1,200 children had participated in educational courses. The quota of girls participating in school activities was gradually nearing 50%. Of these children, 59% could read and write French, and knew the basics of mathematics.

Adults also participated in literacy courses. Seventy-five percent of the 750 adults who had attended courses could read and write Wolof and had a notion of bookkeeping. Leadership training was especially important for the management of the mills, which



Salan shrub fencing for erosion control

Peanut harvesting

were entirely in the hands of women. Literacy training was most successful for women, since unlike the men they did not migrate away from the villages in search of employment.

Women and development

Women's needs were a special focus for the Louga region project. In 1992, for example, WVI opened Women in Development (WID) offices in Mbacke and Thies in 1992, employing eight local women professionals as staff. The objective behind this move was to integrate local women more fully into the project's activities and its institutional set-up, hence both responding to the women's needs and implementing the long-term strategic needs of making women and girls equal partners in development. The women were given training in a range of skills, including income generation, institution-building, management and leadership, bookkeeping and credit. Mothers and daughters were also provided with family planning education.

Replication and sustainability

Once a water supply was assured, the people of Louga generally accepted the expansion of the *tokeur* plantation system, the natural regeneration of trees, and the planting of multi-purpose trees around the villages. The intensive livestock raising in fenced fields contributed to the improvement of soil quality, as the collected manure was used as organic fertilizer. Social group cohesion was encouraged and the villagers considered themselves an integral part of the project activities. In this way, the sustainability of the project activities was most certainly assured. The project laid a good foundation for income generation through specific revolving funds and training programmes for the beneficiaries. Under the circumstances, the project provided a good example of a high level of awareness in the population about both the problems of environmental degradation and the ways to solve them.

Sustainability in the pilot village areas was secured through the use of revolving funds. The mechanisms for accountability were established through community structures for agricultural and livestock activities to promote desertification control. These included nurseries, water maintenance committees, revolving loan committees, mill committees, training committees and many more. The different committees, especially in the pilot villages, had opened bank accounts with the formal Senegalese banking system to assure sustainability. The establishment of WID offices in 1992, with a professional team of eight local women, was another sign of being on the road to sustainability, in a setting where female-headed households were in the majority.

This project initiated positive steps towards combating and controlling desertification in the semi-arid zone of Louga. The project created consciousness and raised awareness in the local community of the fact that desertification control is a long-term process, and that ultimately only they can successfully tackle these problems.

References

Bulletin bimestriel du Centre Technique de Coopération Agricole et Rurale, la Gestion du Terroir: (undated). Un Défi écologique, 15 pages.

GTZ. Van Maydel, H.J. (1986). Trees and Shrubs of the Sahel, GTZ Publication No. 796, 1986 p. 613

Programme de Développement Intégré dans la Région de Louga (1990). Un Aperçu Juin.1990 23 pages + 5 cartes.

Plan d'action Forestier (1993). Sénégal, Juin 1993 Volumes I, II and III.

Rapid Rural Appraisal (RRA) (1992). Socio-économic survey of the villages of Gadiack - W.V.I Mbadiane Keur Mbagne Diop 1, Ndatou - Summary Report July 1992, 15 pages.

République du Sénégal (1994). Ministère de l'Agriculture "Déclaration de Politique de Dveloppement Agricole D.P.D.A., Rapport. Dakar, Juin 1994, p. 43 + Annex.

République du Sénégal (1993). Ministère du Développement Rural et de Hydraulique. Plan A'action Forestier, Vol. I Resumé Exécutif, Vol II Document Principal, Vol III Fiche de projet Dakar, Juin 1993.

Sarr, M, (1973). Louga et sa Région, IFA, N., Bakel 1973, p.292.

Workshop on the method of Rapid Rural Appraisal (RRA) Research Technique (1991). Group report on the provision of potable water and the health and nutritional conditions of the population of the village of "Par Cissé", November 1991, 23 pages.

World Vision International (W.V.I) Sénégal. Mansour Fall (1992). P.N.V.A - Programme Recherche Développement. Seetum Baaxaayu jiwwuyi. (Comment voir les bonnes graines de semence) Avril 1992, 25 pages Wolof et Arabe, 2 documents.

W.V.I. Senegal. Al Johnson et son équipe (1992). Programme de Développement intégré. Louga - Thiés. Rapport Annuel 1992, 97pp.

W.V.I Sénégal (undated). Liste des Villages par Communauté Rurale, Région de Louga, Tableau de Récapitulation des Forages Louga et Thiés. Liste des Villages, Fres par Communauté Rurale Région de Thiés, 16 pp.

W.V.I Senegal (undated). Projet de Restauration et de Protection de l'Environnement. Plan d'Action, 11 pp.

W.V.I Sénégal. Al Johnson (1993). Annual Report Fiscal year, Louga - Thiés Region, 1992 - 1993; 26 pages.

W.V.I Senegal. Schoonmaker, K., Freudenberger, M., Yvette Kinkpé, Babacar Mboup, Désiré Sarr (1993). Fields, fallow, and flexibility: Natural Resource Management in Ndam Mor Fademba, Sénégal. Result of Participatory Rapid Appraisal carried out 25 - 30 October 1991, IIED/ Brylamos/Programme. Paper no.5, 1993.

W.V.I Sénégal (undated). Synthèse Enquêtes, Production Agricoles et Consommation, 14 pages.

W.V.I Sénégal (undated). Synthèse Enquêtes sur l'Organisation Villageoise. 2 documents, 9 pages.

W.V.I Senegal (1993). Consolidation des Projets de Restauration et de Protection de l'Environnement, Programme de Consolidation des Projets de Par Cissé, Mai 1993, 9 pages.

W.V.I Sénégal. Mansour Fall (1994). Integrated Development Programme in Louga and Thiés Region.

W.V.I Senegal (1993). World Vision International Sénégal United Nations Environment Programme. Programme des Nations Unies pour l'Environnement. Désertification Control Programme Activity Centre. Restauration et Protection de l'Environnement au Nord Sénégal. Terroir de Par Cissé, Keur Sidi Mbengue, 1993. Rapport: 27 pages.

The Fertile Desert

The Community Forestry Project, Ed Debba, Sudan

Introduction

This project aimed to prevent sand encroachment from the Sahara desert onto arable land and land for human settlement near Ed Debba, a small town on the banks of the Nile River in the Northern State of Sudan, through the establishment of deep-rooting mesquite-tree shelterbelts, dune fixation and planting of *Eucalyptus* windbreaks. The project started in 1988 with US$1.5 million in funding from the International Fund for Agricultural Development (IFAD) through the Government of Sudan, in response to requests by the community in the area of Ed Debba. It was implemented by SOS Sahel, a British NGO, in close co-operation with the Sudanese Ministry of Agriculture and the Forestry Department, Forests National Corporation (FNC).

The problem the Ed Debba community was facing was that the narrow strip of fertile flood plain along the Nile River is being gradually buried by encroaching sand from the desert, exacerbated by tree cutting and overgrazing. In some areas, mobile dunes creep forward onto cultivated land at a rate of 25 metres per year. Wind-blown sand damages crops and machinery, fills wells and canals and buries houses, clinics and schools. Combined with very high land pressure on this narrow strip, this translates into a shrinking economic base.

Before the project began, local people tried to solve the problem using barriers of dead date-palm leaves and other mechanical methods that proved to be neither cost-effective nor sustainable, as they demanded a great deal of labour to maintain. There was very limited technical knowledge about how to design and manage such innovations. The majority regarded their situation as hopeless, living a life of constant possibility of being forced to move to another area every few years.

The project successfully grew sustainable mesquite shelterbelts and eucalyptus windbreaks to stabilize mobile dunes. In the process, it demonstrated to the communities concerned that they can help themselves to protect their own environment.

The project succeeded inprotecting 630 hectares of land which would probably have been buried without any intervention. Another 60 hectares of land were created by the "vacuum effect" of eddy winds generated after dominant northerly sand-laden winds from the desert were obstructed by shelterbelts. A total of 52,000 people living in 27 villages did not have to migrate from the project area, which also meant that their homes and associated infrastructure were saved from burial by moving dunes. It was estimated that if the protected land were put to good use growing date palms, the main cash crop in the area, an income of approximately US$3,000,000 could be generated annually.

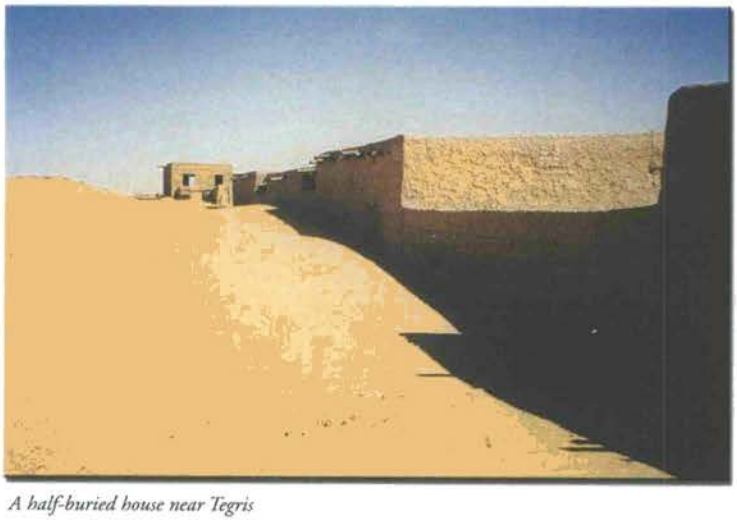
Social benefits included a cooler micro-climate, particularly in summer; increased drinking-water supplies from boreholes sunk by the project; opportunities for women to make money by growing and selling seedlings for shelterbelt and fruit trees which, in turn, gave them some degree of financial freedom and encouraged the construction of better-quality houses. More fuelwood was available for cooking, and there was more shade and fodder for herbivores in an otherwise barren area. Extension activities improved the local people's awareness of the dangers of desert encroachment through drama and videos.

Other benefits included the acquisition of knowledge and skills in designing and managing shelterbelts and fixing dunes, and community empowerment to deal with the desert-encroachment problem through the formation of farmers' or village committees under an umbrella Village Afforestation Committee introduced by the project.

The project was a good example of success in preventing environmental disaster using a participatory approach and sustainable local natural resource management.

Background

Sudan is Africa's largest country. Like neighbouring Chad, it straddles two cultures: Arab in the north, African in the south. Sudan has a population of about 28 million people, 80% of whom, including some 2 million nomads, live in rural areas. Arabs comprise nearly 50% of the population. Seventy percent



A half-buried house near Tegris

UNEP's "Saving the Drylands" award winner, 1996. This project was implemented by SOS Sahel and local communities with funds IFAD.

of the population are Muslim (mostly in the north), 25% traditional animists, and 5% Christian.

In the country's north and west are vast areas of desert that support little life, and in the east is the semi-desert of Nubia. Rainfall is scanty but tends to occur in the form of violent storms that disrupt communications. There are frequent dust storms in summer.

Sudan's economy is based almost entirely on agriculture, but less than 10% of the land is cultivated and only about 1% is irrigated, mainly for export crops - cotton, nuts, dates, sesame, gum arabic and sugar cane. In addition, farmers grow leguminous crops and graze their animals freely in the fields after harvesting, both of which help to restore soil fertility. Areas that can support significant crop cultivation are confined to Gezira, between the Blue and White Niles south of Khartoum, and the narrow belt along the entire Nile basin in northern Sudan.

Site of a village in Argi now buried by sand

The fertility of the soil along the Nile River basin is replenished annually by deposits of silt from the river. Occasionally, the Nile basin experiences severe flooding, which also damages crops and infrastructure.

The project area is situated in the Northern State of Sudan along the River Nile. Land suitable both for agriculture and human settlement along the Nile basin is under serious threat of burial by mobile sand dunes.

The project's objectives were to:

- Save agricultural land and land for human settlement from desert encroachment;
- Recover land already buried by the desert and ensure its sustainable use; and
- Protect infrastructure such as houses, schools, clinics and wells, from inundation by moving sand.

These objectives were to be met through the establishment of shelterbelts of mesquite (*Prosopis spp.*) consisting of:

- Internal shelterbelts for protecting agricultural land closer to the Nile River;
- Shelterbelts further away from the villages to act as the first line of defence in protecting settlements;
- Establishment of windbreaks of species such as *Eucalyptus* which are planted around and on farms in the lee of shelterbelts to protect crops from descending eddy winds;
- Fixation of active sand dunes threatening to bury settlements or agricultural land.

Traditionally people in the Northern Province already used such interventions as "planting" mechanical barriers of dead palm leaves, which were not sustainable because sand accumulating behind the shelterbelts would soon bury them. There is also evidence that before Sudan's independence in 1956, mesquite shelterbelts were established on a pilot basis in the Northern Province, and that these were found then to be effective in slowing desert encroachment. Thus this project was building on indigenous technical knowledge and experience. Mesquite was found to be the most appropriate tree species for dealing with the problem of desertification in this particular area. Once established, it is very effective in reducing the rate of sand-dune movement and does not require extra labour for replanting, as is the case with mechanical shelterbelts.

Achievements

Biophysical: The environment in which the project is located is extremely arid. Evapotranspiration of over 6,000 mm far exceeds the average annual rainfall of less than 20 mm. The hottest months are from April to October and day-time temperatures reach a maximum of 43°C in June. There is a brief cool winter with an average annual daily maximum of 37°C and daily minimum of 20°C.

At present, the project area is mostly desert, with successive waves of sand dunes moving towards the banks of the River Nile. In some areas this sand is moving at a rate of 25 metres per year, burying land and buildings in the process. The greatest movement of sand dunes is the result of the northerly or north-northeasterly wind which blows from October to May and is at its worst from February to April. During the remaining months of the year there is a more variable south or south-westerly wind, which is generally less effective in moving sand.

The project area comprises a narrow band of flat land with villages along both banks of the Nile and the desert immediately behind this strip near Ed Debba some 300 kilometres north of Khartoum. Occasionally, the area along the Nile (including the project area) is flooded after heavy rains in the catchment area. This happened in 1988 and 1994, resulting in the destruction of crops, houses and clinics. The amount of available land for both agriculture and human settlement is rapidly diminishing as a result of natural population increase and desert encroachment.

Types of vegetation cover introduced by the project: *Prosopis chilensis* (mesquite) was introduced for shelterbelts and *Eucalyptus camaldulensis* for windbreaks. Prior to the introduction of these species, the project had experimented with 18 species, and continues to identify others in order to diversify the variety of trees used in shelterbelts. Some people felt that mesquite is also a serious threat to arable land since it is a potential weed, the seeds of which are easily dispersed in the droppings of the

herbivores that eat the nutritious pods. Debate arose on what is popularly known as "The Mesquite Decree" issued by the Federal Council of Ministers describing it as "a dangerous weed that readily multiplies, spreads, encroaches upon agricultural land and therefore should be eradicated."

However, most indigenous species are much slower growing than mesquite and therefore can easily be buried by mobile dunes. Therefore, continued use of mesquite is recommended and, with the critical shortage of land suitable for crop cultivation along the Nile, it is felt that any serious invasion of arable land by mesquite will be controlled by the farmers themselves. One farmer remarked, "Mesquite shelterbelts havemade our dreams come true. They have truly brought hope to all of us here. We realize the species can be a problem, but ... with the land shortage it won't have a chance in the farms because we will weed it out, although with a lot of respect for the wonders it has done in saving our land!"

Soil and water conservation: Cultivable soil must be protected from burial by wind-blown sand. Water conservation is equally important because of low rainfall and high evapotranspiration. Sinking boreholes in the desert is costly, as is investment in water pumps and irrigation pipes. This equipment must also be protected from being damaged or buried by sand. These costs can account for as much as two-thirds of the revenue earned from the crop under irrigation.

The project provided water pumps to the villagers, who in turn provided some of the labour required to dig the wells. During Phase I of the project nine wells and water pumps were installed. Thereafter, pipes instead of furrows were used to transport water to the newly planted shelterbelts in order to reduce loss of water through evaporation under extremely high daytime temperatures.

The main soil-conservation interventions are mesquite shelterbelts and eucalyptus windbreaks. Sand fences supported by dead date-palm leaves were also used as temporary barriers to facilitate the establishment of the living shelterbelts.

Windbreaks were found to be very effective in minimizing evapotranspiration on the farms. For instance, farmers reported that in the absence of windbreaks they needed to water their crops every five days compared to every ten days after the project's intervention.

Effectiveness and sustainability: After a period of one and half years of irrigation, mesquite shelterbelts and Eucalyptus windbreaks were fully established and very effective. However, sand fences are not durable as they need to be maintained regularly. As a result, sand fences, which were also used traditionally by the local people, are only used as a complementary or preparatory method for the establishment of tree shelterbelts.

Community involvement: The local community was involved in most of the stages of project planning: project identification, feasibility studies, project designing and appraisal, fund-raising, implementation and monitoring and evaluation. The local community itself requested SOS Sahel to help stop desert encroachment in this area after they had heard about a similar successful project implemented by SOS in the southern provinces. After informing the *Wali* of the Northern State, the Development Committee and the Local Council for Ed Debba Province, SOS visited the affected community to carry out a needs assessment and baseline study. The project staff first consulted the village elders, whose judgement and advice are generally accepted by all the villagers. Within each village, there is a Salvation Committee of representatives from three sub-committees responsible for the welfare and development of the village, in agriculture, mosque or church-related activities and the provision of services such as health and education.

At the community level, the project introduced an Afforestation Sub-committee to spearhead and co-ordinate all activities related to the problem of desert encroachment, in close collaboration with SOS Sahel staff. All farmers or village committees involved in the establishment of shelterbelts choose one representative to sit on the Afforestation Sub-committee. A public meeting was then held to discuss the findings of the baseline study and to plan what was to be done. SOS then facilitated the formation of village committees or farmers' committees comprising active people elected by the villagers themselves. The project thus empowered existing social structures to raise awareness, prioritize, plan for and implement projects aimed at saving their land from inundation.

The role of farmers' committees: Farmers' committees convened meetings amongst villagers and with SOS Sahel project staff, helped in decision-making regarding the location of shelterbelts or where to fix dunes; and generally helped in the strategic planning process and mobilization of the community's labour contribution. The project staff and the villagers monitored and evaluated project progress during meetings which could be convened by either party.

During the initial pilot phase of the project, SOS Sahel provided a major part of the infrastructural requirements. To enhance the commitment of the villagers during Phase II, which was aimed at extending the gains from the earlier phase, SOS asked the villagers to dig wells in return for water pumps. This led to the villagers to establish their own shelterbelts with little intervention from project staff. This has encouraged many other villagers to start similar activities.

Community contributions: This project is a good example of genuine community participation. The very visible threat of desert encroachment had a direct impact on people's sense of security both at work and at home. As a result, men, women and children have all been involved and made a contribution in selecting locations and planting and watering the shelterbelts. Women have been very active in producing seedlings suitable for shelterbelts, shade and fruit, and children in establishing shelterbelts to protect their schools. Two schools in the project area have been saved from burial by moving dunes.

Economic benefits: In the years since the project began at the four sites along the Nile, 630 hectares were saved from burial by moving sand. In addition, in the villages of Argi and Abkor, about 60 hectares of land which were once buried by moving sand were reclaimed. Assuming all this land were to be utilized to grow date palms as a commercial crop, it is estimated that the potential annual income could be over US$ 3,000,000. This figure was arrived at as follows: 0.2 hectares of arable land are needed to sustain an average family of 6 people producing date palms. Although the project area actually supports 8,692 families, the number of families that this land is capable of sustaining is 690ha devided by 0.2 which addsup to 3,455 0.2ha parcels. Each 0.2ha parcel of land can produce US$1,000 worth of dates per annum (50 date palms can be commercially grown on a

quarter of a hectare and each tree can produce US$20 worth of dates per year). This gives 3,455 x US$1,000, which is US$ 3,455,000. It should be noted, however, that farmers would need to invest in the actual growing of the date palm trees allowing a period of four years before the trees mature. Each tree gives rise to three more trees in its lifetime. This means that these calculations are very conservative and the actual earnings could be three times higher.

Farmers also reported an increase of between 50% and 100% in yields resulting from improved cross-pollination (cross-pollination is reduced under windy conditions) and the general improvement in the microclimate brought about by the planting of windbreaks.

A dune fixed using mesquite shelter belt

At household level, the cash benefits can best be illustrated by the case of one farmer living in the project area. He planted 50 date palms on land in Argi village that was saved from encroaching dunes. After four years of nurturing the plants, he expected to harvest 50–70 kg of dates per tree. At a market price of US$ 20 per 50 kg, the entire crop would earn him more than US$ 1,000. (In 1992, Sudan's GNP was US$ 420). After another four years, three offshoots would have grown from each tree, earning the farmer a further US$ 4,000-5,000. He planned to invest this income in a better house and to improve his family's general standard of living.

Involvement of women

In keeping with the local culture and tradition of restricted direct working relationships between men and women, women formed their own village committees with specific complementary inputs to the project. These were to consider the following activities identified by villagers and the project's women officers: establishment of home and village nurseries to produce seedlings for the project and for fruit projects; growing vegetables; making improved charcoal stoves; preparation of food for those planting shelterbelts; and in some villages where there is severe male out-migration, watering and planting the shelterbelts.

Fodder benefits

By growing mesquite trees whose pods and leaves provide good fodder for herbivores, the project contributed towards the provision of both fodder and shade for the animals. This was acknowledged by one farmer who said that now he does not have to drive his animals out to the fields so frequently since he can collect mesquite leaves and pods and feed the animals at the homestead. However, no data were available on the quantity of fodder obtained or increase in numbers of livestock reared.

Cost effectiveness

From 1988 to 1995, over US$1.5 million was spent on water pumps, management and other expenses by the donor. Assuming, at a rough estimate, that the villagers injected an equivalent amount in labour, the annual rate of return is over 100 per cent. This means, that an investment of US$3 million would generate earnings of US$3 million annually, ignoring inflation, exchange rate movements, etc. The return on investment is more pronounced when the social and development benefits are considered, for example saving infrastructure from being buried by sand, extra fodder availability and shade provided by trees. The shelterbelts do not require additional expenses for maintenance as the mesquite trees tap water from the deep water-table through their very long roots.

Social benefits

Community empowerment: The project has empowered the community with the technical know-how to plan and manage forestry projects aimed at stopping the threat of desert encroachment. The farmers' committees, whose formation was facilitated by the project, not only conform well with existing social structures but also play a specific role in raising awareness of desertification as a major problem.

Equal opportunities: The project responded well to the needs of people faced by the problem of desertification irrespective of colour, creed, cultural background or gender. The mechanism of intervention was fashioned by the affected people themselves, following cultural patterns. For instance, women formed their own farmers' committees to implement complementary activities to those organized by men. One male farmer remarked "This project is good for women because it makes them more confident working in a male-dominated environment. Besides, it generates some pocket money for them." The project provided transport to facilitate the sale of seedlings in other villages and this support was judged essential for sustainability of this activity.

While shelterbelt establishment is normally considered men's work, the project worked with women who actually established their own belts, particularly in villages suffering from severe male out-migration.

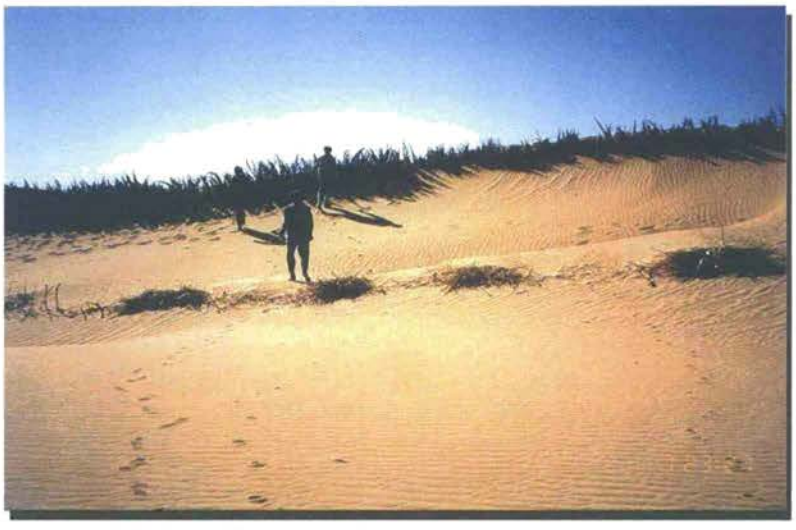
Almost all the farmers in the project area were actively involved in the pilot project and others have begun to establish shelterbelts for themselves following project demonstrations. Targets for the production of seedlings were exceeded in both phases, and this was attributed to high levels of participation by women because the sale of seedlings produced in home nurseries generates income for them. In addition, the sense of hope resulting from the realization that something *can* be done about the encroaching desert, generated enthusiasm amongst farmers/villagers to plant their own shelterbelts, thus creating greater demand for seedlings.

External shelterbelts are planted a considerable distance away from and behind internal shelterbelts, which form the divide between farms and the desert. In some cases where the planting of external belts requires too much labour from the local community, the project assisted by purchasing extra labour time through food-for-work programmes.

Since internal shelterbelts constitute the most direct interface between the farm and the sand-dune front, and whoever plants a shelterbelt owns it, incentives to participate in the establishment of these shelterbelts was high. On the other hand, the degree of participation in the establishment of external shelterbelts, which constitute the first defence line against the sand and to a large extent protect houses, was low.

The project's extension workers are implemented a programme aimed at encouraging the villagers to actively participate in planting external shelterbelts even though they may not appreciate the direct benefit of these belts as long-term protection for arable land.

Their endeavour was to raise awareness through public shows, exhibitions, lectures and films depicting the dangers of sand-dune encroachment. The project also took demonstrations closer to the people through frequent farmer–extension officer contacts to educate people on solutions and inform them about successful practises elsewhere. In a very informal way, the programme encouraged a two-way communication between the target group and SOS Sahel project staff.



Mechanical shelter belt in Abkor farming village

Having realized the benefits, farmers were enthusiastic about establishing windbreaks and plant them on their farms and around the edges to reduce the negative effects of eddy winds caused when the shelterbelts interrupt the prevailing sand-loaded winds.

Security: If the project had not intervened, 52,000 people who were occupying the land protected and created by the project might have been forced to move elsewhere. Such was the case with Argi village, where the villagers had approached the local authorities requesting permission to move to a new area because both their houses and the arable land around the village were under threat. Almost immediately thereafter the project intervened. The village survived and the population had grown from 8,000 to 12,000 people, 1,900 of whomhad immigrated from other villages and towns where they were engaged in casual work. Villagers' living conditions improved as a result of the project. For example, they had began to build better houses because they now had a sense of long-term security. The project also brought clean borehole drinking water to the villagers.

Land-tenure: Land in the project area is both privately and state owned. According to local culture, privately owned land is passed on from one generation to the next following the Islamic tradition that two-thirds of the land is inherited by male children and one-third by female children. In families which have only daughters, the situation may be complicated by the involvement of male cousins.

The land-ownership system is uneconomic, particularly in the case where a family has many children who each inherit a very small plot of land on the death of the parents. This partly explains the finding that while the land saved and created by the project can comfortably sustain 3,455 families commercially producing date palms, the area is in fact supporting 8,692 families. This is an indication of the value of land along the Nile basin and the reason for the strong incentive farmers have to plant and irrigate their own trees for stabilizing dunes that may threaten their property.

Government policy favours increasing the amount of privately owned land in the project area. For instance, there are several cases where the villagers have pooled resources, built shelterbelts on state-owned land and then approached the government for land-tenure rights, which are generally granted. This encourages more landless villagers to join in desertification-control efforts.

Policy issues and government support: SOS Sahel collaboration with the Government of Sudan at all stages of project development and implementation in part ensured the project's success. For example, the Forestry National Commission (FNC) seconded a local forester to manage the project, and the FNC benefited from a successfully managed project with additional opportunities for practical training of FNC forestry staff in other arid areas.

The government encouraged villagers to support project activities by agreeing to the transfer of state land to private proprietorship. It showed commitment by providing continued support for replicating this project through provision of extension officers, assistance in carrying out research on the different species suitable for dune

fixation, and mobilizing and paying for labour where there was a shortage. One FNC official said, "We consider this a very successful pilot project to the extent that, resources permitting, we would be happy to replicate it along the entire 3,000 km Nile basin."

The project precipitated a breakthrough in raising awareness among government officials and environmentalists on the potential of mesquite for tackling desert encroachment. FNC successfully explained the importance of mesquite as an effective shelter tree and obtained government endorsement, but with the proviso that farmers should eradicate any mesquite saplings that might appear in their fields.

SOS Sahel was judged a good partner given its focus on agricultural issues and a reputation for attracting highly competent and experienced local staff.

A water pump in Affad farming village

The International Fund for Agriculture and develoment (IFAD) judged this as the best of the projects they were implementing in Sudan because its impact was very clear, and the villagers themselves appreciated the work done and were calling for extension of the project.

Lessons learned

- The project's approach on communication and gender issues did not conflict with the existing culture but rather enhanced the target group's capacity to deal with the desertification problem through men's and women's village committees and through a special Salvation Sub-committee on Afforestation established by the project. The success of the project was clearly indicated by the amount of land saved, improved income levels, number of houses saved from burial by moving sand, and increased fodder supply.
- Biophysical solutions appear to be the most cost-effective way of dealing with environmental problems such as desert encroachment. Maintenance costs are minimal and they are sustainable compared, for example, with the use of mechanical shelterbelts which have to be renewed, or the use of bulldozers to create land or move sand threatening to bury infrastructure.
- A participatory approach to development is the most sure way of achieving political, economic, financial and social viability of projects. This was exemplified by the support this project received from the Government of Sudan and its impact on a very supportive target group.
- Encouraging the community to establish their own shelterbelts over which they can then claim ownership ensures sustainability. This was also enhanced by the government's decision not to take a direct part in project management and to encourage private ownership of land in the area.
- In order to win the confidence of target groups, implementing agencies must respond to possible changes in their priorities. For example, SOS Sahel responded to the local people's needs during the floods of 1988 and 1994 even though this meant an interruption in project activities.
- Donor agencies must work closely with organizations which employ competent and experienced staff.
- In rural Africa, conservation, rural development and political empowerment are inseparable. This project recognizes that people who live closest to the land and depend on it most directly for their survival will determine the future of that land and its natural resources.

Recommendations

- It is important for the Government of Sudan to have a clear policy promoting the use of mesquite in combating desert encroachment along the Nile basin as any misunderstandings of government policy might stifle progress and people's drive to replicate SOS Sahel's experience.
- SOS Sahel should explore ways of involving the agricultural and development banks of Sudan in financing and encour aging farmers to purchase water pumps and consolidate the gains made by the project in desertification control.
- The project should serve as a model for other NGOs in their efforts to combat desertification in the Sahel region.

The SOS Sahel Community Forestry Project, Ed Debba, is an example of a promising solution to conservation, environmental and rural-development problems. It showed that sand encroachment can be halted or reversed and appropriate management practices applied to the recovered marginal agricultural lands.

References

COWI Consult (1991). "Afforestation and Reforestation in the North Region of Sudan".

Deneve, Robert et al. (1993). "Community Forestry Project, Ed debba, Sudan - Mid term Evaluation Mission", November, 1993.

Dixon, John A. et al (ed.) (1990). Dryland Management: Economic Case Studies, Earthscan, London.

UNICEF (1995). The State of The World's Children 1995, Oxford University Press

Farming Within the Environment

The Whole Catchment Approach to Land Use Management in Southwestern Australia

Ron and Suzanne Watkins of Frankland, Western Australia, have developed an innovative new approach to managing their 552 ha farm. They call it "Integrated Whole Farm/Whole Landscape Planning", tackling land degradation by working closely with the shape and contours of their land and carefully managing water supplies on the entire farm. This integrated approach to farm management has enabled the couple to intensify and diversify their farming enterprise, increasing their farm's carrying capacity and overall productivity.

Holistic land use

The Watkins' farm, called 'Payneham', is located in a small farming community in the southwest region of Western Australia. Production is based on the area's traditional farming enterprises, with 2,000 sheep, 50 head of cattle, and about 110 ha of crops, including oats, lupins and canola. Irrigation is restricted to three ha of flood irrigated lucerne.

The climate here is Mediterranean, with hot, dry summers (13°-38°C) and cool, wet winters (5°-14°C). The average annual rainfall is 580mm, spread over a six month period from mid-April to mid-October. Distribution varies widely from year to year, and very little rain falls during the dry season.

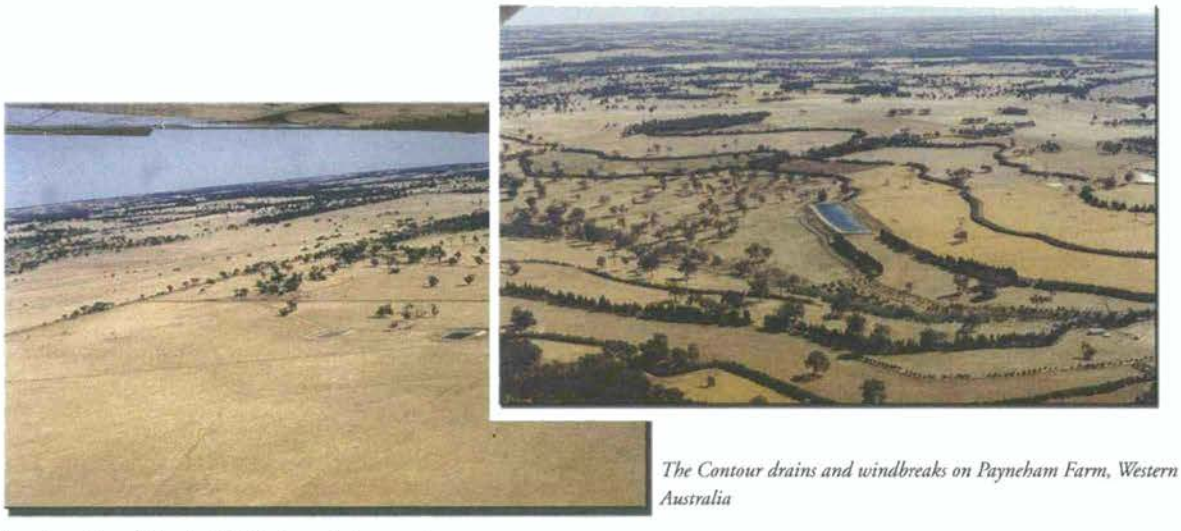
Before it was settled, Frankland was a botanically rich medium forest, dominated by an upper storey of Jarrah (*Eucalyptus marginata*), Wandoo (*Eucalyptus wandoo*) and Marri (*Eucalyptus calophylla*), and an under storey of diverse grasses, shrubs and wildflowers. Many of these species, along with indigenous bird and marsupial fauna, have become rare, endangered, and in some cases extinct as land was cleared for agriculture and introduced animals, in particular rabbit and fox, took hold.

Clearing of vegetation began in the early 1900s but progressed slowly until the 1950s, when the introduction of bulldozers sped the process greatly. Only in recent years has clearing become more strictly regulated; government approval is now required to clear areas of more than one hectare. Much of what remains, however, is fragmented and degraded, and some areas have less than 5% of their original vegetation. This ongoing loss is of enormous concern to the general community.

Managing degraded soils

The two main soil groups occurring on the Watkins' property are sandy yellow podsolic, and the more common gravelly lateritic podsolic duplex soils. These soils are mildly acidic (pH 5.5-6.5) in the A horizon, with naturally low levels of phosphorous, potassium, sulphur and trace elements. The B horizon of both soils is of low hydraulic conductivity and acts as a physical barrier to the vertical downflow of water, parching aquifers in the winter and causing extensive waterlogging that persists until early spring. In some years, as much as two-thirds of the district may be waterlogged.

Secondary salinization is also a widespread problem. Significant salt deposits, thought to have been carried from the ocean by prevailing winds and deposited over thousands of years, occur naturally in the sub-soils of southwest Western Australia,



The Contour drains and windbreaks on Payneham Farm, Western Australia

Payneham Farm before the holistic approach treatment

UNEP's "Saving the Drylands" award winner, 1995; UNEP's Global 500 Winner, 1996. This private ranch project was implemented and funded by the owners, Ron and Suzanne Watkins.

at levels as high as 10,000 t/ha. With the clearing of deep-rooted perennial native vegetation, rising groundwater tables brought much of this salt to the surface. Salinity also appears as salt scalds higher in the landscape where hardpans, dolerite and quartz dykes, shallow bedrock and changes in slope concentrate groundwater and force it up to the surface.

Other forms of soil degradation have also appeared since the introduction of agriculture, including wind and water erosion, sodicity, soil structure decline and loss of organic matter. Poor natural fertility has led to a history of heavy fertilizer use, causing surface and sub-surface acidification.

All of these problems are evident to some extent on the Watkins' property, and are being managed within the framework of their holistic approach.

A contour check dam stores water for irrigation

The history of Payneham

Originally settled by his grandfather in 1908, Mr Watkins took over the family farm in 1973. But toward the late 1970s, an increasingly saline household water supply and salt scalds on some of the farm's older paddocks led him to believe that traditional farming practices were causing a severe environmental imbalance, and the Watkins' began searching for alternatives.

Their first discovery was that salinization was caused by excess water in the soil rather than excess salt, to which the Watkins' responded by leaving belts of trees along contours during the final clearing of the property. Based on Department of Agriculture hydrological figures, Mr Watkins calculated that 337,500 cubic metres of water were running off his property each year. Water was not, as many thought, in short supply; traditional systems were simply not making efficient use of the available supply. Excess water was not only being wasted, it was also contributing to soil degradation. With this key discovery, Mr Watkins then began looking at ways of better managing the farm's water.

He turned to the work of PA Yeomans, developer of the Keyline Plan, and Harry Whittington of WISALTS, a Western Australian organization seeking to manage the problem of secondary salinization. Yeoman's emphasis on working with the shape of the land and his method of harvesting water for storage and gravity-fed flood irrigation formed the basis for much of Watkins' own work. From WISALTS, he learned how to survey drains to capture water from the B horizon aquifer. Combining elements from both Keyline and WISALTS, the Watkins' constructed a 30,000 cubic metre contour dam in 1982.

The following year, by carefully observing six metre-deep pits on his property, Watkins identified four pathways water was taking through the soil: surface runoff; a freshwater aquifer perched on the B horizon; a perched saline aquifer associated with silicified hardpans; and a deep saline aquifer.

Mr Watkins determined that any system of controlling water must deal with all four pathways. Surface drains or tree belts in isolation would not deal adequately with all sources of water. After observing the movement of water, wind and soil in the catchment, he decided that a holistic approach would be necessary to tackle all forms of land degradation, and from this he designed and installed the first interceptor drains of his new whole-farm plan.

The intregrated system

"Farming within the environment" is how Mr Watkins describes the overall philosophy of Integrated Whole Farm/ Whole Landscape Planning, the primary aim of which is to stabilize the environment in order to reduce land degradation and increase farm productivity.

The arrangement of drains and treebelts, dams, waterways and fenced vegetation designed to provide protection against extreme climatic events were the first steps in creating what Watkins calls a 'macro protection' system, followed by intensive land use management techniques such as biological pest control and soil improvement.

Mr Watkins' approach is based on two fundamental premises. The first is that the most immovable object in any landscape is the shape of the landscape itself, and therefore all planning must be founded on and make the greatest use of existing shapes and contours. Farming systems based on straight lines, what Watkins calls "straight farming in a round world", completely ignore this key premise. The Watkins farm plan incorporates land and land use management into the landscape based on each individual feature – ridge and valley formations, saddles, rocky outcrops, changes in slope and large dam sites.

The pattern of the landscape is used to locate the best dam sites, which are then linked by drains positioned to intersect saddles and changes in slope. The paddocks, developed between the drains, are linked by a laneway system that facilitates quick access to each paddock. Less productive land, such as rocky outcrops or salinated areas, is fenced and replanted with trees, while remnant vegetation is fenced to exclude livestock.

The second fundamental premise is that water is the most precious resource; agriculture cannot survive without it. As traditional farming systems were not designed to suit the Australian climate, farmers were forced to cart in stock water during the summer, while excess winter water went to waste and contributed to erosion. Mr Watkins' plan is designed to collect and store the greatest possible amount of annual rainfall.

Beginning at the top of the catchment, surface drains flanked on their lower sides with rows of trees fall at a gradient of 1:400 and feed into storage dams. The drains are dug to a depth of 30-

45cm below the surface of the B horizon to collect surface runoff and water from the perched aquifer. Overflow from each dam is collected by further drains and fed to still more dams downhill. Excess water that cannot be stored is discharged into a revegetated natural waterway to minimize erosion before it leaves the property.

Initial drains are located according to the position of significant landscape features, and intermediate drains are positioned to ensure adequate wind protection from tree belts. The number of intermediate drains is determined by the gradient of the slope and the height of the tree belts, on the assumption that trees can provide wind protection up to 15 times their own height on the leeward side. Paddocks of approximately 30ha each and 150-200m wide are located between the drains.

Tree belts planted along the lower side of the drains assist in controlling water by absorbing sub-soil water that has not been intercepted by the drains. This does not prevent all groundwater recharge, but it does slow the salinization process and allows time for the establishment of perennial pasture. The trees also provide fodder, timber and posts.

Early drains were lined with three continuous rows of trees, but four rows later proved ideal as this encouraged deeper rooting of the middle rows. Future tree belts will be even wider in order to enable harvesting of tree products without affecting the windbreak, to create a wider wildlife corridor and increase the number of 'water pumps' for groundwater salinity control.

Of the 38 tree species planted, the most prominent have been Spotted Gum (*Eucalyptus maculata*), Wandoo (*Eucalypus wandoo*), Golden Wreath Wattle (*Acacia saligna*) and Tagasaste, also known as tree lucerne. The Spotted Gums are planted closest to the drains to increase their height as windbreaks, and will eventually be harvested for timber, pulpwood, fence posts and firewood. Tagasaste is planted on the lower side to provide sheep and cattle with green feed during prolonged droughts. Wandoo and Golden Wreath Wattles are planted in the middle to provide nectar for birds and insects and create a more diverse wildlife habitat.

From a 1988 Churchill Fellowship in water use management and agroforestry, Watkins found that deep-ripping and weed control in the planting area were significant factors in good tree establishment. Weed control on spoil from the drain bank is unnecessary due to the burial of weed seeds, but beyond the spoil it has been necessary to hand weed or 'scalp' the soil with a tractor blade. Spreading the spoil over a larger area may increase the success of planting, particularly for direct seeding.

Seedlings are planted in the winter at spacings of 3m x 3m and hand weeded in the spring; little maintenance is required after this. Electric fences on either side of the plantings minimize competition between trees and crops or pasture, while tracks on the lower side allow all weather access.

Better land use techniques are a key part of the Watkins' holistic approach. Stubble mulching, green manure and organic fertilizer build up the soil's biological activity and reduce nutrient losses through excessive leaching. Dolomite (lime) corrects acidification; gypsum corrects sodicity. Chisel ploughing is being tried as a means of increasing root development.

Chemical insecticides and herbicides have been abandoned in favour of integrated biological systems, comprising natural predation, strip grazing, hand picking of weeds, and the introduction of dung beetles to break down manure. This has reduced both the time and cost of pest management, and has improved microbial and worm activity in the soil.

Attention to biodiversity is a key aspect of the Watkins approach. Remnant and riparian vegetation, fenced from stock to allow regeneration, provides safe habitats for native flora and fauna. Tree belts shelter small animals and act as wildlife corridors, and storage dams provide rich wetland environments and refuge for migratory birds.

Replicating success

Mr Watkins' approach has been adopted successfully on other farms in Australia. After an initial assessment to identify key landscape features, Watkins designs a specific system for the particular environment and available budget.

Using contractors for all of the work, an estimate of the cost for one kilometre of drain is A$ 2,440, or A$ 244/ha, excluding water storage works, but this can be substantially reduced by employing local skills, labour and equipment. Commercial fencing materials, for example, can be replaced with live thorn fences.

The guiding principle is that work must begin from the top of the catchment. Low lying areas require cooperation with landowners living higher up in the catchment, but the wider the system's application over a catchment, the greater the social, environmental and economic benefits to all landowners in the catchment.

The development of the Watkins' own farm is not yet complete, progressing as time and money permit. Modifications continue as new information from scientific research and practical application becomes available. At this point, 17 km of drains have been constructed, planted and fenced from stock, and two of the six new dams have been constructed. When completed, the total area fenced out for drains and trees, rocky outcrops, remnant vegetation, saline areas and laneways will be roughly 162ha, or 30% of the total area, leaving 390ha of arable land on which the Watkins' plan to intensify production with irrigated horticulture, aquaculture and perennial pasture.

Having installed the trees and drains to protect the farm from climatic extremes, the next stage is to develop the soil between the macro-protection system, expand rotational grazing in order to better utilize pastures, and incorporate a system of 'sabbatical farming', in which a seventh of the arable land lies fallow each year.

Environmental, economic and social benefits

The implementation of the Watkins' approach at Payneham has confirmed the value of a holistic approach to farm planning and management, as opposed to piecemeal solutions, ensuring that available resources are used more wisely and that future developments are not compromised by short term goals. Decision making and fieldwork are now both easier and quicker.

The integration of landscape features into the larger plan is key to the approach. The redesign of paddocks onto the contour has eased the movement of vehicles and livestock and reduced erosion. Dams built in natural depressions at higher elevations are cheaper to excavate and allow year-round gravity-feeding of

freshwater. Tree belts planted along contour lines provide greater protection against wind from all directions.

As originally intended, the arrangement of drains and dams has provided much greater control of water. Soil erosion and siltation of dams has been reduced, stock and domestic freshwater supplies have increased, and potentially damaging rains are now welcomed events. As more dams are constructed there will be increasing potential for the expansion of irrigation through the dry season. Waterlogging has been nearly eliminated, leading to higher yields/ha, more land available for cropping, improved trafficability in winter and better maintenance of aerobic conditions in the soil.

It is difficult to quantify the effect of the system on salinization, but it is expected that the decrease in groundwater recharge due to greater surface storage, and the growth of tree belts to soak up deeper water sources, will have a significant impact on groundwater levels in the future. This will be complemented by perennial pasture species to make better use of water where it falls. Observation wells and piezometers have been installed to monitor future changes in groundwater levels.

The tree belts, combined with stubble mulching, have reduced the loss of topsoil from wind erosion, moderated climatic extremes and improved the microclimate. They provide stock, crops and pasture with greater protection from strong winds and temperature extremes, leading to higher yields and greater resistance to pest attack and weed competition. Taking up only 8% of the farm's productive land, the belts are an integral part of the whole production system, generating timber for milling, nectar for birds and bees, and stock feed when green pasture is in short supply.

Biodiversity has been increased with the addition of 38 new tree species and the natural regeneration of many native species. Cold burns in autumn have removed alien grasses and encouraged natural regeneration; the appearance of native orchids has been particularly rewarding. Bird counts over seven years show a strong increase in the abundance and diversity of species, and it is suspected that this has helped to control crop pests.

While many in the community question the economic viability of the holistic approach, Watkins remains adamant that land owners have a moral obligation to care for the land, regardless of economic benefit. In seeking to first secure the health of the environment on which agricultural systems depend, he believes the economic rewards will be evident, and substantial, in the long run. More efficient use of resources under his system has actually improved Payneham's economic outlook while improving the farm's general ecological health.

Despite the fact that he has fenced off a significant portion of his farm, carrying capacity has actually increased by 10%, and a greater area is now available for cropping. An economic analysis of Payneham found that gross margins for crops were more than double the local average, and for sheep, almost four times the average. Other farmers adopting the system have also shown it to be economical, with considerable benefits apparent on previously waterlogged soils in just one cropping season. One Frankland farmer recorded a 25% increase in gross income just one year after adopting Mr Watkins' system.

Before Watkins implemented his innovative plan, he was supporting one family on a farm considered to be economically unviable. The perception was and continues to be "get big, or get out"; farmers are expected to purchase other farms in order to meet their own needs and provide for their children. But as properties have expanded to cope economically, the rural population has declined, facilities in rural towns have diminished and the land has become further degraded.

Canola crop growing on drained soils

Rather than follow this extensive and financially crippling approach, the Watkins' chose to invest in the land they already owned, and the farm may now be able to support two or even three families. This potential to intensify and diversify output has been made possible without added chemical inputs or government handouts, demonstrating that carefully planned and managed land can sustain more people on less area, and bringing hope that the rural community may be able to reverse its present decline.

The Integrated Whole Farm/Whole Landscape Planning system is an innovative, effective and holistic approach to the problems of dryland degradation. It benefits all aspects of the farm ecosystem: soil, water, macro and microclimate, plants and animals. It is a model of sustainable use, flexible but specific to the land for which it is designed, adaptable to commercial and small holdings. In bringing his innovation to the attention of the public through numerous farm tours, guest talks, media briefings and international and national awards, Mr Watkins has contributed significantly to the understanding of the causes of dryland degradation, and the practical solutions.

References

Land Management Society (1990). *Directory of Innovations and Land Management Practices: Farmer No. 2*, Land Management Society, Perth, Australia.

Land Management Society (1991) *Tree and Water Combinations in Five Countries: A Farmer's Report*, Land Management Society, Perth, Australia.

United Nations Environment Programme (UNEP) (1994) *Success Story Evaluation Mission Report on Ron Watkins' Farm 'Payneham'*, Frankland, Western Australia.

Yeomans, P.A. (1968) *Water for Every Farm*, Murray Books Pty Ltd, Ultimo, Australia.

Reclaiming Wasteland

Harnessing Summer Floods for Afforestation and Salinity Control Using the Tamarix Shrub in Western China

Background

Desertification is a pressing problem in China's arid and semi-arid regions, where a growing population is putting heavy pressure on already fragile ecosystems. But one project has made significant practical headway in reversing dryland degradation, through a simple, technically sound and cost-effective programme employing hardy indigenous Tamarix shrubs to rehabilitate degraded arid soils.

The Tamarix project is located in Cele, Yutian, Mingfeng and Jiashi counties of western China's Xinjiang Uygur Autonomous Region, along the southern margin of the Taklimakan Desert, the largest desert in China and the second largest shifting sand desert in the world. Xinjiang is the most westerly region of China and occupies about one-sixth of the country's total land area.

Preparation of ditches for Tamarix cultivation under flooding

Surrounded by the Tianshan Mountains to the north and the Kunlun Mountains to the south, the Taklimakan is extremely arid, very sparsely vegetated, subject to extreme temperature fluctuations and devastating sandstorms. It is only in the narrow belt of alluvial hills and plains between the mountain ranges and the desert that people can live and practice agriculture.

Precipitation in the mountain areas is higher than the desert, and more than 100 rivers and streams flow from them into the Tarim Basin, providing water that irrigates small oases around the perimeter of the desert. The precarious survival of the people who live in these oases depends on their ability to manage these limited and variable water resources for their irrigation and domestic needs.

The project area has an average annual rainfall of between 31 and 46mm, concentrated mainly in the summer months, and potential evaporation is many times higher than precipitation.

The area is also subject to strong winds for more than 200 days per year, bringing severe sand storms between 19 and 64 days each year.

The dominant ethnic group in this region are the mainly Muslim Uygur. Within all four counties there are networks of villages comprising large villages (Xiang), medium-size villages (Cun) and small villages (Zheng). At each of these levels, regional government departments address and oversee a variety of development projects, from agriculture and water to health and education.

Each village is communally responsible for maintaining irrigation channels, planting and watering trees, maintaining rural roads and managing other common property resources within their village. The management of larger works covering several villages are planned by the respective cun or zheng, and the work shared by all households.

The people depend mainly on agriculture, cultivating annual crops such as wheat, cotton, and maize, and fruit crops such as melons, pomegranate, apricot, apples, grapes and pears. Fodder and pasture cultivation and sheep, goat and cattle raising are also important to the local economy. The grain crops meet family food demands, while the sale of fruit crops, cotton, fodder and animals provides the main source of cash income.

Encroaching desert

The people of Hotan Prefecture have a long history of suffering from the southern movement of the desert; towns have often been forced to relocate under threat of inundation by sand dunes. Increasing population is also an important factor in the acceleration of desertification. Between 1911 and 1983 the population of Hotan Prefecture approximately tripled from 419,000 to 1.2 million. This has been accompanied by deforestation for fuelwood and over-use of scarce water resources for irrigation, resulting in drastic reductions in natural forests (mainly *Tamarix spp.* and *Populus euphratica*), agricultural expansion into marginal lands and reduced groundwater recharge.

Jiashi County has serious salinization problems. Located in the middle of the Kashgar River basin, agriculture here depends on water from the river, which has a mineral content of 4-10 mg/l and salt content of 1-10 gm/l. The area receives summer floods, but experiences shortages for the rest of the year. Soils in

UNEP's "Saving the Drylands" award winner, 1995; UNEP's Global 500 Winner, 1996. This project was implemented by the Xinjiang Institute of Biology, Pedology and Desert Research and local communities with funds from the Chinese Government and local communities.

this county are heavier, with extensive flat and poorly drained areas where summer flooding causes severe waterlogging. As a result of extensive destruction of vegetative cover, the high water table and evaporation, salinization has degraded more than 60% of Jiashi's agricultural land. Forests and grasslands are also badly affected.

Reversing degradation

The Tamarix project evolved from over 30 years of experience accumulated by a team of scientists, led by Professor Liu Ming-Ting of the Xinjiang Institute of Biology, Pedology and Desert Research (XIBPDR). They discovered that it was possible to reverse the environmental deterioration of degraded dune forests and heavily salinized areas through natural, cost-effective propagation of *Tamarix spp,* dispersed by the waters of the summer floods.

Tamarix is an indigenous species valued locally as a source of fuelwood, fodder and raw materials for tool and basket making. It grows well in conjunction with *Callogonum spp.*, another hardy pioneer, though Tamarix survives better under conditions of sand inundation, waterlogging and salinization, and offers longer term protection once established, with a lifespan of 50-100 years.

Tamarix not only provides productive tree cover, but acts as a biological pump, lowering water tables by as much as 1 metre, an important benefit for places like Jiashi that are prone to waterlogging. A parasite that lives on Tamarix roots is also highly valued as a traditional medicine.

The project employed a simple technology. It was already well known that *Tamarix spp.* propagates naturally by seed carried and distributed by the summer floods. The aim was to use the same method to regenerate large areas by directing surplus floods to degraded areas.

Delivery systems to divert the floodwaters varied between sites, from simple earthen embankments to more complex concrete channels. Only one watering is normally required to achieve good Tamarix establishment on relatively flat surfaces.

Replanted areas are protected and managed by guards under the control of the county Forest Department, or by community members appointed by the village. The trees are completely protected for three years, after which local people are allowed to harvest fuelwood on a rotational system. Anyone caught harvesting illegally is fined.

Afforestation with Tamarix shrub using summer flood waters

Fuelwood from Tamarix plantations

Significant benefits

The project has managed to increase overall vegetative cover by as much as 60% in the project areas within a period of four years, using a mix of 16 different Tamarix species. More than 65,000 hectares have been rehabilitated so far using this approach: over 6,650ha each in Cele and Yutian Counties, more than 13,300ha in Mingfeng County, and 40,000ha in Jiashi County.

Fodder production: The cultivation of Tamarix has increased fodder production significantly. In Jiashi, the per capita number of animals increased from 1.7 in 1985 to 2.7 in 1993. Because there is now more available fodder many people have adopted the cut and carry feeding system, abandoning free range grazing in the forests on the borders of the oasis, which had contributed to the original problem.

Increased productivity: The project has resulted in degraded land being rehabilitated and returned to agriculture, leading to an overall increase in productivity and household incomes. For example, the average annual household income in Jiashi County rose from RMB 2,179 in 1985 to RMB 3,374 in 1992.

Cottage industries: The marketing of products manufactured from Tamarix provides cash for households, a third of which are involved in cottage industries. One household manufacturing baskets, earth carriers and trolleys can generate a net profit of about RMB 6,000 per year.

Because of these considerable benefits, all four counties continue with their commitment to protect the rehabilitated areas. In Jiashi, the county government had no effective programme for protecting natural forests prior to the project, but now contributes the major share of the salaries for 800 forest guards who have been employed to protect new forests.

The ingredients of success

Several key factors contributed to the success of this project. Perhaps most importantly, the technique merely assists and supports an established natural process. The maturity of Tamarix seed coincides with the summer floods, the seed is transported effortlessly by floodwaters, and constructed dams retain moisture that stimulate germination and sustain young seedlings.

This technique is simple, easily understood and very inex-

pensive. There is no need for seedling nurseries or labour intensive planting. Labour, equipment and salary costs were estimated at about US$ 85 per hectare in Jiashi, but the value of sustainably harvested fuelwood and raw materials for baskets and tools on rehabilitated areas was estimated at more than US$800 per hectare per year. These calculations do not even take into account the immense environmental value of making wastelands productive, or stopping the encroachment of sand dunes.

The existence of well organized local institutions, into which all households are integrated, as well as the established rural Chinese practice of contributing voluntary labour to communal projects, was another essential ingredient.

The project not only established a strong system of protecting rehabilitated areas but also provided significant tangible incentives in the form of sustainable harvests of fodder, fuel and craft materials for community use and sale.

Scientists from the XIBPDR played a critical role in identifying and promoting this simple approach, and in supporting the county governments during project implementation.

Sustainability and replication

There is a very high level of enthusiasm about the project. Although the project period is over, communities actively participate in the management of the Tamarix areas, and continue to contribute voluntarily to the maintenance of the plantations and irrigation structures.

The project remains a regular annual development activity in all four counties. There is also considerable enthusiasm among Jiashi County officials, who have prepared a masterplan for this work up until the year 2050, with targets of over 3,300 rehabilitated hectares per year. Rehabilitation work has been sufficiently successful here so far that more than 5,300ha has been returned to agricultural production, and over the longer term county officials estimate that up to 50% of treated areas will eventually be returned to use.

The project has also influenced local governmental budgets for land management activities, as all four counties now include annual allocations for Tamarix cultivation. Of the total required budget, the county governments provide 40%, the provincial government 10%, and the remaining 50% is provided by the local communities in the form of voluntary labour.

It is claimed that this technology is now being adopted in 50 counties throughout Xinjiang, as well as the counties of Anxi and Dunhuang in neighbouring Gansu Province.

The availability of water is a major limiting factor in the further expansion and replication of this technology, as well as the ability to mobilize and organize local voluntary labour. But wherever conditions allow, this project deserves replication. It has made a major contribution in developing a simple, innovative technique for re-establishing ecological stability under extremely challenging environmental conditions, with considerable social and economic benefits for local communities.

References

Background notes on the project titled "New Techniques of Rapidly cultivating the Tamarix Shrub Forest in Sandy and Heavy Saline-Alkali Soil by Utilizing Summer Floods" (1993). Prepared by the Xinjinag Institute of Biology, Pedology and Desert Research.

Chinese Academy of Sciences (1993). Wondrous Taklimakan. Science Press, Beijing and New York.

Liu Ming-ting (undated). Brief Report on Technique of Cultivating Tamarix Shrub in Sandy Alkaline Soil Ares by Use of Floods. Xinjinag Institute of Biology, Pedology and Desert Research

Yu-Hua Liu (1993). Report on the evaluation of the project on Large-scale Irrigation of Sandy and Saline-alkali Land by Diversion of Flood for the Development of Chinese Tamarix. Xinjiang Research Institute of Forestry.

Xia Xuncheng, Li Chongshun et al. (1993). Xinjiang Institute of Biology, Pedology and Desert Research, Chinese Academy if Sciences. Desertification and Control of Blown Sand Disasters in Xinjiang, Science Press, Beijing, China.

Products manufactured from the Tamarix shrub

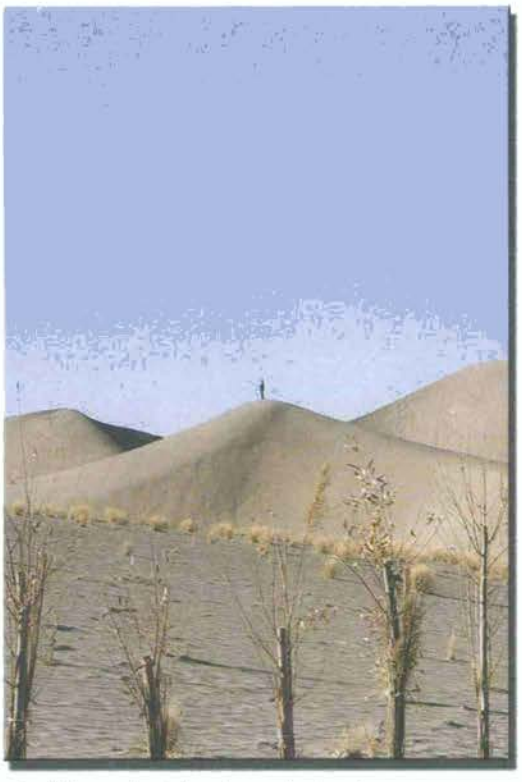
Shifting Sands

A Comprehensive Approach in Protecting Human Settlements from Drifting Sand and Increasing Production, in Cele County, Western China

Background

Cele County is located in the far west of China, in the Xinjiang Uygur Autonomous Region. The project area is about 2,100 km southwest of the regional capital of Urumqi on the southern margin of the Taklimakan Desert. The agricultural area of the county is 350,000 mu (1 ha = 15 mu), with a population of 120,800 inhabitants.

This area is extremely arid, experiencing drastic extremes in temperature and severe wind storms. It has sparse vegetation and a fragile ecosystem. Precipitation is higher in the mountainous areas to the south, and seasonal streams and rivers that flow from here provide water for irrigating small oases around the perimeter of the desert. The precarious survival of the people who live in the Cele oasis depends on their ability to manage these limited and variable water resources to meet their irrigation and domestic requirements.



Sand dunes and windbreak vegetation barriers

An increasing human and animal population places severe pressure on the environment in and around the oasis. There are growing demands for fuelwood and fodder from the desert forests around the oasis, agricultural land is expanding into marginal areas, and an increasing demand for irrigation water has diminished supplies to the lower reaches of the rivers to sustain desert vegetation and recharge groundwater.

The people of Cele have a long history of suffering from the southern movement of the desert; the county town has been moved three times during its history due to the encroachment of sand dunes.

This project was initiated in response to a crisis. In 1980 the dunes were once again threatening to engulf the town. They had already swallowed 1,330 ha of agricultural land, and had forced 60 families to relocate because their houses were in danger of being buried under the dunes.

The regional government responded with a project entitled "Experimental Research to Control Drifting Sand of Cele County." The major objectives of this project were to halt the forward movement of the dunes, to reclaim 660 ha of agricultural land, and to rehabilitate 4,000 ha of degraded forest on the periphery of the Cele oasis. The project was implemented over a six year period from 1983 to 1988.

The project in a regional context

Cele County is located on the southern margin of the Taklimakan Desert, which almost completely occupies the Tarim Basin in the southwest of Xinjiang Uygur Autonomous Region. Xinjiang is the most western province of China, occupying about one-sixth of the total land area. The Taklimakan Desert is the largest desert in China, and is considered to be the second largest shifting sand desert in the world. It covers an area of 337,600 square km, roughly the size of Japan.

These arid desert areas are subject to extreme temperature fluctuations and severe wind storms, with sparse vegetation and a fragile ecosystem. Evaporation is many times higher than precipitation. More than 100 rivers and streams flow into the Tarim Basin, providing water to irrigate small oases around the perimeter of the desert. Only two of these rivers actually flow through the desert; the rest end in the middle of the desert, where they contribute to groundwater recharge and the maintenance of vegetation along riverbeds.

Mobile sand dunes commonly invade villages and cultivated areas along the southern fringes of the Taklimakan. Much of the original alignment of the Silk Road along the southern rim has been buried by sand; in the project area this ancient route lies between 5 and 10 km north of the current boundary of the desert.

UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by the Xinjiang Institute of Biology, Pedology and Desert Research and local communities with funds from the Chinese Government.

Cele County (sometimes spelled 'Qira') is located about 2,100 km southwest of the regional capital of Urumqi. The Cele oasis covers 33,147 sq km, of which 350,000 mu (23,333 ha) is under cultivation; the rest is desert. The town, villages and agricultural areas are located within the oasis. The average land holding is 11.8 mu. The oasis is surrounded by degraded dune forests.

The total population of the county is 120,812 inhabitants (1992), spread among 30,200 households, with an average of four people per household. The dominant ethnic group in Cele and the region as a whole are the Uygurs, who are predominantly Muslim.

Biological barriers against encroaching sand

Within Cele County there are seven larger villages, or "Xiang". Each of these is divided into sub-villages called "Cun", and each of these into even smaller villages called "Zheng". Government appointed officials are responsible for administration at regional, prefecture and county levels; the administration of all levels below the county are the responsibility of local leaders. At each of these levels there are representatives of various departments of the regional government, such as forestry, agriculture, water resources, electricity, health and education. Under this system all households are linked to a network of organizations headed by their own local leaders and regional officials.

Leaders at the zheng level are responsible for planning and organizing households to implement development work in their area. Each village is communally responsible for the maintenance of irrigation channels, planting and watering trees, and looking after other communal resources within the village. Villages often pool resources and labour for larger projects.

Agriculture is the main economic activity in Cele. Crops include wheat, cotton, corn and fruit crops, and fodder and livestock production also play a major role, with an average of 9.6 animals per household. The sale of fruit crops, cotton, fodder and animals is the main source of cash income, bringing an average per capita annual income in the county of a little over $60 in 1993, whereas the regional average was a little less than $100.

Water for irrigation in the Cele oasis comes from 9 seasonal rivers that flow from the mountains. Water is unevenly distributed; three-quarters of the 400mm average rainfall comes in the summer months, often as floods.

Increasing population in the area is an important factor in the acceleration of desertification. Between 1949 and 1983 the population nearly doubled to 1.2 million inhabitants, and subsequent land pressure exacerbated degradation even further.

Project approach

The project employed an approach called the Comprehensive Protection System (CPS), combining a series of physical and biological barriers. Each component of the system was designed to progressively reduce wind velocity near the ground surface, in turn reducing the potential for the wind to transport sand.

The first barrier is a 50-100 m wide channel designed to trap encroaching sands. It was created by constructing a diversion on a major drainage line and diverting summer floods to cut a new channel.

The second barrier is a 3,000m wide strip of grass and shrubs immediately behind the channel, established with natural vegetation irrigated with diverted surplus summer flood water. Forest guards protected this area from grazing and fuelwood collection as it took hold, while Cele County officials conducted an information campaign to explain to residents what was being done and why. Vegetation in this barrier consists mainly of desert grasses such as *Basia dayphylla*, *Salsola ruthenica* and *Corispermum heptopotamicum*, and the shrubs *Albagi pseudalhagi* and *Alhagi sparsifola*, and secondary regrowth of *Populus euphratica* and *Tamarix taklamakansis Lui*.

The third barrier is a narrower line of planted shrubs about 500m wide, slightly taller than the previous barrier, which is managed for sustainable fuelwood production.

The final barrier is a 1,000m wide windbreak of taller trees, bordering the agricultural land in the oasis. These trees, mainly *Populus nigra* and *Elaeagnus oxycarpa*, were planted on either side of irrigation ditches about 30m apart, and intercropped with *Medicago sativa* to provide fodder and green manure. After three to five years, soil structure and fertility improved sufficiently to begin planting horticultural crops in this section. The total width of the CPS, designed to establish a permanent and productive interface between the desert and the oasis, averages 4.5 km.

There is a small, extremely arid area on the northeastern side of Cele town where the dunes were particularly mobile and irrigation proved impossible. The CPS system would not work here, so other options were explored. After several trials with different species, the project team settled on planting eight species of the *Calligonum* genus (*arbores*, *cancellatum*, *caput-medusa*, *deusum*, *klementziia*, *leucocdum*, *rubicudum*, and *rubrovskii*), which proved successful in stabilizing the problem dunes.

Implementation

The lead agency for implementation of the project was the county Forest Department. The Water Resources Department arranged the construction of wells, the Agriculture Department supplied seed and planting materials, and the Livestock Department provided veterinary support. Throughout, Associate Professor Zhang He-Nian of the Xinjiang Institute of Biology and Desert Research provided scientific guidance to technical staff.

At the county level, a unit comprising the County Chairman, other county officials, farmer leaders and scientists supervised the project implementation. Much of the labour was provided by local people under the traditional system of voluntary communal labour, contributing an impressive total of 240,000 person days over the life of the project. The community continues to provide labour for maintenance and repair of infrastructure, demonstrating that the project has an in-built system for long-term sustainability.

Economic impacts

The total rehabilitated area was 10,860 ha. Of this, 10,000 ha comprised natural vegetation (the original target was 4,000 ha), 590 ha was planted with fuelwood and timber species, 70 ha was devoted to horticultural plantations, and 200 ha was returned to agriculture. Vegetative cover increased from 3-5% at the beginning of the project to between 50-60% by 1995.

While the reclamation of agricultural land is a major achievement, finite water resources place a limit on the extent to which the rehabilitated area can be expanded without damaging the delicate environmental balance in the oasis.

The most obvious and important household level benefit is that homes and farmland were saved from inundation by the dunes. More, and more productive, land is available for agriculture and grazing. Livestock numbers increased from 3.9 per household in 1983 to 9.6 in 1993. Per capita income increased by 180% since the beginning of the project, and is now higher than in adjacent non-project villages. It is estimated that approximately 75,000 people benefited directly from the project.

Due to the success of this project there is now an annual budgetary allocation for desertification control work. In order to reduce the pressure for fuelwood extraction from rehabilitated areas, the county government now has a programme to plant 666 ha of fuelwood trees in an adjacent area. A third of this was planted, and is being protected by forest guards and local communities.

Social impact

The project has promoted the active involvement of local organizations to solve pressing environmental problems. Benefits have been shared equally, and both men and women participate equally in providing voluntary labour.

Costs and benefits

By the end of the project the forward movement of the dunes had not only been stopped, but the mobile dune area had been pushed back about 5 km; 90 families moved into these areas that had previously been inundated with sand. While these benefits are difficult to quantify in economic terms, they certainly outweigh the total project cost of US$ 205,000, or US$ 18.90 per ha of rehabilitated land. The approximate value of new trees

Grass barriers reduce wind velocity near the ground surface

and increased annual fodder, fuelwood, fruit and livestock production alone is US$ 1.6 million, yielding a very satisfactory direct cost-benefit ratio of 1:8.

Lessons learned

This project demonstrates that it is possible to control and reverse desertification in a very challenging physical environment. While the CPS model was not replicated in full in other areas, similar systems incorporating parts of the CPS are being employed to the benefit of neighbouring regions. It appears to be clearly understood by county officials and farmers that the survival of Cele town depends on maintaining this unique system. The main lessons arising from the experience of this project have been:

- The chances of success are greater when field-level technical staff are given constant support from scientists.
- When transferring the experience and knowledge gained in Cele County to other areas it will be necessary to adapt these technologies to the new physical conditions, as well as to the financial and human resources available.
- Local institutional arrangements must be capable of informing local people of the reasons for the project, to gain their support in mobilizing labour and to obtain their agreement in altering resource management practices.
- In order to get the enthusiastic support of local people it is important that the output is not only long-term environmental protection, but also more tangible benefits such as fuelwood, fodder and new income generating opportunities.

References

An Experimental Study on Sand Control at the Quira County of the Xinjiang Uygur Autonomous Region, China (undated). Report prepared by the Xinjiang Institute of Biology, Pedology and Desert Research.

Chinese Academy of Sciences (1993). Wondrous Taklimakan. Science Press, Beijin and New York.

The Experimental Research to Control Drifting Sand of Cele County (1993). Prepared by the Xinjiang Institute of Biology, Pedology and Desert Research.

Increasing Productivity on Fragile Soils

Comprehensive Desertification Control Using Sustainable Moisture Conservation, Crops and Animal Husbandry Technologies in Naimanqui Banner County, China

Background

Desertified land in China, over 3% of the total land mass, is found mainly in the western, northern and eastern parts of the country. The Chinese Government, in collaboration with several other international agencies, has made attempts to control desertification since the 1970s, with varying degrees of success. This unique project, entitled 'A Comprehensive Project on Desertification and its Control in Naimanqui Banner', conducted a series of experiments at the Naimanqui Banner sub-station of the Institute of Desert Research, the Chinese Academy of Science, between 1985 and 1989. Yaoledianzi, the village selected as the pilot for the project, was one of the poorest in Naimanqui Banner, but has since made considerable progress. Several new technologies were introduced for the rehabilitation of sandy land and for the development of agriculture. These included:

- High yield cultivation techniques for sandy soils, such as covering corn and rice fields with plastic film to conserve moisture, improved methods of watermelon, soy bean and wheat production, intercropping methods in sandy cropland, and vegetable cultivation in greenhouses.
- Cultivation techniques for high-yield fruit trees on sandy soils, such as plum, pear, hawthorn, grape, plum, strawberry and apricot, including indigenous varieties that can grow on dunes.
- Techniques for revegetating barren, sandy soils, including protective windbreaks, shrub-willow and pine tree cultivation to fix dunes, and straw thatch checkerboardcover for sand dunes.
- Establishing artificial meadows on sandy soils.
- Animal husbandry techniques, including management of pasture, pig and chicken feeding methods, and improvement of sandy pasture.

These innovative measures have had considerable beneficial results for local agriculture:

Project impacts

Crops and cropping patterns: There is evidence that the project has been instrumental in changing crop mixtures and cropping patterns not only in the experimental village but also in many other villages. The number of crops cultivated as well as the durations within which crops can be planted have increased.

The introduction of wheat, cultivated mainly for consumption, has improved nutrition. Watermelon and maize have become major cash crops. Wider application of irrigation and the introduction of inter-cropping wheat and watermelons have increased the duration of growing seasons.

Animal husbandry: The project has introduced three innovations in animal husbandry: the introduction of better pig breeds, improved pig and chicken feeding methods, and a ban on goat farming. Pig husbandry, now a money-spinner according to farmers, is popular in all villages. Livestock numbers have increased by 64% from 397 to 650, but are now controlled, and goats have been eliminated in the project village because of their destructive grazing habits. Meadow areas and crop forage have increased ten times.

Soils: Poplar wind-breaks, pine tree plantations, aerial seeding of desertified lands, fencing and the introduction of new shrub species have stabilized active sand dunes. Nutrient levels have improved with increased vegetation and fertilizer amendments.

Water: Improved retention and use of rain water stems from shelterbelt protection and restored tree and plant cover on dunes and sandy soils. The film-bottomed paddy system provides good water conservation for rice production, but has yet to be taken past the demonstration stage, perhaps due to its higher cost implications.

Impact of wind erosion on forest plantations

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by the Institute of Desert research, Lanzhou and local communities with funds from the Chinese Government and local communities.

Vegetation: A larger proportion of treated land is now under cover, fostering natural seeding and germination of grasses and herbs. While most of the revegetation methods have been effective, two innovations have yet to be adopted: the 'checkerboard' straw treatment, designed to stabilize active dunes and encourage the regeneration of vegetation, as farmers value straw too highly as fodder; and the use of pine (*Pinus sylvestris var. mongolica*) for dune stabilization. While pine tree products are very marketable, the tree takes 50 years to mature, and farmers are reluctant to invest in a project with such a long pay-out period. While the rate of adoption of agricultural technologies introduced by the project is high, direct desertification control measures have been less popular.

Establishment of rice paddy on sand dunes

With increased ground cover, floral diversity and local incomes have grown, leading farmers to extend the project's activities to new areas.

Profitability: Farmers in the study villages report that the profitability of crop farming has increased severalfold. Total yields of marketable crops have increased by over 50%, new crops such as watermelon and improved maize varieties have a better market, and crop outputs per unit of land have increased. There has also been an increase in the efficiency of labour use, as cropping areas have been reduced due to higher yields.

Marketing: Production increases have not been accompanied by a corresponding change in marketing mechanisms or price structures. For example, although there were bumper harvests of watermelon and maize in 1991 and 1996, farmers found it impossible to market the excess, and prices of the two crops plummeted. Although the Government established a floor price for maize and appointed a watermelon marketing officer to help farmers find markets, a lack of focus on marketing infrastructure was one project oversight.

Income and savings: The project has led to a fivefold increase in household income, made apparent by new possessions such as televisions, radios, sewing machines and furniture sets, as well as the quality of housing. In all four villages, housing improvements have increased by 50%, houses with television and radio sets by 100% and those with furniture sets by 90%. Farmers also report that their savings have increased, though exact amounts are considered confidential.

Social Issues

Land ownership and tenure: For crop production, land is allocated to individuals on a household basis. The rights here are clear: all of the produce from the land goes to the person who did the work, and the Government taxes any income from this produce. The rights to plant and harvest on communal land used to be vested with the community, a situation that discouraged tree planting by individuals. But in 1995, the Government made a decision to provide limited rights to individuals to plant trees and grasses or shrubs on communal land, in which those who plant have harvest rights for up to 30 years, and this has had a considerable impact on farmers' attitudes and behaviour.

On rangelands, the experiment started to divide the area earmarked for stabilization among different households, entrusting them with management responsibility. They were permitted to extract materials from their own plantings, providing for better accountability and responsibility. Although these changes in land tenure are significant, only about 50% of the households have taken advantage of the change. The reasons for this may have been partly due to insecurity of tenure and partly the low level of participation of villagers in decision-making and implementation of land-based activities.

Community empowerment: The project has not created any new institutions, instead working through existing ones. The only informal organization among villagers is the traditional labour exchange arrangements at the time of crop harvesting, which helps to complete the harvesting more quickly and promotes co-operation and goodwill. Farmers report that the increase in crop yields has made exchange arrangements more necessary, thus strengthening this important tradition.

Gender: In the project area, as well as in Banner in general, women hold a significant position. The Women Bureau of the township, working in collaboration with project staff, planned carefully around gender issues. As a result, some activities introduced by the project, especially those that take place in the house compound, such as new techniques of pig and chicken feeding, have led to higher incomes for women. The Director of Women's Affairs in the township reports that women have moved away from traditional occupations of cooking and fuelwood gathering to income generating activities. More income in the hands of women may have been one of the reasons which contributed to better housing and standards of living. The protection of women's rights in Banner has complemented the position of the women in the project area. They are also becoming environmentally conscious through limited participation in windbreak planting, grazing area planting and protection work.

Social capital: The project has had some success in building the capacity of local people, enhancing commitment to environmental protection, strengthening women's rights and developing a sense of ownership of natural resources. Dividing rangeland areas and assigning management responsibility to individual households has increased accountability for natural resources. Some households have, however, shied away from these activities, which may be attributable to limited participatory planning.

Environmental Costs: The increase in applications of chemical fertilizer could increase the risk of groundwater pollution. Since wells are the only source of water for domestic use and dry season irrigation, pollution of this source will have severe repercussions. Although levels of application are not yet very high, farmers continue to increase the quantity in expectations of even higher yields. During the last five to seven years, the level of application has increased nine times. The optimum levels of application of these chemicals have also not been worked out partly due to the absence of an agronomist to conduct necessary studies. As well, farmers have begun to apply pesticides, which were not required in the past. Another possible negative effect could well be the increased popularization of irrigation, which could lead to the build up of soil salinity.

Use of grass and shrubs to stabilize sand dunes

Lessons learned

Research-policy: One of the factors which has contributed to the effective implementation of some of the interventions is the linkages that have developed between the research and administrative set-up of the township. If it had not been for the active backing of the extension agents and other field workers attached to the township on the one hand, and the linkages between the officials and the village administrative framework on the other, the implementation of the experiment at village level would have been severely hampered. The county administration responded to the initial areas of success of the experiment by formulating new policies. The policies themselves were based on the results emerging from the experiment in the village. It is to be noted that this linkage would contribute further refinement of the research while also leading to combating desertification effectively. The policies concerning the banning of goat farming, granting grazing land protection to individual households and tree tenure rights are cases in point. It should be pointed out, however, that these linkages between village administration and township is unique to China. Similar linkages do not exist in many other countries affected by desertification and this issue must be considered before replicating this approach elsewhere.

Other crucial issues: There are three crucial issues which have contributed effectively to the present level of success of the experiment. These issues must be given due attention in planning and implementing similar interventions elsewhere. These include:

- The shallow water table in the project area, which has made many of the interventions a success. Water being the most crucial commodity for life everywhere, and more so in an arid land ecosystem, the experiment would be far from successful without easy access to water.
- Favourable land tenure, facilitated farmer involvement in tree planting and protection of grazing areas. Tenure rights for land, trees and other resources is a necessary condition for success.
- The success has been mostly determined by the socio-political system, including the administrative framework of the village and the county. Similar structures are rare in many other countries. Hence, it may be necessary to plan and facilitate the development of an appropriate institutional framework in the implementation of similar programmes elsewhere.

References

The Experimental Research to Control Drifting Sand of Cele County (19930. Prepared by the Xinjiang Institute of Biology, Pedology and Desert Research, April, 1993.

An Experimental Study on Sand Control at the Quira County of the Xinjiang Uygur Autonomous Region, China . Report prepared by the Xinjiang Institute of Biology, Pedology and Desert Research.

Chinese Academy of Sciences (1993). **Wondrous Taklimakan.** Science Press, Beijin and New York.

Rehabilitating Vital Watersheds

Integrated Management of Jhanwar Watershed, Shiwalik Hills, India

Background

As a part of a national initiative to combat desertification, the Central Arid Zone Research Institute (CAZRI), Jodhpur, initiated the Jhanwar Watershed Project in 1986, with financial assistance from the Government of India's Desert Development Programme. Realising the importance of healthy watersheds for improving productivity of degraded lands, 46 watershed projects were launched in different agro-climatic regions of the country.

The major problems confronting the inhabitants of this watershed area were legion, including: low and erratic annual summer rainfall (360mm); high evapotranspiration (1,800-2,000mm/year); low fertility sandy soils; low crop yields and frequent crop failures due to drought; scant vegetation cover; acute shortages of drinking water; fodder and fuelwood scarcity; poor animal productivity; and seasonal migration of both human and livestock populations. Against this back-ground, the overall goal of the project was to develop sustainable dryland farming with efficient management of natural resources in the watersheds. It was a unique collaborative effort among researchers, national and state level executives, state extension agencies and the farmers themselves. A number of committees at national, state, institute and village levels were constituted for effective planning, implementation, monitoring and evaluation.

The Jhanwar Watershed lies 25 km southwest of Jodhpur town, in western Rajasthan State. The total area of the watershed is roughly 4,600 hectares, covering five villages: Bujawar (38%), Jhanwar (35%), Chokhan (21%), Rohilan Kalan (4.8%) and Doli (1.2%). About 39% of the watershed area is rocky, 15% is fallow and the rest (47%) is under cultivation during the rainy season. Irrigated land in the watershed is negligible (37 ha). In the first phase of the project, from 1986-93, a 1,200 ha area of the watershed with severe soil and water erosion hazards was selected for execution of the development plan. Various agro-climatic conditions of the project area are as follows:

Climate: Annual rainfall is low (360 mm) and erratic (C.V. 70%), High solar incidence (600 cal/m^2) and wind regime (30 to 40 cm/hjg in summers) leads to high potential evapotranspiration (1,800-2,000 mm/yr) resulting in negative moisture balance through out the year. The summer temperatures are very high (45° C to 48° C) while winters are mild.

Soils: Soils in the watershed area are mainly sandy with low fertility (organic content: 0.02%, available P: 8 to 10 kg/ha , available K : 180-220 kg/ha) and have poor moisture retention capacity (100-120 mm/m soil profile).

Hydrology: The upper reaches of the watershed are mainly rocky, devoid of vegetation cover, and have steep gradients. Run-off rates from three large streams are high. Apart from these streams, several drains have developed, which, after flowing a short distance, get clogged-up in fields and damage crops. Uncontrolled runoff both from streams and drains has led to considerable sheet and gully erosion in the whole of the area.

Groundwater: Groundwater in the area is very deep (30-35 m), scarce and of poor quality. There are only 3 wells in the watershed, serving an area of only 21 hectares.

Vegetation: Vegetation in the watershed area is sparse and composed of bushes and shrubs of very low palatability. The

Community water-harvesting through water dam construction

UNEP's "Saving the Drylands" award winner, 1996. This project was implemented CAZRI , the Sate department of Soil Conservation and local communities with the Government of India.

main plant species were *Capparis decidua, Leptadenia pyrotechnica, Balanites roxeburgii, Crotalaria burhia, Zizyphus nummularia, Acacia jacqmontii, Panicum turgidum, Cenchrus biflorus,* and *Aristida spp.*

Land use patterns: Of the total 1,290 ha, about 64% was under cropping, 5.42% was rocky wasteland, 11.5% under community grazing land, and 10.5% lay fallow. The local economy depends on dryland crop production and community grazing.

Socio-economic conditions: Out of the total 452 farm families in the watershed, 148 were involved in the project. Of these 148 families, 6% owned 0-3.5 ha, 25% owned 3.5-7 ha, and 15% owned more than 7 ha of land. The per capita population of cows (1.50) and goats (1.29) was also quite high in the watershed. Depending on the size of the farm, the average income per household varied from Rs. 2,548 to Rs. 3,253. Baseline data on human population revealed that annual population growth in the watershed area was 4.4%, with an average household size of 8.3 persons. The literacy in watershed area is very poor, and the schooling of boys is preferred over girls.

Development plan: Hydrological, benchmark and land capability surveys were conducted to assess the problems and potential for the integrated development of the watershed. Based on these investigations, an action plan was then prepared in consultation with state extension agencies, technologists and farmers. The plan focused on three broad aspects :

Winter cropping

Engineering: Water retention bunds around the margin of tablelands to arrest the sheet flow, guided bunds for contour cultivation, dry stone check dams and brushwood check dams at suitable locations in gullies to resist the dissipated thrust of discharge, and stone masonry structures on three main *nallahas* adopted for efficient soil and water conservation. For main *nallahas* adopted for efficient soil and water conservation. For protection of these areas from biotic interferences, loose stone walls and ditch-cum-mound fencing were constructed.

Agro-economics: The agronomical techniques included crops and their improved varieties, primary and secondary tillage operations, seed rate, fertilizer use, integrated pest management, and *in-situ* and inter-plot water harvesting and recycling systems. To stabilize production, various alternate land use systems, such as horticulture, agri-pasture and farm forestry were also adopted.

Community participation: To motivate farmers to participate actively in the work, as well as to create awareness about the project, various training programmes, demonstrations, farmers' fairs and field days were organised. The active participation of all beneficiaries was a major focus from the beginning.

Achievements

The integrated management of natural resources in the Jhanwar Watershed stands out as a success story to control desertification and promote dryland farming. Improved agricultural practices, improved community grazing land, reclaimed wastelands, and better surface water management proved effective in promoting resource conservation and sustainable dryland agriculture.

Soil and water conservation measures

Approximately 70 hectares of degraded rocky wasteland were fenced with 1.5m high stone wall to protect against biotic interferences. Three masonry dams (anicuts) were constructed on the main streams to regulate and control soil erosion on cultivated fields downstream, as well as 135 loose stone and 80 brush wood check dams at 1m vertical intervals (VI) in the gullied area. Box trenches were dug along contours at 1.25m VI and planted with *Acacia tortilis, A. senegal, Prosopis juliflora* and *Zizyphus rotundifolia* seedlings and reseeded with buffalo grass *(Cenchrus ciliaris)* between tree rows. As a result of these interventions, the gullied land in the catchment area was reclaimed and soil erosion was controlled on both cultivated and grazing lands. There was a gradual decrease in silt deposition in the anicuts from 20.1 tons in 1988 to 7.1 tons in 1994. A substantial quantity of water was stored in the anicuts (33,000 m^3), and a reduction in the flow rate of water in the main stream facilitated the deep percolation of surface water, resulting in 9.1m rise in the water table in the watershed over the project period.

The project also created a micro-climate conducive to regeneration of endangered plant species, such as *Commiphora wightii* and *Tecommela undulata*. This has not only improved land use values in the area, but the biodiversity of the ecosystem as well. By 1992, the population of *C. wightii* had increased by 500%, while *T. undulata* established itself at a slower rate, with no significant increase during this period. By 1994, however, it had recorded a 450% population increase. These species are of immense economic and medicinal value in this region. The table below illustrates the population dynamics between 1987 and 1994 of those species that had almost disappeared from the upper part of the watershed by 1984. And as vegetation cover returned, so did wildlife, including wolves, bluebulls, partridges, rabbit and deer.

Aquaculture

Additional water storage capacity was created through the construction of 12 rainwater harvesting ponds, of which five were open (270m^3) and seven were closed (90m^3). The ponds not only played a significant role in establishing fruit and forest tree seedlings in various integrated farming systems, but also served the drinking water needs of people and livestock throughout the watershed. It was estimated that about 4% of the water collected in farm ponds was used to establish trees and the rest for human and livestock consumption.

Community grazing land

Out of 150ha of degraded community land targeted for development, 120ha was subdivided into six buffalo grass paddocks and protected against free ranging animals by ditch-cum-mound fencing coupled with staggered planting of three rows of *A. tortilis* spaced 3m x 3m in trenches around the perimeter of the paddocks. The recommended forage use system during the initial two years of the project was "cut and carry". This system, besides yielding 10t. of valuable grass seed in the first two years, resulted in forage productivity of 2.5 to 3t with a carrying capacity of 1ACU/ha, compared with 0.3t of forage and 0.25 ACU/ha carrying capacity before the project period. Regulatory grazing of the animals was allowed from the third to fifth years, but this management system collapsed after the project period due to indiscriminate grazing; as a result, the carrying capacity of the pasture reduced to the original 0.25 ACU/ha. The trees established on the perimeter of the community paddocks are still managed by village *Panchayat* as woodlots for fuel, fodder and timber.

Dryland crop production

Crop yields were generally poor in the Jhanwar watershed area prior to CAZRI'S intervention, but the watershed project spurred dramatic improvements in crop yields with a combination of improved water conservation measures, the use of improved varieties and crop management support. Also as a result of the project, farmers have allocated more area to dryland legumes, which have more stability compared to pearl millet, particularly in this fragile eco-system. Also the area under irrigated and commercial crops (tomatoes, chillies, mustard and wheat) have increased by three to four fold due to improved water harvesting techniques and groundwater recharge.

Integrated land use systems

The project has raised about 6,000 multi-purpose trees species (MPTS), namely *P. cineraria, A. tortilis, P. juliflora and Z.rotendifolia,* on 2,000 hectares of farm field boundries. Besides serving as windbreaks, they also provide fencing material, fuelwood and fodder. Systematic inter-cropping of drought-tolerant, high-yielding crops with fast growing MPTS improved the output per hectare. Traditional agroforestry systems were improved with the introduction of *Z. mauritiana,* which besides sustaining 700-1,000 animal days (goat) serves as a commercial crop through its fruits (2.4 t/ha) which are sold in the market at high prices (Rs. 7-10/kg). This fruit tree did not interfere with the growth and yield of intersown dryland leguminous crops (4-5t/ha) and grasses (1.5-2t/ha). To promote horticulture in the area the root stocks of *Z. nummularia* and *Z. rotendifolia* were also successfully grafted with improved cultivars of *Seb* and *Gola* of *Z. mauritiana.* Systematic planting (100 p/ha) of fast growing species of *P. cineraria* has also helped farmers reach agricultural sustainability.

Livestock productivity

There has been a general increase in numbers of all types of livestock except goats, which have decreased in number. The increase in camel populations was very high due to increased availability of quality feed from woodlots in the community grazing lands and degraded gullied wastelands. The reduction in goat population is attributed to farmers' inclinations towards more productive dairy animals like cows and buffalo, in view of increased fodder.

Improved income

There was significant improvement in farmers' real incomes, to the tune of 11.9 to 80% in various categories. The rise in income was the result of a combination of a number of factors, including increased livestock and crop productivity, generation of marketable surpluses and greater wage earning opportunities. Technological options for managing degraded wastelands, community lands and cultivated fields were implementable and yielded useful results in restoring

Community water dam for land and livestock use

vegetation cover, productivity and carrying capacity. Productivity of cultivated lands has increased severalfold with the adoption of improved dry farming technology and with the introduction of integrated land use systems. With the improved availability of fodder there has been a 3-fold increase in milk yield, and an overall increase in farm income of 56.8% between 1986 and 1993. This income has been invested in better housing, household items, improved literacy and better farm infrastructure.

The rates of adoption of new technologies were 124% for farm forestry, 100% for dryland crops, 80% for silvi-pasture, 42% for horticulture, 28% for agroforestry and negligible for agri-pasture systems. These technological interventions are very replicable under similar agro-ecological situations. With the success of the model watershed project both state and national authorities have stated that only projects formulated on the integrated approach will be approved for funding. As of 1996, more than 100 watershed development projects were in progress in Rajasthan state.

Lessons learned

- Although there were high levels of community participation in the implementation of the project, to create more awareness and participation new extension methods like Rapid Rural Appraisal and Participatory Rural Appraisal should be adopted.
- Although no major difficulties were encountered in collaborating with the state extension agency, but it was felt that frequent transfers of agents should be avoided to improve accountability.
- There should also be a separate watershed level committee representingtarget community instead of village *Panchayats*, which keep changing with the expiry of their term.
- The involvement of NGOs should be encouraged to improve community participation further.
- The prices of principal farm commodities are reviewed on a regular basis by the government, but there is a need to enlarge the scope further by including other crops (chilies, cumin etc.) both at the national and regional levels.
- With the withdrawal of the project, the community does not hold responsibility for maintaining common property resources like grazing lands, farm ponds, woodlots etc. Some agency within the farming community itself should be created for the rational use and maintenance of these assets.
- No fixed package of development should be thrust upon the inhabitants of a project area; technological options should be made available so that communities can select appropriate measures for themselves.

References

CAZRI, (1996). Master Plan for the model Watershed Jhanwar for Integrated Development of dryland agriculture, CAZRI, Jodhpur

CAZRI, (1996). Annual Report, CAZRI, Jodhpur, various issues

CAZRI, (1995). "Summary Report of Integrated Management of Natural Resources on Watershed Basis to Combat Desertification and Land Degradation" CAZRI, Jodhpur

Bhati, T.K. (1995). "The Role of Watershed Management Approach in Improvement and Sustainability of Agricultural Production in Rajasthan". Paper presented at Seminar on "Development and Management of Minor Irrigation Resources in Rajasthan State", (14 January 1995) organized by Bankers Institute of Rural Development, held at Lucknow, Uttah Pradesh

Bhati, T.K. (1994). "Planning of Integrated Land Use Systems". Paper presented in Training Workshop on "Identification and Development of Index Catchment Areas". Sponsored by Government of India, Ministry of Rural Development and Held at CAZRI, Jodpur.

Dixon, John A. et al. (1990). Dryland Management: Economic Case Studies, Earthscan, London.

Singh, H.P. and Bhati T.K. (Ed.) (1993). Manual for Development of Model Watershed projects in DPAP and DDP Areas of India, Ministry of Rural Development, New Delhi

Returning Forests to Communities

The National Joint Forest Management Project, Haryana Province, India

Background

Dam used for water harvesting and pisciculture

The National Joint Forestry Management Project (JFM) is located in the Himalayan foothills (Siwalik Hills) in the Haryana State of India, about 300 km northwest of New Delhi. Approximately 82% of the state is under cultivation and 3.8% of the state is forest, amounting to 1,685 km^2, 40% of which is found in the Siwalik Hills, foothills of the Himalayas. The project covers 20,000 hectares of degraded forest land area in the Siwalik Hills.

Climate: The climate of the Siwalik Hills region is sub-tropical, with prevailing humid and semi-arid conditions. The area receives an average annual rainfall of 1,116mm, ranging from 716 to 1,897mm. Rainfall is bimodal, with about 886mm, or 79% of the total, falling during the monsoon months of June and September, and about 164 mm during the winter season between November and March. Winter rains are erratic and poorly distributed.

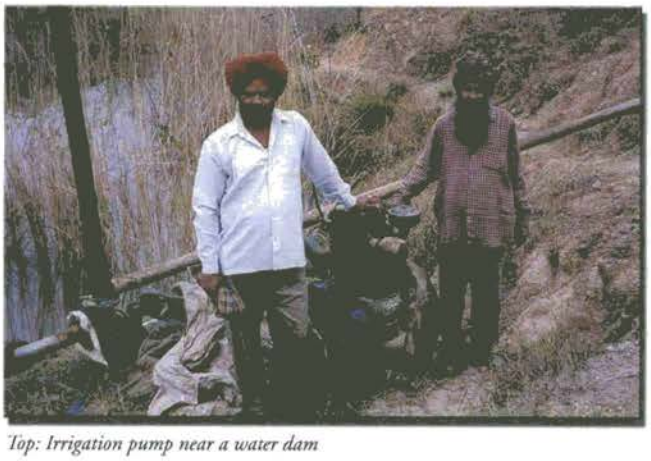
Soils: The Siwalik Hills consist of alternating beds of sandstone, conglomerates, pseudo-conglomerates, clays and silts. The area is composed mainly of tertiary sediments, forming low parallel ridges with south-facing escarpments. Soils in the Siwalik Hills are prone to severe erosion. Prior to the 1980s, a long history of uncontrolled exploitation of forest resources resulted in the depletion of vegetation cover, leading to desertification.

Vegetation: The major forest types are Siwalik chir pine, tropical dry mixed deciduous, dry deciduous scrub, *Dodonea* scrub and dry bamboo brakes. Chir pine (*Pinus roxburghii*) is the predominant tree species, mixed with *Coromandelica, Bauhinia spp, Toona ciliata, Emblica officianalis, Ougenia oogenesis, Cassia fistula, Grewia spp* and *Pyrus pashia*. The project area is dry deciduous scrub forest, a degraded stage of tropical mixed deciduous forest. There has been overgrazing, cutting of trees and recurrent fires. Natural regeneration was absent prior to the JFM project. Shrubs such as *Lantana* and *Carissa spp* dominated the areas close to human habitation.

Bamboo (*Dendrocalamus strictus*) forests occur with shrub species on clay loam soils or loosely textured conglomerate formations between 500 to 950 metres above sea level. In good sites the bamboo forms a close canopy. On poor sites the bamboo clumps are scattered and mixed with scrub species such as *Carissa spinarum* and *Dodonea viscosa*, with thickets of *Lantana camara*. The key grasses are *Eulaiopsis binata* (bhabbar grass), *Chsysopogon fulvus* and *Heteropogon contortus*. In the pre-project period, natural regeneration of all the above species was low due to fire and over-grazing.

The problem

Since the early 1800s, the Siwalik Hill forests have been used as grazing areas by neighbouring village communities. People



Top: Irrigation pump near a water dam

UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by Tata Energy Research institute (TERI) and local communities with funds from the Government of India and Ford Foundation.

kept large herds of cattle, as well as sheep and goats, which were grazed in the state forest. This open access resource system led to severe erosion in the hills and poor agricultural production. Decreasing production brought increased pressure on the forests, and decreased forest productivity. Restrictions on access to the forest were then imposed on communities by the Haryana Forest Department.

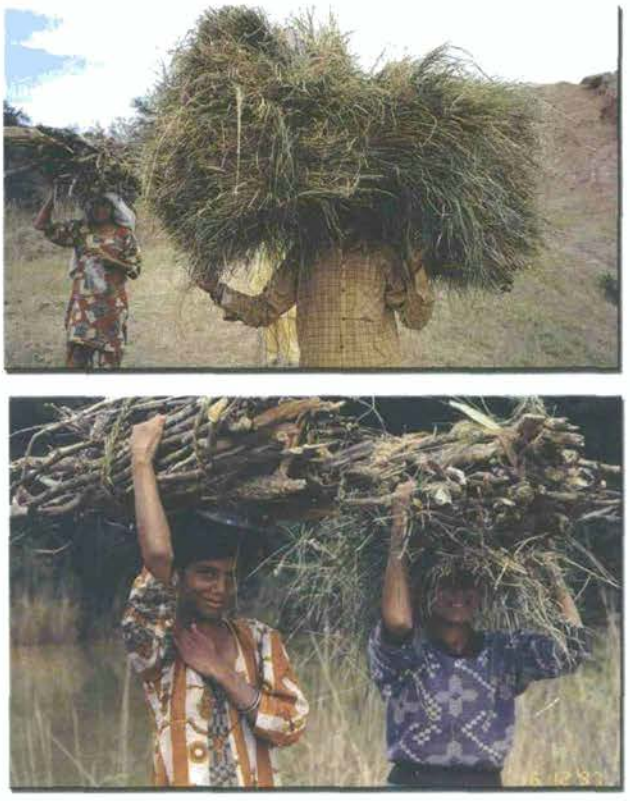
In the Siwaliks, inherent soil properties govern the extent of soil erosion in the region. In the hill watersheds, the shales, the clay formations and the sandstones occur side by side in the horizontal and vertical bands. Landslides, slips and potholes lead to the release of a large amount of sediments in the rivers. Vertical gully and ravine-like erosion features are common. The detritus carried by flash floods is deposited over productive agricultural fields year after year, rendering them unfit for cultivation. Deforestation, uncontrolled grazing and frequent fires increase the rate of soil erosion and landslides in the hills.

In the mid 1970s the rate of erosion in the catchment of Lake Sukhna was estimated to be 700 tons per hectare per year, reflected by the level of siltation in the lake. Efforts by the Forest Department to prevent the erosion in the forest area of the catchment were costly and ineffective. Money spent by the Department on the construction of barriers to prevent erosion and on replanting trees did not produce the desired results.

Solving the problem

State forestry officials realized that individuals could be motivated to collective action in pursuit of common goals, in this case the regeneration and rehabilitation of degraded state forests, if they were provided with enough incentive. Neighbouring communities debated their options with state foresters, but the lack of alternative resources available to most village families left no option but dependency on forest resources for their livelihoods.

Key incentive: The Haryana Forest Department identified a key incentive: providing water for irrigation to neighbouring communities by building dams in or near the forest area. The Department approached communities in Sukhormajri village, which lies in the catchment of Lake Sukhna. After much debate the communities agreed to cooperate in the protection of the water catchment area in return for water for irrigated agriculture.



Top and bottom: Sustainable fuelwood and fodder harvesting under the Hill Resource Management Society

The water from the dams was distributed equally to all households, irrespective of land holding, caste or gender. Irrigation brought increased crop yields, resulting in reduced pressure on the forest for fodder and fuelwood. Communities voluntarily chose to stop grazing their livestock in the forest, and formed a Water Users' Association (WUA) in 1980 to regulate water distribution and catchment protection. The numbers of goats decreased and villagers changed to stall feeding

The key incentives

Incentive	Effect
Water for irrigation	Reduced dependence on forests, encouraging villagers to stop grazing their animals in the catchment area to protect their water source; provided for an alternative form of agriculture - irrigated cropping.
Grass for fodder leases	Grass leases given to HRMS instead of auctioning to private contractors resulted in communities accepting the need to protect forests from open grazing.
Grass concessions	Commercial grass leases given to HRMS instead of private contractors or paper mills encouraged villagers to protect the forest.
Bamboo for basket making	Increased quotas of bamboo, on the condition that villagers maintain the clumps at optimum productivity levels and assist in fire prevention, motivated villagers to look after bamboo forests.
Timber, firewood and other forest products	Gave HRMS a stake in improved management, which has resulted in sustainable protection of these resources. HFD has committed a percentage of the increased timber resources to the villagers.

their cattle and buffalo instead of open grazing in the forest.

Institutional development: In order to share the increased productivity of the state forest with the communities and develop community participation in forest management, the Water Users' Associations were reorganized into Hill Resource Management Societies (HRMS), registered under the Societies Registration Act (1860), with responsibilities for:

(i) Protecting forests against grazing and illicit felling;

(ii) Distributing irrigation water;

(iii) Fixing rates for water and grass;

(iv) Maintaining dams and conveyance systems;

(v) Maintaining accounts;

(vi) Cooperating with the staff of the Forest Department.

All adults of all families in the village are free to become members of the Society.

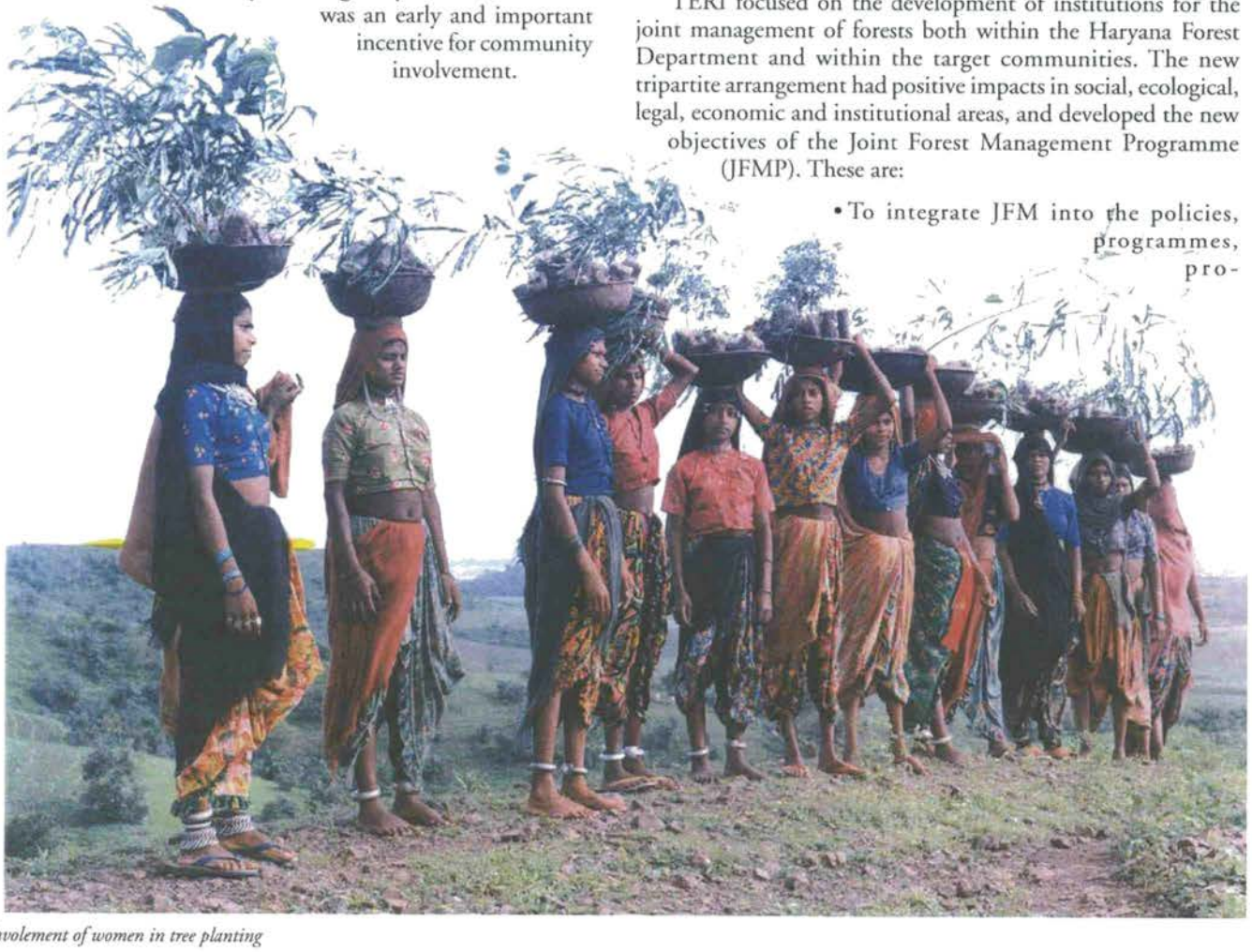
Economic incentives: The improved management practices and changes in attitude of the villagers led to leasing of the forest areas to registered management societies by the Department. The societies paid the average price obtained in the last three open auctions, with an annual increase of 10%. This resulted in a reduction of rates for fodder grass from Rs 450 per head per year charged by the contractor, to Rs 150 per head per year charged by the societies. This was an early and important incentive for community involvement.

Natural regeneration of vegetation under protected areas

The role of NGOs: In 1990 the Government of India issued a circular on the 'involvement of village communities and voluntary agencies in the regeneration of degraded forests'. It outlined the key role of NGOs as the interface between the State Forest Department and the village communities. The government circular proposed a tripartite agreement between the Forest Department, communities and NGOs. The Government of Haryana also issued enabling orders for JFM in 1990, following which the Tata Energy Research Institute (TERI) became the programme's facilitating agency, with responsibility for recruiting new villages to form HRMS.

TERI focused on the development of institutions for the joint management of forests both within the Haryana Forest Department and within the target communities. The new tripartite arrangement had positive impacts in social, ecological, legal, economic and institutional areas, and developed the new objectives of the Joint Forest Management Programme (JFMP). These are:

• To integrate JFM into the policies, programmes, pro-



Involement of women in tree planting

cedures and operations of the Department;

- To motivate local communities to protect and manage the forests on a sustainable basis for their own benefit;
- To provide institutional training and development-related consultation services;
- To disseminate information on the impacts of JFM on ecological regeneration, economic productivity and environmental security through publications and workshops.

Impacts

- The effects of years of increased state forest protection are evident in a number of biophysical and ecological indicators, such as grass productivity, an increase in trees per hectare and the regeneration of trees and shrubs. The results show that the longer the protection, the greater the improvement in forest ecosystems.
- The management societies have developed their own systems for regulating forest use and the harvest of forest products.
- Rules have also been developed for stopping outsiders from felling wood or harvesting grasses. This system of community self-policing has relieved the Department of the onerous task of trying to protect the forest.

Increased production and income: Increased income at the household level has come from increased agriculture capacity through irrigation, from increased bamboo supplies, the provision of bhabbar grass for rope making, increased milk yields and proceeds from high milk yielding cattle due to increased fodder from forest and agriculture lands. Total yields per hectare of forest products nearly tripled after three years of protection, rising from 1t/ha to 2.7t/ha. Income to HRMS comes from the sale of water, fodder grass, surplus bhabbar in open auctions, fish, fines, and membership fees. Savings at the management society level are reflected in the books of accounts maintained by the societies, and at the individual level in improved quality of life.

More jobs: New employment opportunities have been generated by increased production of bamboo for basket-making, bhabbar for rope-making, and the increase in livestock rearing as more fodder is being produced in forests and on agriculture lands. Employment has also been generated at the household level from increased opportunities for wage labour in agriculture fields and in forest areas.

Community empowerment: The project has ensured equitable distribution of benefits to all members of HRMS, including marginalised members of the community and women. The project ensures the participation of all members in the decision making process and management of village institutions.

Resource use and conservation: The project interventions have resulted in enhanced tree and grass cover in the forest areas, improved soil moisture regimes, reduced silt loads from the forest catchment areas, reduced water run-off from the catchment and fewer floods downstream.

Cost effectiveness: The financial resources required for the construction of dams by the Department came from budgets allocated for other forestry works, such as afforestation and reforestation, protection, and fire control. Under the benefit sharing arrangements, the state derives a percentage of the profits from the joint management of forest areas. Also, a portion of the communities' share is set aside for development of forestry resources.

Replicability: The initial success achieved by the Department and the Association at Sukhomajri has been replicated at 60 other sites. The Joint Forest Management Programme is being implemented in 17 other states across the country, covering nearly two million hectares of degraded forest areas. The community based forest management programmes are being successfully replicated and implemented in South and Southeast Asian countries like Bhutan, Cambodia, Indonesia, Nepal, Philippines, Thailand, and Vietnam.

References

HFD and TERI (1992). JFM Series 2: Impact of Forest Management on the ecology of Shivaliks Hills in Haryana State, TERI, New Delhi.

HFD and TERI (1992). JFM Series 3: Economics of Bamboo basket making: a case study, TERI, New Delhi.

HFD and TERI (1993). JFM Series 4: Economics of goat and buffalo rearing: A case study from Haryana State, TERI, New Delhi.

HFD and TERI (1993). JFM Series 6: Management of bamboo forest under joint participatory forest management Haryana State, TERI, New Delhi.

HFD and TERI (1993). JFM Series 7: Systems of Bhabbar grass lease management in Haryana State, TERI, New Delhi.

HFD and TERI (1993). JFM Series 9: Economics of rope making under participatory forest management ,TERI, New Delhi.

HFD and TERI (1993). JFM Series 11; Women as partners in the regeneration of Shivaliks in Haryana State, TERI, New Delhi.

HFD and TERI (1994). JFM Series 13: Women in Godam Haryana: A gender and caste based study on conservation of forest resources, TERI, New Delhi.

HFD and TERI (1994). JFM Series 14: A dynamic process of institution development in Lohgarh village in Haryana State, TERI, New Delhi.

HFD and TERI (1994). JFM Series 16: Rehabilitation of degraded tropical forest watersheds with people's participation, TERI, New Delhi.

HFD and TERI (1995). JFM Series 18: Institutional, legal and socio-economic impacts of community participation, TERI, New Delhi.

HFD and TERI (1996). JFM Series 23: Role of community institutions in fire control in in Haryana State, TERI, New Delhi.

The Barefoot College

Integrated, People-focused Approach to Environment Conservation and Development-The Social Work and Research Centre, Rajasthan, India

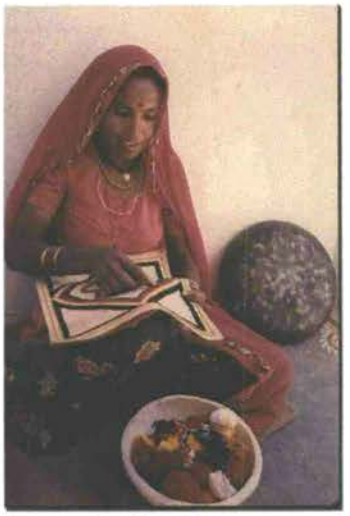
Background

The Barefoot College, also known as the Social Work and Research Centre (SWRC), is a voluntary organization founded in 1972 to provide training and essential services to the rural poor of Silora Block, Rajasthan State, India. The College is located in the rural area it serves, Tilonia village, 55 kilometres from the district headquarters of Ajmer. The area extends over 82,349 square kilometres, with 110 villages and a population of 100,000. Silora is arid, and experiences frequent drought.

The Barefoot College builds local capacity through nine programmes: water, education, health, social forestry, agriculture, animal husbandry, women's issues, communications and rural industry. Of 178 staff, 95% are local people who have received training from the college. Its eight field centres, which provide training and resource outreach for communities, employ resident local staff across the project area. SWRC considers environmental conservation and development to be one indivisible issue, and human resource development to be the key to both.

SWRC's environmental work began in 1973, when it carried out a survey of existing and potential water resources, followed by socio-economic studies to identify viable solutions for the alleviation of drought, particularly for the rural poor, in Silora.

In 1976, the College worked directly with the community to plan and implement land use plans for environmental improvement in local villages. SWRC and local *Panchayats* focused on community land leases, grazing land, afforestation and inadequate access to infrastructure and services, especially water and sanitation. Their research found that technical interventions based on surveys were not having any discernible impact on rural livelihoods or the management of natural resources.



Community craft-making

This experience led to a change in SWRC's policy and strategies, from technical interventions delivered by graduates of external institutions to a community-based development approach designed to influence local attitudes and behaviour. They realized that they had a lot to learn from the people before communities would participate actively in SWRC programmes, and that they would need to assist communities to handle problems on their own, with locally available resources.

Thirty percent of Barefoot College programmes are financed by its own core activities, professional services and goods. The Government of India contributes another 30%; the remaining 40% comes from donors. Government grants are allocated towards eight programmes where the College has a comparative advantage over Government in their access to communities. The devolution of power and funds to *Panchayats* means that communities have access to public financial resources for the programmes of their choice, including SWRC's services.

Solar panels provide lighting and power the telephone exchange

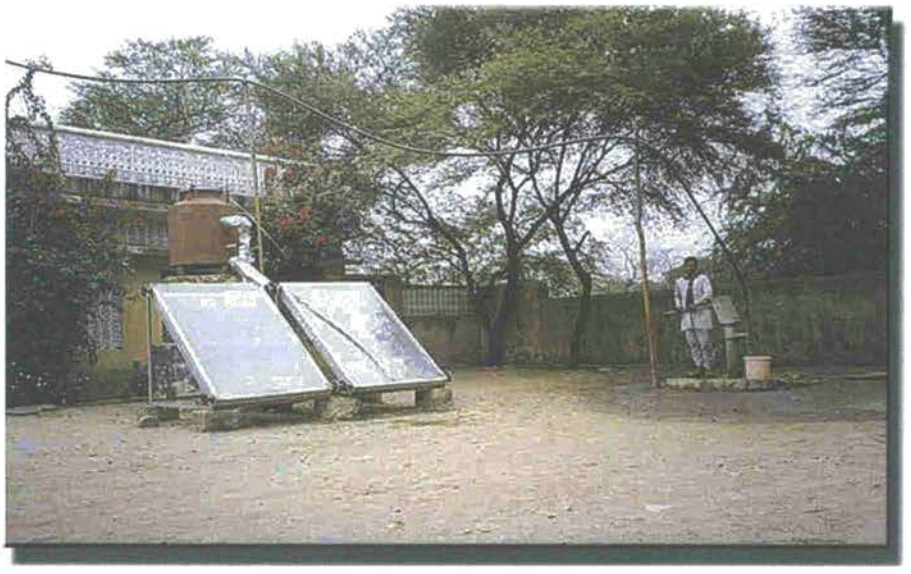
Land use constraints: The Silora Block faces several land use constraints, arising from:

- An increase in human and animal population;
- Encroachment on open-access grazing land;
- A breakdown of village level institutions for land management, which contributes to overgrazing and deforestation;
- Cows and buffaloes are being replaced by small ruminants;
- An increase in land use pressure, leading

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by the Barefoot College, Tilonia, and the local communities with funds from foreign sources and the Central Government Departments, India.

to land degradation and falling pasture productivity and carrying capacity and creating 'wastelands';

- Inadequate fodder and grazing, giving rise to low livestock productivity. The Wasteland Development and Goat Programme were initiated to address these constraints.



Solar power for water heating

The Barefoot approach

The Barefoot approach to reclamation and prevention of dryland degradation is focused on people. It is estimated that up to 80% of the investment in the programme is in people and processes, and the remaining 20% in tangible strategies such as wasteland reclamation, water conservation, rooftop rainwater harvesting and energy alternatives. This has given rise to an integrated and inter-sectoral development approach where livelihoods and short-term basic community needs (food, energy, water, health, literacy, employment) are central priorities, together with sustainable environmental programmes. SWRC's success is based on the community interface with natural resource conservation and preservation, so that the environment is in harmony with local development.

Achievements

Wasteland development and goat programme:

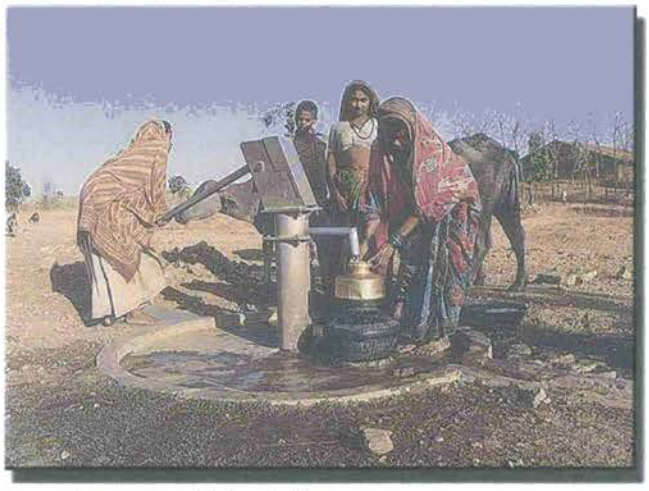
Approximately 2.4 km^2 of wasteland have been successfully reclaimed and regenerated with trees. Out of the eight wasteland development projects reviewed, there was a failure rate of 25%, mainly due to community land use conflicts at Gundli and Singla, where reclamation failed.

Vegetation has been revitalised on reclaimed wastelands, there has been an increase in wildlife species and soils have improved with reduced erosion rates. There has been a notable rise in the water table, resulting in higher yields from wells and increased irrigation. Rehabilitation of vegetation focuses on economically valuable indigenous species of trees, legumes and grasses that are palatable to livestock.

The programme has successfully decentralized nurseries for communities outside wasteland development areas. Night schools and village communities participate in this reforestation programme, where the seedling survival rate is as high as 80%.

Wasteland development incorporates the management of the indigenous Sirohi goat, introducing a superior animal through selected buck servicing at field centres that maintain pure breeds and quality Sirohi does. Goat stall feeding was not adopted, however, due to labour, economic and production constraints.

It was envisaged that participating communities would demonstrate that planned and systematic management of village commons was beneficial, and that this would lead to a demand for the development of remaining areas, but this process has been slow.



Improved access of water for household use

Rural water: The rural drinking water supply programme has benefited 1.9 million people in the following areas:

- Well drilling and the successful installation of 1,300 hand pumps;
- Construction of a pipeline for sweet water supply in areas with brackish water. A pipeline water supply was installed where lower caste households have no access to water pumps due to caste discrimination. Fourteen thousand families in six districts now have access to piped water;
- Nine million litres of water were conserved by applying local knowledge to harvest rainwater from rooftops and redirect it to concrete underground storage tanks. This is an effective low-cost solution in areas with brackish water where the community has direct control over the water resource;
- Digging man-made depressions for monsoon rainwater col-

lection for livestock watering and groundwater recharge have helped to desalinize and raise the water table;

- 600 local jobs have been created by training youth, women and the illiterate in water pump management and operation;
- The water programme generates income for staff salaries.

Education, training and employment: Communities operate 85 night schools for 3,000 pupils who cannot attend day school because of farm work. Through this programme 114 local teachers have been trained and have found employment. The programme includes environmental awareness and protection, and has set up a children's parliament. The Government of India has established 275 additional schools in other remote areas.

Underground water storage at the SWRC compound

Up to 50% of project's budget is channelled towards alternative employment creation, helping the poor to break the vicious cycle of poverty and land degradation. There are 2,500 artisans employed through the rural industry programme, while projects employ as many as 2,600 people in the Silora community. Impressive achievements have been made with respect to SWRC training and employment of the youth as Barefoot doctors and engineers.

The women's programme: The women's programme, targeting 58 groups with a total membership of 2,000, is instrumental in the initiation of wasteland reclamation, water schemes and the construction of mechanical conservation works. Through their collective action and lobbying, these women's groups have gained a minimum wage status and equal opportunities for relief work. The women truly believe they have been empowered through SWRC, and the programme has proven sustainable, receiving no external funding.

Other achievements: SWRC runs several other successful programmes that contribute toward the improvement of local livelihoods and environmental protection. These include a successful rural communication system, a community health programme and the solar programme. SWRC research, trials and demonstrations seek to fine tune environmentally friendly farming systems, incorporating biogas production, organic farming, and vermiculture. Development programmes contribute directly to infrastructure improvements through the construction of water storage tanks, pipes and pumps, sanitation, solar lighting, day and night schools, a crèche, clinics and the eight field centres. The main campus hosts a post office, a telephone exchange that operates on solar power, a clinic, school and training facility for the community and the State. The Tilonia craft shop and export company, which is a member of the Alternative Trading Organization, is housed at the SWRC campus.

Social capital

The Barefoot approach develops sustainable local institutions through broadly based participatory processes based on elected committees who administer the various projects. These committees collect service fees and operate their own bank accounts. The impact of institutional building was reflected in 1995 *Panchayat* elections, when 40% of the elected leadership had SWRC links as staff or committee members, giving SWRC philosophies an upper hand in community politics and priorities.

Sustainability of essential services: Communities sustain their own basic service needs, such as education, water and wasteland reclamation. It is evident that the culture of financial contributions and *Shramadan* (community voluntary labour) is now acceptable. Consequently, programmes that matter to the community are economically sustainable and their maintenance is institutionalized, so ensuring reliable infrastructure and service provision once the project has been implemented. Villages select their representatives to be trained at the Barefoot College, who then return to their communities to operate and maintain project infrastructure under the supervision of the committees.

Preservation of local culture, skills and knowledge: The Barefoot approach respects, builds upon and gives legitimacy to local culture, skills and knowledge systems. The rooftop water harvesting and rural communication programmes are examples of improvements of indigenous practices. The college has five non-negotiable principles: equality, decentralisation, collective decision-making, self-reliance and austerity. These principles imply that the institution is accessible, approachable and flexible in its approaches. The poor, disabled and disadvantaged participate in all programmes. SWRC service delivery systems have remained relevant and sustainable, while achieving notable progress across socio-economic classes and castes, especially the poor, throughout its existence.

Socio-economic constraints: Problems remain, despite the massive input and efforts by SWRC in changing attitudes, increasing social cohesion and strengthening organisational structures. Human development is a slow process. Some of the projects have failed to make the expected impact due to a variety of problems at the community level:

- Land-use conflicts between communities and individuals;
- Social problems of resource sharing;
- Attitude problems prohibit adoption of innovations;
- Management of common property remains problematic.

While SWRC has recorded remarkable achievements in the service sector, there is still some conflict of interest, ideas, practices

and standards with formal institutions. That graduates and technical reports are not always a prerequisite to development has been demonstrated by the approach. Nonetheless, certain technical problems still require the attention of specialists and researchers. For example, there is a need for benchmark surveys for monitoring and evaluation, since SWRC is experienced in application and dissemination of local knowledge systems, and this could be shared with the wider community. From this perspective, documentation and collaboration with formal institutions remains valid.

Replication and impact

The Barefoot College has had an impact on policy at all levels. At local institutional levels, communities now submit written requests for development projects. Proposals include community financial contributions, labour, implementation and project management arrangements.

SWRC receives more requests for development projects in Silora Block than it has the capacity to implement. The State Government now runs various education programmes based on Barefoot principles, such as the Lok Jumbish and Shiksha Karmi programmes. A community-based water pump maintenance system has replaced the three-tier system, which was controlled at the district level.

The Barefoot College is the official State training centre for mechanics in water pump programmes. At the national level, SWRC has influenced a shift from the charity or welfare approach for the rural poor, to more technology-oriented and sustainable participatory development programmes.

To this extent 0.02% of the national budget is now allocated to voluntary organization work with the rural poor at village and grassroots levels. Up to 23 voluntary organizations (VOs), which share similar aspirations with SWRC, are affiliated to the Barefoot College through a network. The majority of these VOs were founded by former SWRC graduates and staff members, who went back to their home areas and began similar work.

The Barefoot programme is a success story in its socio-economic and cultural dimensions, especially in taking a holistic approach to environmental conservation and the alleviation of poverty. It is difficult, however, to measure the effect of human resource development on the environment, as this is a long-term programme.

The programme has been very successful in improving the livelihoods of whole communities through an integrated approach that provides basic services and alternative employment in an arid environment.

References

SWRCA (1973). "Ground Water Survey Report for the Rural Electrification Cooperation Scheme of Silora Block. SWRC, Tilonia

SWRC (1977). "Feasibility Study for Raising the Socio-economic level of 500 Marginal Farmers in Panchayat Sammiti Jawaja, Ajmer District" SWRC Publication Tilonia

SWRC (1994). Identification of the Wild and Weed Plants of Ajmer District. File Records SWRC (Tilonia)

Narula A (1994). "Final Report on the Goats and Wasteland Development Project in Silora Block, June 1992 - June 1994 SWRC Tilonia

SWRC (1997). "Wasteland Development and Goad Programme in Silora". SWRC File Records

Sharma J and Jain, S (1990). "Process Review SWRC Famine Relief Activities 1987 - 1988 Institute of Development Studies, Jaipur.

Government of India, Department of Rural Development, Ministry of Agriculture (1989). "Report of the Working Group on Wage Employment Programmes for the eighth Five Year Plan" Government of India Department of Rural Development, Ministry of Agriculture, New Delhi.

SWRC (1987). ""Footprint in the Sand, Vol. 1" The Environmental Jatha Padayatra, 1987. Silora Block Rajasthan, India.

SWRC (1987). ""Footprint in the Sand, Vol. 2" The Environmental Jatha Padayatra, 1987. Silora Block Rajasthan, India.

SWRC (1976). "Survey Report for Establishment of Allied Services in the Vicinity of Focal Village Khori, Khol Block, Mohndergarthg District, Haryana". SWRC Publication, Tilonia.

Rattunde, E.W. Meril, Whitaker, Aners M. Kshirgagar K and Voortman U (1992). "Farmers Preferences and Production constraints for Pearl Millet Genotypes in Rainfed Crop-Livestock Systems in Different Agro-Ecological Environment of Rajasthan" Final Report, Kharif 1992 Season" ICRISAT, Hyderabad.

Kshirsagar K. G. and Ladole V.B. (1993). "Tour Report: 7th to 20th June 1993" a report of a Farm Research Training, Selection of Respondent Farmers and Distribution of Pearl Millet Seed to Farmers for the 1993 on Farm Research in Tilonia SWRC file record reference (iv/2) undated.

Anandalashmy S and Singh, D (1997). "Social Work Research Centre, Tilonia - Evaluation Report." An external evaluation studyReport. SWRC Files Tilonia.

Datwani L. (1996). "Sustainability Report: SWRC, Tilonia." SWRC files, Tilonia.

Government of India (1996). "Government of India, National Afforestation and Eco-development Board, Guidelins for Grants-in-aid Scheme", National Afforestation and Development Board, Ministry of Environment and Forests. Government of India Press, New Delhi.

Ministry of Environment and Forests (undated) "Integrated Afforestation and eco-Develo0pment Projects, Centrally sponsored Scheme, Operation Guidelines and Area Oriented Fuel Wood and Fodder Project Scheme Centrally sponsored Guidelines, Operational Guidelines" Ministry of Environment and Forest Internal Circular.

Muthuswamy and Brinda (1994). "The Constitution of India. Par ix: The Panchayats Paragraph 243-239 234D, and the Eleventh Schedule" Swarmy Publishers, MADRAS.

Jain Sharad, Night Schools: Journey a decade; SWRC.

UNESCO/UNICEF (1996). The Barefoot College or Knowledge demystified.

Institute of Development Studies (1986). Wage Study: an Experiment in participatory action research 1984 - 1985.

Roy B. S. (1997): Production employment for youth: Sixth innovative approaches submitted for the 1995 ESCAP HRD Awards (pg. 5 - 15), UNE and the Social Commission for Asia and the Pacific, New York.

Voices of Change (1997). The World of NGOs. 1997 pg. 30 - 31; Vol. No. 2

SWRC (1997). Project for running of 125 night schools for rural working children. Project No. F 20-14/94 (NFE 11). Final Report, Oct 1994 - Sept. 1997; SWRC, Tilonia.

SWRC (1995). Report on Technical Needs Assessment of Community Based Primary Health Care Programme (PVH-H Project), SWRC, Tilonia.

Integrated Wasteland Development

The NCHSE Experience in Madhya Pradesh, India

Background

The National Centre for Human Settlements and Environment (NCHSE), an NGO established in1984, believes that given rational land use, the protection of vegetation, afforestation and pasture development, minimal water conservation and human resource development, the fight against desertification can be won. In pursuit of this belief, the NCHSE worked on four different types of development models in a watershed of 5,000ha covering nine tribal villages of Jhabua District, Madhya Pradesh, India: wastelands development, watershed rehabilitation, dairy and pasture development, and entrepreneurship development.

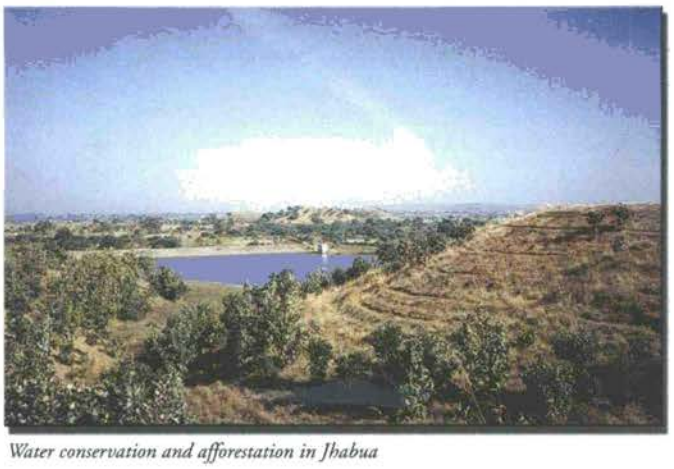
NCHSE was able to achieve all of its targets within the stipulated time and cost constraints, but more importantly, it marked the beginning of people-led development in a land alien to this concept. The wasteland development projects initiated by the NCHSE are now being protected by villagers themselves, and are being adopted by neighboring villagers as well.

The tribal populations of India tend to live in remote, hilly, forested areas. The tribal population of Madhya Pradesh constitutes 23% of the total tribal population of India, mainly Gonds and Bhils. Such tribal peoples have unique ways of life and particular socio-cultural and religious characteristics. In the past, the majority of tribal peoples depended on the forests for their livelihoods, but few forest resources now remain. The collection of forest produce, for instance the leaves of *tendu*, *palas*, *mahua*, fruits and flowers, barely allows for 20 days employment in a year. In Jhabua, the annual fodder deficit is estimated at 1.27 million tonnes, which calls for a 61.5% reduction in livestock numbers. Dairying is pursued more out of tradition than as an enterprise.

The countryside, which three decades ago boasted thick cover of dry to moist tropical deciduous trees, is today a barren landscape. More and more forest land is being brought under the plough, without adequate soil and water conservation treatment. Stripped of protective overgrowth, the sandy loam soils have been heavily eroded. In the absence of irrigation, single cropping of limited species is the norm, and yields are extremely low, but agriculture is still the mainstay of the tribal economy. Wage labour is limited, and seasonal out-migration has become common. The settled Bhil, the hunter-cum-cultivators of the past, have lost their identity and are now known as *Mamu*, the name given to migrant construction laborers in urban areas.

The Integrated Wasteland Development (IWD) scheme is largely implemented by State governments, but capable NGOs also execute projects. The basic objective of the scheme is to assist in the startup of pilot projects based on village/microwatershed level plans prepared taking into account land capability, site conditions and local needs. The hope is to promote optimal land use for both ecological and socio-economic needs. The scheme provides for people's involvement at all stages and equitable and sustainable sharing of benefits from the projects. The extension of technologies in special problem areas such as Jhabua is also a primary objective of the scheme.

Land degradation in Dhai District adjacent to Jhabua



Water conservation and afforestation in Jhabua

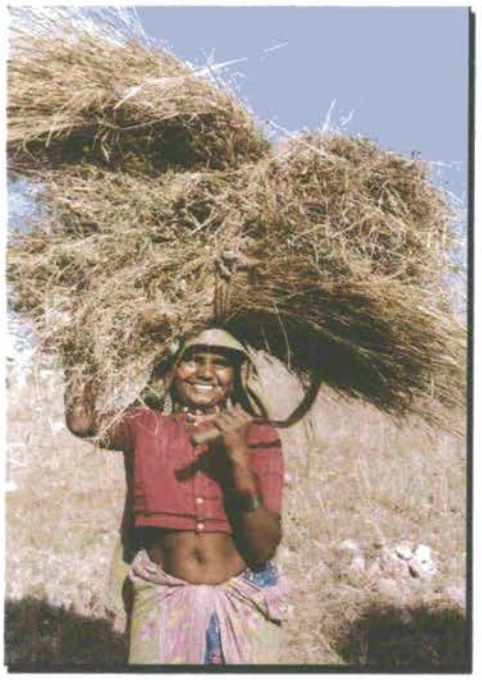
UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by the National Centre for Human Settlements and environment (NCHSE)and local communities with funds from the Government of India.

Project achievements

The project was carried out in three villages in central Jhabua: Bijyadungari, Kalapan and Piplipada. Private plantation targets were attempted in the three other villages: Thuwadra, Bhoot Barda and Tikrijogi. These villages, with the exception of Kalapan, were not the original target villages. Preliminary discussions with residents of two other villages made it clear that intended project activities would neither be welcome nor feasible, hence the changes.

Grant-in-Aid: The first Grant-in-Aid (GIA) project began in 1992 in Thuwadara, Tikrijogi and Bhootbarda. While GIA project had similar goals to the IWD scheme, activities concentrated on supporting individual farmers, woodlots and tree nurseries. In addition, the project included an environmental awareness component. Again, the project met and exceeded its targets of physical outputs.

The project trained private farmers in seed germination and nursery techniques and supplied polythene bags and seeds to individual nurseries. Distribution of free seedlings to farmers in projects and peripheral villages from subsidized private nurseries as well as a central nursery in project and adjacent villages was also attempted.



Fodder for household use

Initially two villages agreed to build stone walls around a tract of community land in order to facilitate unimpeded natural regeneration. The result of this protection was extraordinary. The local flora of the region has revived, with many of the original trees now standing 10 ft high, and there are reports of a revival of wildlife in these protected areas.

Plantations and woodlands: The afforestation of community land was a major component of IWDP, with an output target of 247 hectares and a plantation target of 378,505 saplings planted. The current survival rate of saplings on community land was 80%.

Goats are a major cause of land degradation

Twelve species of indigenous and exotic trees were planted on community land: *Terminalia tomentosa, Tectona graudis, Albizia lebbek, Dendrocalantus strictus, Acacia catechu, Acacia nilotica, Albizzia amara, Leucaena leucocephala, Dalbergia sissoo, Emblica officianalis, Tamarindus indica,* eucalyptus and guava. Bamboo, teak, eucalyptus, Leucaenea, albizia and acacia varieties are growing well.

In IWD villages, only bamboo and eucalyptus were planted on private lands, according to the wishes of the farmers. Eucalyptus produces straight utility poles in less than 10 years. Poles are normally imported from over 1,500-2,000 km away, at a cost of about Rs 650 per pole. Bamboo produces intermediate crops from years 5 to 35, when it fruits and reaches maturity. In addition, bamboo has many agricultural and domestic uses, such as roofing, irrigation pipes and parts for agricultural tools.

Pasture Development: The planting of pasture grass species on community land and government land proved to be one of the most successful and welcome project initiatives. Rapid increases in yield, with the accompanying economic returns, led to better land management and protection for pasture.

Integration of live fencing and contour trenches allowed local forage species to regenerate, and two new leguminous fodder species were succesfully introduced: *Stylosanthus* and *Pedicellemm*, both nitrogen fixers. A thick healthy cover of grass and leguminous pasture was visible on every site.

The key to the success of community pasture was the almost immediate economic returns for villagers, along with significant increases in yield over three years of harvesting. Differences in yield were partially due to the quality of land and the level of soil erosion at a given site.

Although many farmers had previously been growing grass for fodder, most were obliged to buy additional grass to supplement their own production, at Rs 1-2 per bundle. As a resulto fthe project, the beneficiaries not only enough grass for their own requirements but are also growing surplus for sale.

The original community and private pasture areas were prepared and developed by the villagers on a daily wage payment basis. At the end of the project, the maintenance and harvesting was carried out by them at no cost to the project. The villagers' willingness to adopt afforestation and pasture practices and their feelings of ownership of and responsibility for the treated community lands indicated the sustainability of these initiatives. The economic benefits from grass harvesting also meant that the beneficiaries had a vested interest in maintaining live fencing and stone walls around the sites.

Top and bottom: Healthy pasture development

Fuel Conservation: One of the most welcome project innovations was the introduction of two fuel-saving devices, the *sigdi* and the *chulla*. The *chulla* is a permanent smokeless stove originally designed by the Madhya Pradesh Energy Development Corporation but redesigned with the help of local women to use 50% less fuel. The stove has two plates which allow two dishes to be cooked simultaneously, and use a combination of wood and dung and straw patties as fuel. The *sigdi* is a small single surface iron stove that has proved even more popular among village women, with a total of 600 distributed as of 1997. One reason for the popularity of this fuel-saving stove was its mobility; it can be transported when villagers migrate.

Socio-economic issues

Integrating indigenous communities into developement:The two project areas had an entirely Bhil population. An understanding of Bhil culture and a sensitivity to their very specific situation was, therefore, critical to the success of the initiatives. The Bhil feel largely alienated from the rest of Indian society and are now suspicious of outside agencies and government intervention. The NCHSE was conscious of the need to win the support and confidence of the communities and to involve them in the decision-making process.

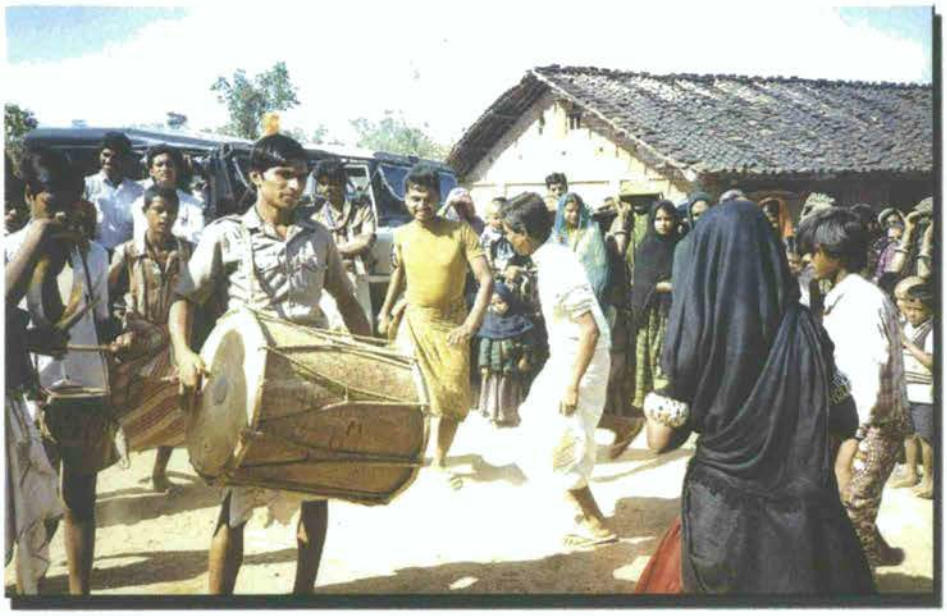
Land tenure: Two aspects of Bhil culture were especially important. One, the Bhil do not practise primogeniture. Land holdings are subdivided with each new generation of sons. Population in the project area had increased by more than 50% over the last decade. Even if the birth rate were to fall it was still likely that there would be extreme pressure for land over the next ten years, making any remaining community land vulnerable to encroachment. But nearly all households either hold title to their land or regard the land they farm as their own, which gives the population a certain autonomy and pride.

*Gender empowerment: W*omen have relatively high status in Bhil society; work is shared more equitably between the sexes and women are consulted and make key decisions concerning household finances. Although a patriarchal society, the Bhils do not have a dowry system, unlike the rest of Indian society. A bride price is paid to the wife's family, but the woman has the right to refuse a husband. Women seem to have a significant voice in farm and household management. Although certain tasks are traditionally carried out by women, such as water collection and fuel gathering, all other tasks are shared between the sexes.

Migration and related child labour: Seasonal migration by marginal farmers, though central to the economic survival of most villagers, is of major concern as it has adverse effects on health, education and livestock grazing, and poses a major threat to project initiatives. Nearly 50% of all villagers migrate from November to May. Twenty years ago, the Bhil travelled relatively short distances looking for casual unskilled jobs. Now, however, they are forced to travel muchurther to look for work. Although it is now rare for children under 15 to migrate with families, they have to take over many of the household chores and livestock care. School attendance drops by 50% because of migration.The project is encouraging government departments to work with villagers on those issues that lead to large scale migration, and as a result income generating projects such as small-scale cottage industries are now being supported by the government.

Community water-collecting dam

Community involvement: Increased attendance at village project meetings, the formation of a women's group, the introduction of a Community Fund for future maintenance of treated land, a high turn out for environment rallies and a continuing willingness to maintain and protect community land demonstrate a high level of community involvement.The NCHSE has worked with the project villages, and there appears to be a growing sense of ownership among the villagers. Both men and women are enthusiastic about the changes. From the start, the NCHSE took the approach that no activity would be successful or sustainable without the full engagement of the communities.



Village reception at Pilipada

Prospects for sustainability

After two years of the three-year life span of the project, there was strong documented and visible evidence of:

- A turnaround in the ecosystem of targeted areas;
- Increasing volumes of high-quality cattle feed have been grown, harvested and sold;
- A reduction in the number of migrating farmers;
- An increase in crop production through two season cropping;
- An increase in secondary income-generating activities, such as fish farming;
- Many participants now have more income and increased crop yield, and have learned a wide range of new technologies;
- A reduction in fuelwood consumption;
- An increasing desire and demand for replication of project initiatives in adjoining villages.

The project has great potential for sustainability, as it is both environmentally and politically viable. The integral elements concerning soil conservation, land use practices and the introduction of domestic energy-saving devices validate the viability of the project. The fact that government policy supports the development of sound environmental protection programmes in scheduled tribal areas confers strong political credibility to the project.

Funding for NCHSE activities in Jhabua has been greatly enhanced recently. The National Tree Growers Cooperative Federation under National Dairy Development Board, as well as the Gas Authority of India Ltd, have concluded separate agreements with the NCHSE to fund its watershed conservation projects in Jhabua. The Rajiv Gandhi Watershed Development Mission and CAPART have opened new doors of institutional support. Above all, the NCHSE has demonstrated its capacity for delivery, a critical attribute to project sustainability.

Lessons Learned

- *Project design:* The projects are well conceived and encompass most of the necessary and related development concerns. The strength of the projects' design, particularly IWD, lies in thier broad-based, integrated approach to the target area. The project proposals were premised on the need to know and understand fully the target villages, the communities, their resources and the land-use potential. Thus, a central component of NCHSE activities were based on detailed information about the areas collected through baseline surveys on the sustainable utilization of resources in Jhabua District. This process of data collection and information gathering has led to the transformation of the project from a top-down approach to a community, needs-based approach.
- *Integrated project activities:* The projects integrate changes in land use and environmental protection with activities intended to improve standards of living. As the project title suggests, the activities are indeed integrated, and these complementary activities are enhanced by GIA activities, which concentrate more on the individual farmer. Since the project began, other activities that have come about through the other district departments have been supported by project staff and actively embraced by the communities.
- *Institutional capacty-buiding*: The combination of the NCHSE's proven capacity to implement its programmes and its strong and active links with all levels of government is a key factor to the success of the projects. A question mark remains as to whether the NCHSE can influence the future of land tenure legislation, which might help protect rehabilitated community land. The NCHSE is an unusual NGO in many respects. Its board consists of committed and dedicated people who have years of experience in diverse fields. Many of them were once senior civil servants in the State Government. Their experience and connections with people in state and national governments facilitates excellent working relationships at different levels. Because NCHSE is fully aware of current government policies and evolving issues it has been able to secure funding for its programme.
- *Land tenure:* This is a thorny issue. Legislation protecting community land from encroachment is rarely enforced. The NCHSE was careful to reassure encroachers around remaining areas of community land that project activities would not interfere with or threaten their 'tenure' on community land. This respect for existing land use contributed to the communities' acceptance of the NCHSE. The District

Revenue Department has little say in land tenure legislation, as this is determined at the state level. Perhaps the best hope for the long-term survival of community land lies at the *Panchayat* level.

- *Community participation:* The capacity of the projects to help the target population generate income from project activities is largely responsible for the increasing level of community participation. More than 558 households are now involved. There has been effective project activity in the six target villages, with more than two years of financial returns to beneficiaries on project initiatives. The project has also distributed a large number of seedlings to farmers in nearby villages who are keen to plant woodlots and are even persuading their relations to participate.
- This active participation clearly lies in the high income potential of trees and pasture grass. As the communities recognize these benefits and put in place their own mechanisms of management, such as the community fund, the chances of long-term participation and sustainability are enhanced even further.
- *Adoption of technology*: Technical knowledge and expertise has been acquired by a relatively large number of people through the process of rehabilitating community land. Farmers involved in tree nurseries and private woodlot planting gained particular technological expertise. The high rate of technological knowledge acquisition and adoption with respect to nursery practices, fencing, bunding and channelling for irrigation was evident. Ignorance on two important aspects, the high mortality of seedlings on individual farms and the inappropriate spacing of trees on private holdings, was also noticeable however. The problem is a lack of knowledge rather than a low-level of technological adoption; technical support, therefore, needs to be strengthened.

References

Adivasi (1992). Vol III no.3, July 1992,

Buch M.N. (1991). TheForests of MadhyaPradesh, Madhya Pradesh Madhyam.

Malcolm J. (no date). A Memoir of Central India including Malwa - Vols I and II.

NCHSE (1992). Urban Slums. Vol III no.4 Oct.1992,

NCHSE (1992). Lost Horizons. Vol III no. 1 Jan. 1992.

NCHSE (1993). Sustainable Utilization of Natural Resources in Jhabua District, India.

NCHSE (1990). The Upgrading of Skills of Tribal Women in Agriculture an Allied Sectors to Generate Employment Opportunities.

Patel M.L. (1974). Changing Land Problems of Tribal India, Progress Report Bhopal.

Verma S.C. (1978). The Bhil Kills, Kunj Publishing House, Bombay.

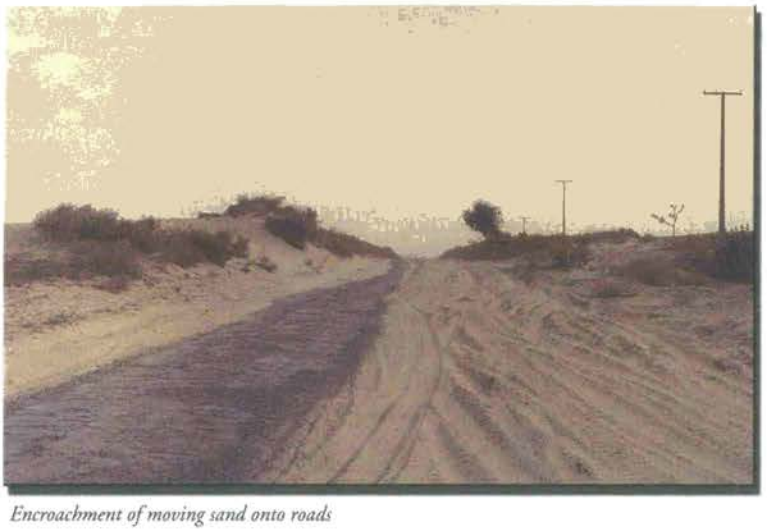
VACHAM (1994). (NCHSE Quarterly Pub.) Forest Concordat - Vol.V no.2., April 1994.

Reclaiming the Desert

Using shelterbelts in Thal, Pakistan

Background

This project, entitled "Desert reclamation using shelterbelts in Thal, Pakistan" was initiated by the Range Research Institute (RRI) of the Pakistan Agricultural Council (PARC) in 1980. It aimed to convert the vast sand-dune-covered Thal Desert into productive agricultural landaa, thereby enhancing the country's food-production capacity and improving living conditions through the creation of new employment opportunities. The plan was to encourage farmers to establish shelterbelts on their own lands, with government inputs limited to technical advice through a forest extension programme, the supply of planting materials and the provision of water for farmers close to irrigation canals.



Encroachment of moving sand onto roads

Large areas of the desert have now been reclaimed, as evidenced by the many trees that now protect considerable areas of cropped land under irrigation. Because of the numerous benefits that have accrued from tree plantations, private farmers are now making their own land-reclamation efforts using the same methods. Many farmers raise funds from their own resources or borrow money from relatives or banks to establish their own tube wells and irrigation systems. Of the 2.5 million ha of the Thal Desert, some 750,000 ha (30%) are now reclaimed and are under cultivation. Of the remaining desert, about 150,000 ha (6%) are designated government land destined for reclamation. Another 1,600,000 ha (64%) is privately owned by people who have not yet been able to find the necessary resources for reclamation.

The project receives full support from the Government of Pakistan. Farmers both large and small are very enthusiastic about adopting project methods, leading to real changes in the environment and living standards in the Thal Desert. The Thal Desert (the name derives from the local word for desert) is in the Punjab region of Pakistan. The name Punjab is a combination of two Persian words: *punj* meaning five and *aab* meaning water, as there are five rivers in the region: the Jehlum, Chenab, Ravi, Sutlej and Bias. For centuries nomadic pastoralists have used the vast expanse of the Thal as grazing land for their livestock.

After the partition of India in 1947 and the subsequent creation of Pakistan, there was a dramatic increase in the population of the Thal region. Muslims coming into the area from India were given land in exchange for the property they left in their former homeland. Later came people displaced by the construction of the Kalabagh dam and its extensive canal system. Other land was auctioned by the Pakistan Government to settlers and other landowners, and yet others were given land as an incentive for digging tube wells; one farmer received 7 acres for sinking a well.

The combined population of the Thal Desert, including nomadic pastoralists from Afghanistan, is about 2.5 million people, and a livestock population of 3.91 million head. In the recent past, Afghani pastoralists brought their flocks to the Thal region for summer grazing and then returned to their home territory during the winter, but because of civil strife in their country, many of these people have now claimed refugee status and hold Pakistani identification cards.

The project objectives

The project covers some 20,000 ha of the total Thal area of 2.6 million ha and encompasses about 50 settlements ranging from sparsely scattered hamlets around water wells to large villages and townships. The general objective of the project was to reclaim the Thal Desert, converting it from wasteland into agriculturally productive land. The specific objectives were to:

- Stabilize moving sand dunes;
- Protect arable lands against desiccating winds and sand;
- Provide water for irrigation;

Pakistan- UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by Pakistan's Rangelands Research Institute and local communities with funds from the Government of Pakistan and local farmers.

- Improvement of rangeland; and
- Enhance living standards for the communities living in the Thal area.

Biophysical aspects The project area is a tropical sandy desert where the main landforms are sand dunes and numerous inter-dune arable valleys. The climate of the Thal region is arid to extremely arid; rainfall ranges from about 90 mm per year in the south to about 350 mm in the north, falling in a bimodal regime of summer (60–70%) and winter (30–40%) rains. Although the winter rains are less than those in summer, they are more effective in aiding plant growth because of their gentle nature, which allows most of the water to infiltrate into the soil. Summer rainstorms tend to create floods and temporary water-logging in the inter-dune valleys. Temperatures in the Thal Desert are in the range of 32°-40°C in the summer (May–August), with a maximum of 45°-50°C. The coldest month in winter (January) has a range of 3°-8°C, with widespread frost. Hot, desiccating winds prevail from April to August, reaching speeds of 90 km/hr. This reduces the effectiveness of summer rains and causes evaporation to reach 1,250 mm per year.

Cropping between planted windbreaks

Socio-economic aspects: Although the majority of the people of Pakistan are Muslim, because of long-term Hindu influence in the Punjab, the society here has been described as stratified, based upon class, clan/caste, sex, and location.

In the Thal area, both prior to and shortly after the annexation of India by Britain, there were various forms of land title loosely held by tribes, clans, individuals or families of various social, religious or caste standing. The acquisition of such titles, and the exertion of claims over them, largely depended upon individuals' relative power within this hierarchical system; the weakest being tenants.

Land tenure

Seven different socio-economic groups were identified:

Urban elite/higher grade bureaucrats: These people are engaged in various forms of economic enterprise and may also be absentee landowners in the Thal region;

Large landowners: They may or may not live on their holdings in the Thal region. Some live in cities and delegate the management of their land to on-site managers. These people, referred to as "progressive farmers" by the PARC, comprise approximately 1% of the population. This group was first targeted as recipients of the reclamation project and they have greatly benefited from the subsidies and extra attention from the forestry and agricultural extension workers;

Small landholders/tenants: These comprise the majority of the agricultural population. 95% have holdings of 5 acres or less;

Craftsmen and merchants: Traditionally, the craftsmen of the Thal Desert included carpenters, cobblers, potters, blacksmiths, weavers, woodcutters and tailors;

Landless farmers: These earn their livelihoods as labourers;

Refugees from Afghanistan: Nomadic pastoralists who have traversed the mountain ranges for centuries to pasture their animals in the Thal Desert in the summer and have now chosen to remain in the Thal area. Some have constructed semi-permanent housing of reeds and canvas;

Indigenous nomads: These people are at the bottom of the economic ladder. They have very few animals - usually only a few goats or sheep and donkeys - to pull their carts with their household belongings. They subsist by hunting, selling trinkets (e.g. plastic bracelets), begging and perhaps day labour.

The canal irrigation system

The government established a massive irrigation system for agricultural development in the Indus Basin, of which the Thal is a part. It is supplied by three large dams at Tarbela, Chasham and Mongla, with a combined storage capacity of 18.6 billion m^3. The water is transferred through 48 major canals, with a conveyance capacity of 125 billion m^3 that discharge into smaller canals with a total length of 2 million km and serve 14 million ha of arable land. In addition, there are thousands of private and government-owned tube wells and Persian wells.

However, the crucial factor here is that about 90% of the water is lost - mostly as seepage, which causes severe waterlogging and salinity. Government reports show that 25% of the water is lost from the dams and the major canals, 40% from the minor canals, and a further 25% is lost on the farms, mainly due to highly porous sandy soils and inefficient farm operations.

The government has tried several techniques to control these problems, but with little success. The latest control measures include pumping water from specially constructed tube wells, with the discharge going into the canal system. The problem is becoming increasingly difficult and threatens very large areas of the Thal and its productivity. Some government officials suggested that the only feasible way to control the problem was to construct an elaborate drainage system and line all the canals with fired bricks and concrete.

Government support

Four main issues pertaining to the project were listed in the Government of Pakistan's *Economic Survey* of 1991–1992: (i) unavailability of land due to a shortage of water for irrigation; (ii) increasing salinity and waterlogging; (iii) fragmentation of landholdings; and (iv) soil erosion. In 1991, a comprehensive agricultural policy, with the following objectives relevant to the project, was announced:

- To create self-sufficiency in essential farm products;
- To conserve the agricultural resource base (land, forests, water);
- To address research gaps and ensure transmission of new technologies through an effective extension programme; and
- To enhance the private sector's role in the agricultural economy generally.

Measures to implement these policies included the launch of a Productivity Enhancement Programme (PEP), the reduction or exemption of import tax on agricultural machinery, advancement of credit for the purchase of tractors and other machinery, and the provision of a subsidy for each tube well in the *barani* (rainfed) and flood areas. Another important measure was to improve on-farm water management and to increase irrigation water through the renovation of 7,685 water channels, the creation of 515 new water ponds to control waterlogging, and the development of 55,000 acres of agricultural land. The programme was intended to benefit 500,000 farmers throughout the Thal region.

There is also a strong forestry extension service in Bhakkar District, assisting farmers to establish shelterbelts and woodlots. The aim is to produce 30 million seedlings and rooted cuttings of various tree species on nearly 40 acres of nurseries.

The Thal Development Authority

The Thal Deveopment Authority (TDA) was formed in 1950 because of the great demand for land arising from two major influxes of people into the Thal. The first group comprised those whose lands were inundated or otherwise rendered inaccessible after the construction of the Kalabagh Dam, and the second was the larger wave of Muslims who fled India in 1947. The Government of Pakistan relocated both groups to the Thal area for two reasons - the loose land-tenure system already prevailing in the area, and the fact that there was nowhere else to accommodate the newcomers.

Those who fled from India brought with them land claims from that country, as they had been promised compensation in Pakistan as part of the arrangements made for the creation of the new state. The TDA settled these claims, resulting in 95% of the Thal population owning about 5 acres of land per family, 4% between 5 and 100 acres, and 1% more than 100 acres each.

One advantage for farmers in the Thal Desert is that they do not pay income tax on agricultural profits. This incentive makes investment by large landowners desirable because the money can be reinvested in farming operations or used to offset taxes on potential earnings from off-farm investments.

Land use practices: There are two distinct farming systems in the Thal area: a traditional farming system, which is still dependent on rainfed subsistence cropping and open grazing of livestock, and a system based on irrigation. The majority of the people practise rainfed subsistence farming cultivating millet (*Pennisetum typhoides*) and *guar (Cyamopsis tetragonolobus*) in the summer, and wheat, *gram* (chickpea), barley and *tara mira (Eruca sativa*) in winter.

Traditionally, crop rotation was used both to maintain soil fertility and crop diversification in different seasons. Chickpeas and wheat are the main winter crops; *guar* and millet replace them in summer. Crop stubble is often used for grazing, and chaff from crop threshing is fed to animals. Crop rotation is, however, dependent upon the size of landholding and the general economic conditions prevailing at the time of sowing.

Livestock are grazed in the summer on open lands after the crops have been harvested, while in winter they are mostly stall-fed on crop residues and prunings from fodder trees, especially *Prosopis cineraria*. In the winter, stall-feeding is the only option because almost all the available land is cultivated with the main cashcrop - chickpeas. Summer grazing causes environmental degradation through overgrazing and the destruction of trees for fuel. It is so intensive that all the grasses and shrubs are destroyed, after which animals resort to heavy browsing of the few remaining indigenous trees. As a result, most of the area is subject to severe wind erosion and sand-dune movement, which continue until the late summer when the rains begin. The problem is aggravated by cutting of trees for fuelwood.

Food security poses a serious problem for many people, particularly since the average family is large and most must subsist on 5 acres of rainfed land. Few crops are cultivated because of blowing sand and the lack of irrigation water. Food is imported into the area, and diets are often supplemented by watermelons, turnips and wild fruit. Watermelon is an important crop; a type of soup is made from the pulp of the fruit, and the rinds are fed to livestock. Milk and milk by-products remain an important

Selling animals in a typical village market

part of the diet. Bread (*chapati*) made from either chickpea or wheat flour is baked in outdoor ovens.

The land-use practices of those families able to secure water for irrigation are very different. There are several methods of irrigation: from canals that cover part of the northern Thal area; by sinking tube wells powered by diesel or electric motors, or sometimes by tractor; buying water from a neighbour who has a tube well; or the construction of wells operated by Persian wheels powered by a camel or donkey. These farmers mostly use bought or rented tractors for land preparation, although a small group still use camel or oxen power.

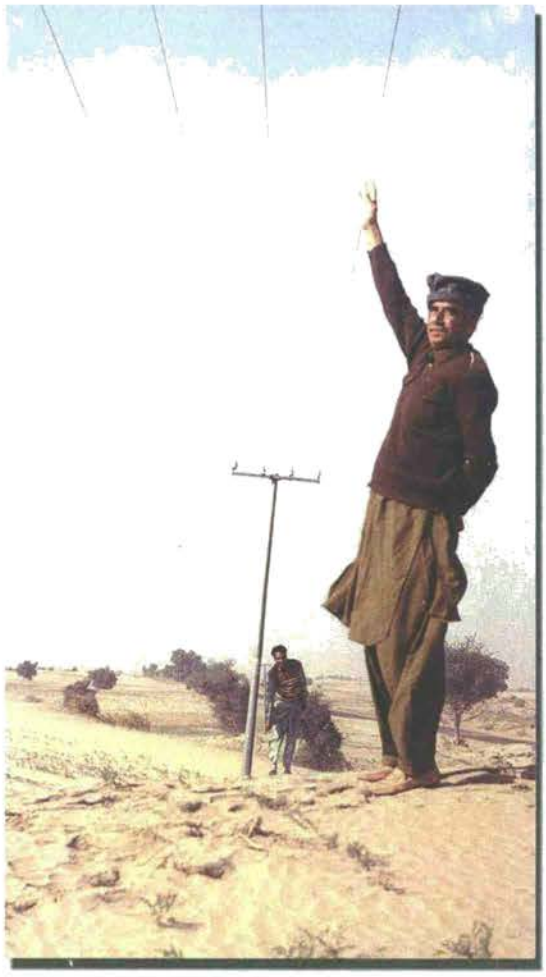
The cropping pattern in the irrigated sector of the Thal area is also different in many respects from that of the rainfed sector. The most important advantage in the irrigated sector is that cropping can be done throughout the year. Another advantage is that farmers are able to grow crops they could not grow before irrigation and reclamation, including onions, potatoes, sugarcane, vegetables, spices and fruit. Some of the large landowners are able to grow fodder crops, including sorghum, maize and clover.

Benefits and achievements

The project has been a success, on the following grounds:

- There has been extensive tree planting in barren areas;
- Mobile sand dunes have been stabilized;
- The conversion of desert into agriculturally productive land has created alternative livelihood opportunities;
- The project has enabled the introduction of an appropriate land-use system based upon irrigated crop production, forestry and fodder production;
- The project introduced appropriate farming, animal husbandry and forestry practices;
- Simple but efficient technologies, such as hand pumps, woodlots and grinding mills, have lightened workloads, of women in particular;
- The increase in food and fodder crops and tree by-products has created new employment opportunities (e.g., grain merchants, woodcutters, charcoal manufacturers, mechanics and irrigation-equipment salesmen);
- Because of increased employment, there are now opportunities for many of the younger generation to remain within the Thal region, either on the farms, or in nearby market towns or cities.

Shelterbelts: The trees used for sand-dune stabilization are mainly indigenous species that are well adapted to the local environment. The principal tree planted is *Tamarix aphylla*, which is easily propagated from cuttings, grows fast, has no pest or other problems and provides quick economic returns. A farmer simply needs to plant 9-inch long cuttings, water them twice in the first two weeks, and 3–4 years later they will yield wood. The trees are pruned for fodder when they are 1–2 years old, and dry branches are collected for fuelwood. Farmers sell wood for fuel, poles and timber and prune trees to provide fodder for livestock. Some farmers say that they make more money from the direct sale of tree products than from crops.



Telephone poles gradually buried by sand

Other trees planted in the shelterbelts are *Dalbergia sissoo, Prosopis cineraria*, both indigenous to the Thal, and *Eucalyptus camaldulensis*. Other trees that grow naturally in the area and are protected by the farmers for fodder, fuel, shade and fruit are *Ziziphus mauritiana, Acacia nilotica, Salvadora oleoides, Caparis aphylla,* and *Ficus indica*. A native grass, *Saccarum oficinarum*, has also been used on a limited scale as a shelterbelt.

Apart from some local shrubs and grasses that have grown under the old roadside and canal-side shelterbelts, there is practically no plant growth other than the trees in shelterbelts and woodlots. The trees and shrubs have helped to stabilize the shifting and blowing sand, and has changed the microclimate of the planted areas. Farmers report that sandstorms are now much less frequent and intense.

Adoption: One of the most important issues at the onset of the project was to convince farmers to plant shelterbelts. This required a high level of trust between farmers and project staff and an appropriate technology that could be easily adopted by the farmers. The Field Technical Assistant, a resident of the project area, initially had difficulty trying to sell the tree-planting idea to farmers, but overcame this by persuading close friends

and relatives to establish demonstration shelterbelts. The innovation spread fast, and now almost every farmer in the irrigated sector has planted some form of shelterbelt, windbreak or woodlot to stabilize moving sand dunes and protect crops, livestock and dwellings from hot dust-laden summer winds and the cold winds and frosts of winter.

Trees for soil- and water-conservation: Tree planting has also been extensively used to protect water canals. The major part of the Thal Desert suffers from a continuous rise of the water table as a result of seepage from the canals. At Dhaggar Kotli Research Station, the water level rose from 40 ft below ground level in 1970 to 20 ft in 1994. Tree planting is now used as an indicator of reclamation, as trees will not grow on waterlogged land. The government has been able to reclaim some 70–75% of the 172,000 ha of land severely affected by waterlogging.

Soil-fertility improvement: More farmers now use animal manure for soil improvement than for cooking fuel, since those who planted shelterbelts now have plenty of fuelwood.

Socio-economic benefits

Increased fuelwood and fodder: Both farmers and nomads are unequivocal about the economic and other benefits from tree planting. The problem of scarcity of fuelwood and building timber has been solved, at least in the areas where shelterbelts have been planted. Animals are now better fed because fodder is more plentiful.

Increased yields: Farmers in irrigated areas have stabilized sand dunes by planting shelterbelts and woodlots. Shelterbelts have also improved soil fertility through production of leaf litter, protected the land from sand encroachment and changed the microclimate, all of which have increased incomes and improved the general working atmosphere on the farms. More of the area is now under cultivation during the rainfed winter months. Cash crops have improved the economic standards of the farming families. In Bhakkar District, crop yields are 2–5 times greater because of deeper ploughing, better seed, fertilizers and the correct selection of planting times. Furthermore, the income from tree crops has enabled some farmers to hire labour, either permanent or casual, to boost farm production. The whole system is supported by new infrastructure - roads, markets, agricultural extension, forestry extension and veterinary services.

Improved physical environment: Protection of farmland against sand encroachment is viewed by farmers as a major benefit not only because of improved crop yields but because the good atmosphere created by the trees is conducive to work. Increased incomes have allowed almost all farmers to replace their reed homes with brick and plaster houses. The new homes are cooler in the summer, warmer in the winter, and offer better protection against blowing sand. In the recent past, summer winds were so strong that many reed homes were blown away.

Increased employment and income opportunities: The project has also created diversified employment opportunities for tree cutters, wood traders, transport workers and farm labourers. There are professional woodcutters and a number of wood-processing establishments, including a sawmill and charcoal kiln. Some wood transport is done by truck or wagon, and some by camels owned by the Afghan nomads.

Because of increased production, more people are involved in trade and commerce: grain merchants, mechanics to repair irrigation equipment, charcoal makers and vendors of other goods and services, including fertilizers and pesticides. One indicator of the increased amount of disposable income in the region is that several vendors at one market were selling toys.

Other people have opened diesel engine mills for wheat and chickpea flour, which has greatly reduced the work of the women. Of three farmers interviewed, one was also a grain merchant, another had a tea shop and the third owned a flour mill. The change from barter to a cash economy has allowed people to earn or supplement their livelihoods from enterprises other than subsistence farming.

Some landless people have also benefited directly from the reclamation project through full- or part-time employment from large landowners, or by starting their own businesses. Some of the large landowners interviewed had between 11 and 14 full-time employees and hire additional men for seasonal work. Off-farm employment opportunities for men and women encourage young people to stay in the area rather than migrate to the cities. Women's workloads have been made easier because of the easy availability of fuelwood, fodder and water.

Shelter, sanitation and health: Shelter has dramatically improved as a result of the replacement of reed homes with dwellings of brick and plaster. The villages are clean and free of sand. But a potential source of disease is standing water in waterlogged areas, which can harbour malaria and bilharzia vectors. Nutrition has improved, meat is exported to other parts of Pakistan, and plans are in progress to construct a local meat-processing facility.

Lessons learned

Land issues

- The amount of productive land could decrease because of population growth, continuing subdivision of the majority 5-acre smallholdings among heirs, and because wealthy landowners use their influence to continue to increase the size of their individual holdings in contravention of government regulations; to affect traditional farmers. The fragmentation of landholdings
- Reclamation efforts progress slowly, so sandstorms continue will lead to a reduction in the number of trees and shelterbelts because all available land will be needed to produce crops;
- Waterlogging and salinization are serious problems in irrigated farming areas, particularly where the costs of prevention/ rehabilitation are too high for smallholders;
- Grazing land was open before the reclamation project and the large-scale production of chickpeas. Now, the available area is much less so the nomads cannot keep large herds and they must obtain permission to graze from either the Forestry Department or individual farmers;
- The project has enabled the introduction of an appropriate land-use system based upon irrigated crop production, forestry and fodder production;

- The project introduced appropriate farming, animal husbandry and forestry practices;
- Simple but efficient technologies, such as hand pumps, woodlots and grinding mills, have lightened workloads, of women in particular;
- The increase in food and fodder crops and tree by-products has created new employment opportunities (e.g., grain merchants, woodcutters, charcoal manufacturers, mechanics and irrigation-equipment salesmen);
- Because of increased employment, there are now opportunities for many of the younger generation to remain within the Thal region, either on the farms, or in nearby market towns or cities.

Irrigating costs:

- The limiting factor in establishing shelterbelts is the water required for irrigation. Farmers served by the canal system of the Indus Basin project were able to establish shelterbelts, with minimum cost incurred only in the construction of internal irrigation systems.
- Those outside the system have to sink tube wells, or at least construct a Persian wheel-operated well. Whereas tube wells are the most effective, the initial cost of construction and drilling ranges from 10,000 to over 100,000 rupees, which is beyond the means of most smallholders.
- Irrigation canals within the farm must be constructed with fired bricks and concrete in order to reduce seepage through the sandy soils. This is a high-cost operation that only farmers with sufficient resources can afford. But once established, both the wells and the canals have a fairly long lifespan and can be maintained without much difficulty because skilled labour and mechanics are readily available in the project area.
- The Range Research Institute of PARC had carried out trials in the Karluwala to determine the best techniques for tree establishment. These included the raising of nursery stock in polyethylene or earthen tubes. When planted out, the trees are watered by a hose or from "pitchers" (clay jars). But these techniques are costly and require labour that some farmers cannot easily provide.
- Although the appropriate pitcher-watering technology has been developed for small farmers, some are still unable to afford even this. The prices of the jars and the trees are the major constraints for some farmers, even though the jars cost only 5–9 rupees.

Conclusions

The project is a success in land degradation and desertification control. However adoption rate of technologies by smallholder farmers could be enhanced, and their commitment increased with improved equitable sharing in the technology and financial inputs,currently received largely by large land owners.

References

Bokhari, W.H. (1993)."Frash, the desert pine. Progressive Farming, 13(2):38-41.

ESCAP (1989). Desertification in Indus Basin Due to salinity and The Superintendent, Government Printing, Punjab.

Gazetteer of the Miarnwali District (1915). Volume xxx A. Lahore: The Superintendent, Government Printing, Punjab.

Government of Pakistan (1994). The Pakistan National Conservation Strategy, Environment and Urban Affairs Division and IUCN.

Government of Pakistan (1991). Economic Survey 1991-1992.

Noor Mohammed (1994). "Thal desert reclamation using shelterbelts." In: Progressive farming, 14(1):11-17.

Noor Mohammed (1989). "Desert reclamation using shelterbelts in Thal, Pakistan. Islamabad: Rangelands Research Institute, Pakistan Agriculture Research Council.

Noor Mohammed (1989). "Rangeland Management inPakistan. " ICIMOD Senior Fellowship Series No. 1 Kathmandu, Nepal.

Noor Mohammedm et al, (1994). Combating Desertification in Pakistan. An Action Plan. PARC, UNEP and ESCAP.

Sabari, S.M. (1994). The Culture and Society of Pakistan. Lahore: Publishers Emporium.

United Nations Environment Programme (1993). Success Stories in Desertification Control. DES/PU-242. Nairobi, Kenya.

United Nations (1994). Range Management Manual for Asia and the Pacific. New York: United Nations Economic and Social Commission for Asia and the Pacific.

Community-Led Dryland Development

Combating Desertification through Range Management, Water-harvesting and Renewable Energy Technologies in Coquimbo, Chile

Background

In response to many years of inadequate management of cropping and herding systems, as well as a devastated landscape from intense mining activities, the European Community funded a project implemented by CODEFF (Commitee for the Protection of Flora and Fauna) in the Coquimbo region of Northern Chile from 1995 to 1998. Using a multi-sectoral approach, three communities were trained in the production, selection and sanitary management of goats, the establishment of tree nurseries to provide fuelwood, forage and soil protection, conducting awareness-raising campaigns, installing water collection systems, and more effective application of laws and regulations to address the environmental, economic and social problems of Coquimbo.

Fog-trapping nets capture moisture from the air

Although this region has three provinces, the project concentrated its efforts in the province of Elqui, and particularly in the agricultural community of Quebrada el Talca, based on the trust that the Vida Rural Foundation had already built with women here, as well as the existing expertise of the National Forestry Corporation on afforestation activities, water trapping and storage systems for irrigation. Coquimbo is an extensive area, its rural population dispersed among low density settlements. The project might have been able to cover greater areas and achieve a wider impact, but with the few resources available it would have been somewhat ambitious for such a small NGO.

Coquimbo is located 400 km from Santiago, the capital of Chile, covering an area of approximately 41,000 km^2 characterized by semi-arid valleys that lie between the coastal mountain range and the Andean mountain range. Rainfall oscillates between 700 and 1,500mm.

Desertification is widespread in Chile, affecting approximately 47.3 million hectares, or 62.6% of the country. Coquimbo is no different. Of its 500,000 inhabitants, 100,000 practice agriculture, but apart from the 5% of the area under irrigation, most of the agricultural and cattle raising activity lies in non-arable dryland, a total of more than 3 million ha.

Basic education has reached only privileged communities, mainly in urban settlements, and rural schools lack adequate infrastructure and equipment. Coquimbo has, however, two local universities and regional branches of the two most important centres of higher education in the country: the University of Chile and the Catholic University of Chile.

The problem

Gold and iron mining, along with agriculture and trade, are the traditional economic activities of the Coquimbo region. Mining has lost some of its importance in recent years, but its environmental impact is still evident after centuries of deforestation. Native trees were the only source of energy for the mines, and the long process of massive wood extraction left behind a devastated landscape. Many years of inadequate management of cropping and herding systems has aggravated this already difficult situation.

These practices have affected the regional flora composition, particularly shrubs and grasses. The major limit to biodiversity and soil conservation is unsustainable grazing, which has accelerated the degradation. Free range herding of the region's 500,000 goats and 130,000 sheep remains a very unproductive activity, plagued by low prices for milk and cheese.

The main problems related to desertification in Coquimbo are: a lack of public support for sustainable agricultural development; over-exploitation of grasslands and thickets, particularly in agricultural communities; abuse of soil ecosystems and neglect of soil carrying capacity; unsustainable agricultural and herding techniques; inadequate educational programmes; excessive

UNEP's "Saving the Drylands" award winner, 1999. The IV Region project was implemented by CODEFF (Comité de Defensa de la Flora y la Fauna), Santiago, Chile, with funds from the European Community (EC).

pressure upon fuel biomass; an absence of enviromental legislation on desertification and soil protection, and weak implemention of existing laws.

The CODEFF project focused most of its activities in three agricultural communities: Quebrada de Talca, Almirante Latorre, and Chacay Alto, through training programmes in grassland management, cattle management, water harvesting, afforestation and the manufacture of solar stoves.

In Quebrada de Talca, the project worked with one agricultural community of about 800 people living in an area of 20,000 hectares. Similar communities were selected in Almirante Latorre and Chacay Alto. Different families from these three communities were beneficiaries of a package of inputs provided by the project to improve production and conservation practices, including seeds to develop tree nurseries, materials to build cement tanks for water storage and solar stoves as an alternative to fuelwood, and training courses and technical extension in agronomy and veterinary practices. The project promoted these activities through environmental education at Casa Monte Grande and a series of seminars, workshops and radio programmes.

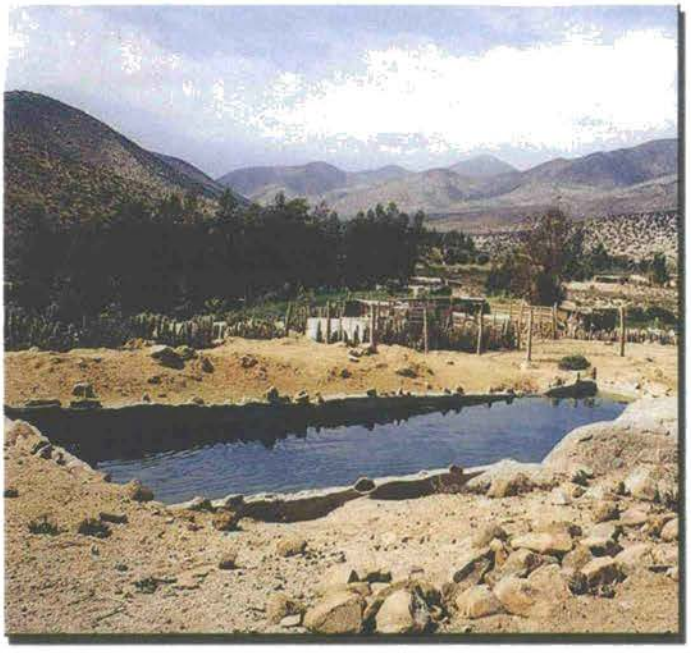
In order to help satisfy local demands for fuelwood, forage and soil protection, the project selected a set of mainly indigenous trees and grass species, including *Acacia saligna*, *Atriplex numularia* and *Acacia caven*, as well as Californian alfalfa, oat, carob trees and hawthorn.

As more than 6,000 goats in the area are an important resource base for local agricultural communities, the project set out to help farmers convert this animal energy into products such as milk, cheese and meat while maintaining sanitary conditions to satisfy recent laws designed to improve the quality of these products for national markets.

Solar ovens have reduced demands for woodfuel

In another area of Elqui province, the project worked with the National Forestry Corporation (CONAF), Chile's Focal Point for desertification, to cofinance and supervise the installation of ten fog trapping nets (see photo) designed to capture moisture from the air in Chungungo, a small coastal fishing village of about 500 people 7 kilometres from El Tofo hill, an abandoned iron mine.

Finally, the project provided environmental education and public awareness to publish educational materials based on the training courses, and develop anti-desertification information campaigns in conjunction with mass media, social organizations, public institutions and government authorities.



Water-harvesting promotes sustainable land-use practices

Overall achievements

The project's novel two-step implementation strategy used a multi-sectoral approach and intensive awareness raising about the practical realities of desertification among a variety of social groups, including institutions from both the government and non-government sectors.

The specific achievements of the project are very comprehensive, including: improvements in goat productivity through reproductive management; training of rural workers in land management and afforestation actions in 3 localities in Elqui Province; the implementation of water trapping and storage systems for 43 families; the construction and use of solar ovens for 60 families; four workshops on desertification for children, agricultural technicians, teenage students and rural teachers of Elqui Province; the publication of a book on desertification, which was distributed to students and teachers; three seminars on desertification issues directed to professionals, NGOs, rural leaders and journalists; the production of 20 radio programmes and 2 television programmes to raise awareness beyond Elqui Province; the implementation of fog-trapping systems for 100 families of a community located near the shore; the establishment of a cultural site in a widely visited area to hold environmental and cultural activities for the promotion of awareness on desertification issues; and the provision of educational billboards and 200 garbage cans along the main route of the region.

Improved food production through irrigation

Social Capital - Community and gender empowerment

The project worked directly with families, avoiding formal local organizations as these institutions were monopolizing local development processes. This approach established a stronger sense of community and promoting the renewal of local ties.

In the community of Quebrada de Talca, with assistance from the Vida Rural Foundation, the project was able to work directly with women by educating and training them in the use of solar stoves. This helped to reduce the vulnerability of the women, giving them free time to join and attend neighbours' meetings, with the men's 'permission'. It is worth mentioning that older women are as active and appreciative as younger women, and the free time that use of solar stoves has provided has reduced their workloads, enhanced community values and increased their quality of life.

The project does not have a long reach because of its temporary nature, but the Vida Rural Foundation is planning to continue supporting women of all ages: girls in the agricultural school (including environmental education), and women both young and old ones in their everyday work.

Lessons learned

Stemming from alliances and successful actions (work with women, motivated teachers, fog-trapping systems) the project in Coquimbo is a major local success story, having developed a set of practical and effective solutions to combat desertification. The main lessons learned include:

- Poorly planned long-term projects often succumb to droughts, causing communities to lose faith.
- Projects work better if they are coordinated in such a way that all actions come together and are implemented jointly and effectively.
- Chosen project areas must be located where target groups will have easy access.
- Women play an essential and often underestimated role in the community structure, even though men often maintain community organization control. A project can reduce the vulnerability of women if training and education are provided.
- Desertification processes continue where inaction or resistance is the usual response, and where farming and herding practices are unsustainable.

Sustainability and replicability

Actions designed to support better farming, herding and fuelwood collection practices were successful. The technology proposed by the project was kept simple but sustainable, such as drip irrigation using hoses and water storage tanks, making the most of scarce water resources. Other initiatives such as live fences, forage production, solar ovens, and semi-intensive goat herding were also sustainable, but in the long run, these efforts would need financial and technical support to maintain equipment and replace expendable materials. Most importantly, persistent afforestation has helped to reverse ecosystem degradation.

The project has been very efficient in the mobilization of authorities, mass media, academic institutions, women's organizations and beneficiary families. While there is no single institution or social group who can lead and continue the project activities and its multi-sectoral objectives,bringing the coordination of these groups together is a positive start.

References

Codeff (1998). Informe final del proyecto "Acciones para combatir la desertificación en la IV región (1995-1998), Santiago.

CONAF/ Ministério de Agricultura (1997). Plan de desarrollo forestal ambiental - IV región de Coquimbo", La Serena.

Universidad de Chile (1997). Diagnóstico de la desertificación en Chile, Santiago.

CONAF/CODEF. (sin fecha). Proyecto "Reposición atrapanieblas", Santiago.

CODEDFF (sin fecha). Aspectos importantes de considerar para el mejoramiento de la productividad del ganado, La Serena.

CODEF/Comunidad Europea (1994). Contrato de financiación en el sector de "La ecologia en paises en desarrollo", Santiago.

Demonstrating Success

A Regional Development Programme on Food Security, Urban Migration Control and Natural Resources Protection in Guantánamo, Cuba

Background

Because of its arid conditions, lengthy periods of drought and frequent, extremely destructive cyclones, the southern part of Guantánamo, Cuba, is the island nation's poorest and most underdeveloped region. Unchecked runoff from the slopes of neighbouring mountains, denuded by deforestation and timber extraction, threatens the area with severe flooding. The area's groundwater interacts with sea water from the coast, yielding a water table with high concentrations of salts and limiting useable water to surface water courses. Limited investment and a general lack of inputs, fuel and equipment make farming difficult.

Migration from the smaller towns to the provincial capital, and from here to the cities of Havana or Santiago de Cuba, is rampant. But health, education and literacy levels in the area have improved considerably in recent years, and it should be noted that access to professional studies is one of the main incentives for migration.

There are two basic types of land tenure: state land (62%), where public companies operate, and land held by individuals and organized cooperatives (38%). A process to transfer state land to private ownership is now under way. Principal land uses vary from one area to another; sugarcane prevails in the valley, livestock raising on the coast, and coffee growing in the mountain region.

Guantánamo authorities have made a concerted effort over the past 20 years to devise and implement a Regional Development Programme to increase food security, slow urban migration and protect natural resources. They have been severely restricted, however, by the island's general economic decline, made even more acute by the collapse of the trading system with the former Soviet Union. Focusing heavily on human rather than financial capital, and taking advantage of scientific knowledge and the mobilization and cooperation of the area's generally healthy, educated and well-organized population, the programme is centred on four demonstration projects designed to popularize innovations. Implemented in coordination with the Ministry of Science, Technology and Environment (CITMA), international agencies, NGOs and, above all, the people of Guantánamo, this programme is a promising example of what can be done when a society is able to organize and act in synergy.

The Projects

The four projects, located in the south-southeastern part of the province in the mountains, the Guantánamo Valley, and the southern coast, are as follows:

1. "Los Laureles", a mountain farm on degraded land that had been abandoned because of its low productivity. The programme here combines soil conservation, crop development and agroforestry techniques to produce bananas, maize, taro, yams, timber and coffee.
2. A valley farm focusing on the recovery of saline land, improved irrigation and recycling of harvest residues to increase production of bananas and vegetables.
3. A coastal reforestation programme centred on *Leucaena* and timber trees.
4. Intensive beef and milk production units.

Above: Land degradation from water erosion. Below: King grass growing along a roadside

UNEP's "Saving the Drylands" award winner, 1999. This project was implemented in collaboration with various agencies of the Cuban Government with the participation of non-governmental and grassroots organizations under the coordination of the Ministry of Science, Technology and Environment of Cuba. The Cuban Government financed the project with specific support from Cubasolar; Humboldt University, Germany; Eurosolar, Italy; and SODEPAZ, Spain.

These projects make use of applied meteorological and agricultural research conducted over the past 20 years. Eleven meteorological stations are located throughout the region, and a soil laboratory in the Guantánamo Valley carries out routine work on fertility, salinity control and microbiology, with an emphasis on the development of nitrification innoculants and vermiculture.

Irrigated banana plantation

Achievements

The Mountain component: The Los Laureles farm has established stone dam gully control and mixed forest shade cultivation systems for coffee, yams, taro, banana, *chayote* and maize. *Caturra* coffee plants grafted with *robusta* developed here have proven to be a highly productive variety, with excellent pest and disease resistance and root exploration capacities that are ideal for the area's stony soils. Plant residue cover provides protection against moisture loss. Land use includes grazing for sheep on pastureland with guinea and other grasses.

The valley component: The Javilla II farm, owned by the "Estatal de Cultivos Varios Guantánamo" company, was severely affected by salinization; 80% of the area had more than 4,000 ppm of salts. Comprehensive treatment consisted of deep drainage, resurfacing the feeder canal to prevent saline pollution, deep subsoiling, the application of manure, phosphorous and plant residues, and irrigation. Banana shoots reproduced *in vitro* were planted on the prepared land, and the company now produces 58% of the bananas consumed in the city of Guantánamo and 100% of those consumed in the municipality of Caimanera. These widely tested techniques are spreading throughout the valley.

The coastal component: In the coastal area, the most arid of the three, reforestation efforts are exploring the potential and best planting methods for both local and introduced species. 447 native species have been evaluated, and *in vitro* production trialled for jojoba, prickly pear, dates and avocados. Techniques for terracing, small garden plots and phased reforestation are also being tested. Reforestation begins with the planting of *Leucaena leucocephala*, a shrub-like, drought-resistant legume that increases soil fertility and organic matter content, helps to weather shale and limestone that have been exposed by erosion, and provides high-quality fuelwood and forage. Once the *Leucaena* have been established, timber species are planted. Ten million trees have now been planted in the coastal area.

The dairy production component in San Antonio del Sur: The main objective of the dairy production project, based on irrigated fodder production and zero grazing, is to supply 3,660 litres of milk daily for children under six years of age in the region. Only 21 per cent of that amount is now produced locally.

Eight dairy units, covering a total of 349 hectares, have been identified for development. A water pipe, 6 km long and 600mm in diameter, will carry 350 litres/second to pressurized spray irrigation systems to water seed production lots for forage plants, mainly, guinea, buffel, star and king grasses, sugarcane, *Leucaena* and legumes.

Several techniques for soil preparation, cultivation and management of grasslands have been tested, including the replacement of conventional ploughing with techniques that do not invert soil horizons, promoting organic enhancers, constructing drains in areas at risk of salinization, and the establishment of *Leucaena* protein banks.

Participatory Approach

Participatory planning and implementation are an outstanding aspect of the Cuban struggle against desertification. The project has benefited from coordinated regional development policies and, at the same time, contributes directly to achieving the objectives of those policies. The programme places strong emphasis on harmonizing the efforts of government decision makers, provincial and municipal authorities, scientific and research bodies, NGOs and citizens. Key citizens and citizen groups actively involved in the programme include municipal presidents, journalists and leaders of non-governmental organizations, such as Cubasolar, Pronaturaleza and the Revolution Defence Committees, the principal social institutions responsible for organizing mass mobilization for communal projects.

Use of local resources

Limited availability of machinery and fuel requires solutions based on locally produced materials and community labour, which facilitates the adoption of organic technologies and the existence and strengthening of citizen organization and participation. Gender promotion, women's participation is also essential. The equality that Cuban women have achieved includes access to education and positions of responsibility similar to those of men.

Outreach

The results of the four demonstration projects are disseminated mainly through visits to the projects by students, farmers, community groups, scientists and decision-makers at all levels, as the projects themselves are a highly educational means of communication. Visits may be as short as a few hours or longer

than one month, for visitors to join in the project work as part of the learning process.

One mobile unit adapted from a discarded military truck is used to reach remote areas. Equipped with photovoltaic cells, a computer and video projection equipment, the project promoters travel in this unit to present educational materials in the field and organize talks, debates, round tables, specific courses and other educational activities. CITMA has also hired a carefully selected and trained outreach team to teach the application of techniques that have been developed by the projects. The programme places great emphasis on the development of basic environmental values through schools in the region. This work consists of performing skits, songs, and environmental activities with the participation of children, teachers and parents.

Appropriate innovations

The programme combines broad, in-depth diagnosis of environmental and social conditions, traditional knowledge and the most up-to-date technological knowledge to develop realistic solutions that take into account the limitations imposed by a shortage of foreign exchange, equipment, spare parts, fuel and purchased inputs. The use of vermicomposting, plant residue recycling, and mixing grasses with legumes in livestock pastures on the coast are indicators of a coherent strategy that minimizes the use of fuel and inputs and maximizes soil fertility. The development of pest-resistant crops and pathogen-free plants through tissue culture and grafting are examples of efforts to eliminate the use of expensive agrochemicals.

In the mountain area, mixed farming overlaps with forest species native to the region, which reproduces the native vegetation structure and creates habitats for wildlife. Intense cattle raising on the coast is freeing up land for conversion to forests at a rate of approximately 12 hectares per unit of intensified area. Reforestation is regenerating conditions for the continuation of natural succession processes, in addition to covering and enriching soils and providing habitat niches for fauna. Conservation efforts in the basin and on the coast are helping to regulate the flow of rivers in the Guantánamo Valley, an essential benefit as groundwater is too salty.

The achievements of the programme, which is still expanding, have been felt at an early stage with an increase in the productivity of coffee, the main source of income, greater availability of milk for the most vulnerable segments of the population, and a reduction of the impact of torrential rainfall. The main value of the programme, however, lies in the long-term improvements it will bring: reducing migration to cities, achieving food self-sufficiency and mitigating the effects of natural disasters such as flooding.

Community contributions

The programme activities were conceived as a public service to the population, and are financed with public resources on State lands. In view of the unique characteristics of social organization in Cuba, the communities contribute through voluntary work in the construction of irrigation infrastructure, soil conservation, reforestation and in the preparation of land to establish the various projects.

Adoption of innovations

The programme is still young and has not yet entered into its expansion stage. However, there has already been replication of complete models and the adoption of specific elements of the projects, as in the cases of private producers in the valley who have benefited from improved water quality from the resurfacing of the canals, coffee growers who are now establishing mixed farming lots in the mountains, and coastal farmers who are intensifying livestock production. Dissemination and training schemes have already formed the links necessary for future expansion.

Public policy

Within the limits of Cuban regulations on conservation and the environment, private producers have joined a programme in which prices are established according to production costs, and purchase is guaranteed by the government. Once production commitments have been met, farmers are free to bring their produce either to the free market or to the government at premium prices that serve as an incentive for increasing production. Farmers are free to choose crops other than those specified by the production programme. These mechanisms provide the producer with both flexibility and certainty, which translates into greater willingness to invest in improving productivity.

Cuban environmental law declares that natural resources are part of the national heritage, and makes it obligatory for private parties and public companies to conserve this heritage. Decree 179 on the conservation of natural resources provides a regulatory framework to guarantee enforcement of conservation-friendly production techniques, and the establishment of related monitoring mechanisms are a notable innovation that is being applied with success, since this monitoring is accompanied by technical advisory services.

Evaluating success

Farm productivity has increased in the area by two to ten times, and is providing higher incomes to farmers who have adopted the new production and sustainable land management schemes. Savings were realized through less damage from floods and lower food imports from other regions, freeing available funds and other inputs for other priorities.

Coastal landscape

The technologies selected and developed in the project are based on the use of intensive labour, particularly in the case of mixed agroforestry mountain farming. In the valley, the programme has minimized the use of farm machinery, encouraging manual work and animal traction. In the livestock units, extensive management has been replaced by intensive management, which has increased the use of labour threefold in animal management and ten times in relation to land management, encouraging new agroforestry activities in land freed by intensive livestock rearing.

The combination of a high degree of institutional coordination, careful selection of the innovations to be developed and adapted, and the availability of extraordinary human capital (principally in terms of education) and social capital (principally in confidence and organization) increases the effectiveness of human and material investments made in the project.

The programme has been planned for long-term expansion through stable, representative and well-organized community institutions that provide a strong foundation for extensive outreach. Through these institutions, awareness-building and training activities have reached 100% of the population. The rate at which models are being adopted and the response to initial dissemination and training efforts indicates that experiences continue to spread.

The strongest points of the project are based principally on the conditions of present-day Cuban society, which are not common or easy to establish in other countries. However, several technological aspects, traveling outreach schemes and the linkage of research with field activities, among other factors, are widely applicable.

Another key aspect of this programme is the decisive value of prior investment in human and social capital. A healthy and educated population is far more likely to participate actively in innovations, reducing the time and cost of adopting disseminating new technologies. The inclusion of opinion, political and social leaders also encourages the dissemination of innovations, builds community confidence and encourages mobilization.

The programme has established specific, appropriate and comprehensive responses to the problems of natural resource degradation and the risk of natural disasters and makes it an example to be followed in other developing countries.

References

Asamblea Nacional del Poder Popular (1997). Ley del Medio Ambiente. Gaceta Oficial de la República de Cuba. Año XCV Núm. 7. Habana.

Consejo de Ministros (1993). Decreto No 179 de la Protección y Uso de los Suelos y sus Contravenciones. Gaceta Oficial de la República de Cuba Año XCI, No 4. Habana.

Gonzalez Novo, Teresita e Ignacio García (1999). Legislación:una Herramienta. CITMA-Editorial Academia. Habana.

Ministerio de la Agricultura (1987, 1990). Clasificación de los Suelos de la República de Cuba. Habana.

Ministerio de Ciencia, Tecnologia y Medio Ambiente (1999). Situación Ambiental Cubana. CITMA. Habana.

Ministerio de Ciencia, Tecnologia y Medio Ambiente (1999). Programa de Accion Provincial de Lucha contra la Desertificacion y la Sequia en Guantánamo. Delegación Provincial en Guantánamo. Comisión de Lucha contra la Desertificación, Guantánamo.

Ministerio de Ciencia, Tecnologia y Medio Ambiente (1999). Proyectos de Referencia. Lucha Contra la Deseretificación y la Sequía. Delegación Provincial. Guantánamo.

Ministerio de Ciencia, Tecnologia y Medio Ambiente (1999). Síntesis de Información Geográfica y Socioeconómica. Delegación Provincial. Guantánamo.

Ministerio de Ciencia, Tecnologia y Medio Ambiente (1999). Comportamiento del Clima en el Valle de Guantánamo y Franja Costera Sur. Delegación Provincial, Centro Provincial de Meteorología. Guantánamo.

Living Fences, Productive Slopes

Conserving Eroded Slopes with Opuntia Live Fences and Mixed Cropping in Loja, Ecuador

Background

The soils of Loja, Ecuador are fragile and rocky. The practice of farming on hillsides here, disregarding the risks of erosion and the difficulty of irrigating steep slopes, was introduced to the region many years ago because of the lack of sufficient flat land for farming, and as a result of unfair agrarian reform. But local communities have revived traditional knowledge to help solve this problem, with the use of opuntia (*Opuntia ficus-indica*), a cactus also known as 'the prickly pear', and the tradition of harvesting cochineal (*Dactilopius coccus*), an insect from which indigenous communities extract dyes for local crafts.

The project

Location: The province of Loja lies in the southern part of Ecuador, in the frontier region north of Peru. Its 10.793 km², 4% of the country's area, are mountainous and extremely irregular, with few areas suitable for farming. Arable land is limited to small inter-Andean valleys, with altitudes varying from 140 metres above sea level in Zapotillo (in the south, bordering Peru) to 4,000m in Saraguro, in the northern part of the province.

Climate: The climate is variable, with temperatures ranging from 0 to 22°C. The greater part of Loja, 62%, enjoys a tropical climate, with a rainfall range between 380-774mm a year. Generally speaking, the soils of the province are poor, shallow and rocky. 26%, or 280,000 hectares, are suitable for cultivation, though fertility is low and water scarce; 40% is suited for livestock production, with similar restrictions, and the remaining 35% are deforested soils, very fragile and vulnerable, unfit for anything but conservation.

Population: The total population of the province of Loja is 389,632 inhabitants, of whom 59.8% live in rural areas and 40.2% in urban areas. Because of the climate, the quality of the soils, the difficulties related to the topography and the natural isolation of the region, 78% of the rural population lives in conditions of poverty, abandoned to their own meagre and degraded resources.

Stabilizing soil erosion with Opuntia on steep slopes

The problem

The Spanish arrived here in 1750, establishing the first villages and beginning the indiscriminate exploitation of natural resources. From the indigenous people, the new settlers learned of the therapeutic properties of indigenous cinchona bark (*Sinchona officiales*), from which quinine is extracted, the only treatment, until the twentieth century, effective against malaria. The use and exploitation of quinine contributed significantly to the deforestation of enormous areas of Loja.

In the nineteenth century, with the introduction of livestock and the expansion of the agricultural sector, the destruction of the remaining forests increased rapidly as areas were converted into grazing pastures and marginal agricultural zones. In most cases, technologies introduced by the Spanish settlers were inappropriate, ignoring the region's biophysical characteristics.

The result could not have been more devastating. Deterioration of soils, increased erosion and loss of fertility account for the decrease in crop yields that began decades ago and continue to the present. These problems, combined with frequent long droughts, have led to extremely high rates of rural emigration to the provincial capital and other urban areas.

In 1964, the Ecuadorian government launched an agrarian reform programme in which the majority of poor peasants were allocated land on the steepest slopes on the highest mountains on the worst soils, with no possibility of irrigation. There are no

Ecuador - UNEP's "Saving the Drylands" award winner, 1999. This project was implemented by the National University of Loja - Department of Agricultural Sciences, Loja, Ecuador, with funds from the Provincial Council of Loja.

Mixed tree cropping and Opuntia live fencing to control land degradation

land problems in the formal sense of property titles, but they certainly exist with regard to the distribution of quality parcels of land.

Experts at the National University of Loja indicate that almost 80% of the province has serious erosion problems and loss of vegetation and fauna. Farmers report that their production is declining and drought periods are increasing each year. The desertification process is advancing, and it particularly affects the steep slopes where the poorest people live.

In order to sustain the valuable relationship between opuntia and cochineal, as well as revive an agro-ecological model that is compatible with the culture and values of local communities, the University of Loja launched a project entitled 'Live Fences of Opuntia and Associated Crops in Conservation of Sloping Land' in 1993. The project has been able to achieve these aims using pilot experiments and simple technologies, including the use of varieties of opuntia for cochineal insect production, and as a source of fruit, forage, fuel and fencing material. Using lessons from the early years of the project's implementation, regional government authorities used the project as a development model for the whole Loja region.

The project proposed to reintroduce opuntia together with native vegetation and crops that are resistant to arid conditions. For the experimental phase, the project selected a small area accessible to the farmers, close to the local road, to plant the most suitable types of opuntia to fulfill two purposes:

1) That the plants would have to be healthy and vigorous because they were intended to serve as barriers for a long period of time, perhaps 30 years.

2) That the plants would have ahigh level of receptivity to the cochineal insect, since this was to be one of the main sources of income in the future;

Other types of opuntia could be selected for their ability to produce fruit or forage. The project selected an area of two hectares in the vicinity of the road that leads from Malacatos to Vilcabamba, where about 1,000 and 800 farmers live, respectively. There were three steps to the process:

- selection of appropriate opuntia species for the area;
- construction of small terraces 0.8 to 1.0 metres wide;
- construction of infiltration burrows 0.25 cm by 0.10 m long, with small separation partitions.

Once these steps were taken, the opuntia was planted in the burrows following contour lines. Native bushes were planted between the opuntia burrows to exploit the existing vegetation and use it as a source of fuelwood. In this case, a tree called *Faique* was selected. It provides good fuelwood and charcoal, besides being resistant to drought and adapted to rocky soils.

Overall achievements

The project sought alliances with the different groups of the regional community to involve farmers as much as possible. Various sectors of society were mobilized in the implementation and dissemination of the project: churches, schools, army and NGOs. All parts of the province were visited by the Project Director, who talked with farmers about opuntia, the importance of this crop and the generation of income through the harvest of the cochineal.

Farmers participated directly in periodical meetings to discuss potential problems and other important matters. During these meetings the first farmers who had adopted the opuntia as a crop explained the technology and the ecological and economic importance of the project to the others. In general there was excellent acceptance of the technology, leading to increases in local incomes, recovery of degraded areas and the prevention of land degradation in other areas of intensive use of natural resources.

Specific benefits

The project provided a number of important benefits:

- The recovery of the opuntia, the cochineal and the local indigenous vegetation;
- The generation of income during the second half of the year, a time of drought in which no other crop survives;
- A system of distributing good quality opuntia seeds in order to replant and increase annually the number of plants on each farm;
- Laboratory data on the improvement of soil conditions;
- A greater awareness of the importance of vegetation, especially those few trees and shrubs that withstand long droughts and furnish fuelwood, the only local source of biomass energy;
- More updated information on the diversity of productive systems in the arid ecosystems that characterize the Loja region;
- A gradual positive change in the attitude toward credit systems that provide loans for planting opuntia and production of the associated cochineal insect;
- A first approach towards the participation of women's organizations in the production of opuntia and cochineal in a communal society that traditionally is organized around men;
- Increased interest from students of the University of Loja to work on research into issues related to the objectives of the project, emphasizing aspects such as opuntia diseases, changes in the conditions of the soils, extension projects; and
- A greater diffusion of the project's approach among different organizations, such as cooperatives, communes, associations, water committees, technical schools and parents' committees.

A local farmer shows off his opuntia burrows

Social Capital-Community empowerment

Communities involved in the project gained increasing control over their lives, and state their satisfaction with the extra income received from both the opuntia cropping and associated cochineal production, as well as the retention of the soil in the opuntia plantations and the use of the fruit as part of their diet. But, above all, is the pride of farmers that the project has recognized the value of ancestral skills and practices. The opuntia and cochineal are part of local cultural traditions. Their revival has strengthened the self-esteem of older members of the community and opened the possibility for younger members to learn about the old ways.

The possibility of extending income-generation all year round, usually restricted to the first semester (the most humid period), increases food security, decreases anxiety during the long droughts and could, eventually, reduce emigration rates.

The implementation of the project contributed to strengthening communal organization, based on meetings every first Sunday of the month to discuss the problems that affect them and to organize shifts in the use of water and the management of other common resources.

Community authorities used this opportunity to replicate the project's messages of reducing land degradation, and thus made members of their communities more aware of the need to manage soil, water and domestic animals, particularly goats. As a result of this process an increased number of families interested showed interest in adopting the technology.

Sustainability and replicability

The sustainability of the project is evident indifferent ways. As mentioned above, opuntia farming on slopes in association with other crops offers a solution to exploit marginal lands and to facilitate the rehabilitation of eroded soils.

Although lack of sufficient data made it hard to precisely evaluate the economic impact of the project, it can, nevertheless, be inferred that the levels of uncertainty with regard to income generation have diminished. The project contributed elements of efficiency (the use of resources that have less negative environmental impacts) and impartiality (attention to present as well as the future generation of farmers).

From a socio-cultural point of view, the technology respected traditions and ancestral skills, demonstrating that it is possible to innovate using these elements athus allowing local communities to have greater control over their lives while maintaining their cultural identity.

A key and extremely encouraging element in the success of the project was the inter-institutional co-ordination and alliances between different groups. This included support from local authories, NGOs, public institutions, the media, academic institutions and, above all, the users of the technology, the poorest farmers of the region.

The project innovations are replicable around the country and in other regions of the world with similar agro-ecological conditions. As result of the success of this project, the technology and the agro-ecological model were disseminated in different parts of the country without any additional resources.

Lessons Learned

The project made several impacts from which lessons can be learned:

- The opuntia and cochineal project was successful to a large extent due to the fact that its design and execution was based on deep convictions of the population about their cultural values, ancestral skills and the traditional attachment to communal resources.
- The presence of the University of Loja and the credibility of the Professor-Investigator and Director of the project made generations of students aware of the importance of the opuntia and cochineal crops, the agroecological perspective in sustainable regional development, and the fight against desertification.
- The creation of a data bank on specific production systems that can be useful to students, leaders, communities and researchers.
- The project created local political sensitivity to the problems posed by desertification, as evidenced by the decision to support a second phase of the project by the local authorities.
- The project developed and implemented a technology that is easy to replicate due to its simplicity, cultural adaptability and low level of investment. Based on this, greater success is envisaged in further replication of the technology and approach in the region.

Enriching Local Knowledge

A Pilot Project by the Soil Conservation and Rural Development Centre, El Dexthi, Mexico

Background

El Dexthi is a community of about 600 small farmers in the Upper Mezquital Valley, in the Hidalgo State of Mexico. The people of El Dexthi are extremely poor. Education, health, transportation and communication services are severely lacking. The climate is unforgiving, soil erosion and deforestation are rampant, and water is scarce. Farm productivity is low, and local diets are poor. Although they live in harsh conditions, however, the people of El Dexthi have a rich resource in their traditional knowledge of sustainable soil management, plant physiology and use, insect and animal ecology, and social and labour organization, as well as an innate capacity to adapt to adverse conditions.

The Upper Mezquital Valley is located in the northern highlands of central Mexico, in a semi-arid steppe climate characterized by frequent drought. The vegetation is typically thorny brush, which has been severely degraded by indiscriminate clearing. The El Dexthi area covers a variety of natural ecosystems, including diverse xerophilous brush, pine forest, oak forest and gallery forest, all of which have been degraded to a greater or lesser degree by human activities.

Most of the people of El Dexthi make their living by gathering and processing *lechugilla* or *ixtle* (*Agave lecheguilla*), a fibrous plant that is used in brushes, and from the harvest of *sangre de grado* (*Jatropha dioica Cerv.*), aloe vera (*Aloe vera I.*) and *xithe* (*Agave lecheguilla*). A cooperative owned by a local association manufactures shampoo from extracts of these plants; the shampoo is then sold outside the region and sometimes exported to other countries.

Most families farm small dryland plots, growing maize, beans, wheat and oats - though yields are very low - and maintain backyard livestock pens to raise goats and poultry.

The Problem

The region's main environmental problem is desertification, caused by severe soil erosion, overgrazing, deforestation and poor land use practices. Soils in the area have low concentrations of nutrients, poor structures, and little organic matter. There is also a high degree of soil loss: 17.33 tons/ha/year are lost through water erosion and 100.58 tons/ha/year through wind erosion.

The Project

In response to widespread poverty and the declining natural resource base, the El Dexthi Pilot Centre for Soil Conservation and Rural Development was established in 1996 to demonstrate and disseminate sound natural resource management techniques. The Centre's programmes focus on practical technologies that detain, reduce and control soil degradation and desertification, and in the process upgrade community living standards in El Dexthi as well other communities throughout the valley.

The Centre was developed by the National Autonomous University of Mexico (UNAM), Iztacala Campus, and the Upper Mezquital Association of Lechuguilla Growers of the Social Solidarity Association (LAMSSS). It was established by the Secretariat of Environment, Natural Resources and Fisheries (SEMARNAP), together with the Secretariat of Social Development of the State of Hidalgo. The Centre is part of a larger national programme carried out by the General Directorate of Soil Reclamation and Conservation, SEMARNAP, which has established similar pilot centres throughout Mexico.

The project's integrated approach

The Pilot Centre runs a wide variety of demonstration and training programmes in soil conservation, water catchment systems, family garden management, small-scale vegetable cultivation, collection and propagation of key plant species, revegetation using *Agave lecheguilla*, community nursery establishment, and environmental education.

The technologies promoted by the Centre were selected by the community and its institutional partners based on a thorough assessment of the area's environmental characteristics, the state and potential of natural resources, the community's needs, and financial viability.

Agroforestry system with indigenous shrubs and *Agave spp*

UNEP's "Saving the Drylands" award winner, 1999. This project was implemented by the Pilot Centre, developed by the National Autonomous University of Mexico (UNAM), Iztacala Campus, and the Upper Mezquital Association of Lechuguilla Growers of the Social Solidarity Association (LAMSSS). It was established by the Secretariat of Environment, Natural Resources and Fisheries (SEMARNAP), together with the Secretariat of Social Development of the State of Hildago, Mexico.

Innovations

Conserving soils: Anti-erosion earth dykes were chosen as the most appropriate soil conservation technique for the area. Plots are cleared of plants and roots and ploughed with a harrow, and their sides reinforced with stone dykes, 1.5m wide at the base, 0.9m wide at the top and 1.2m high, to stabilize soils. Existing dykes were restored following the same procedure. 43 dykes, totaling over 3,000m in length, were built to conserve soils on 40ha of agricultural land. The dykes were reinforced with planted biological barriers of 1,500 pulque maguey cacti (*Agave salmina, var. salmina*), an important native food species.

Increasing soil fertility: Twelve buried compost systems were established to develop a model for making biofertilizers from organic residues, manure and minerals found in the zone to improve soil fertility. All the systems were maintained using the same formula, and the finished compost was analysed at the UNAM laboratory to measure its physical-chemical properties, macro-nutrient content, texture, pH, organic matter, cation exchange capacity, and percentages of nitrogen, phosphorous and potassium. Use of the compost on small plots has generally improved the fertility of local soils, although not yet to optimum levels.

Composting biofertilizer from organic residues

Improving water catchment: Under the specific objectives of reducing water erosion, improving water catchment and increasing storage systems for livestock and agricultural purposes, the Centre promoted filter dams and dyke dams. 129 filter dams were built in 18 ravines, covering a total area of approximately 800ha. On average, each filter dam retains up to 1.5 m^3 of water, which is reserved for livestock. Two earthen dyke dams were also rehabilitated to store runoff water from the ravines and surplus water from the filtering dams. These dams were designed to be cultivated in the winter, using retained soil moisture to grow oats or wheat and encourage the growth of forage plants.

Products made from Aloe vera and Agave

Promoting family gardens: To promote the development of diverse backyard gardens to provide families with nutritious fruits and traditional medicines (see table below), the Centre established a 60 m^2 demonstration garden.

Enhancing vegetable production: To promote improved small-scale (6m^2) organic vegetable cultivation, the Centre established an irrigated bio-intensive demonstration bed planted with tomatoes, radishes and chilli peppers. The bed was prepared with compost to improve soil fertility and covered with a blanket of mulch to conserve moisture and control pathogens.

Promoting useful local plants: The Centre drew up an inventory of local plants with important ornamental, medicinal, forage, food, agro-industrial and construction uses in order to promote local awareness and cultivation. Propagation methods were also standardized for the economically valuable mesquite (*Prosopis laevigata, Humb. & Bonpl.*), *Leucaena leucocephala Lam.*, and *shasni* (*Mimosa deparperata Benth*).

Encouraging agroforestry: Two fenced agroforestry demonstration plots of 6 ha each, including plantings of pulque maguey and forage nopal (*Opuntia ficus-indica L.*), achieved survival rates of 95%. Another 10 ha plot of transplanted mesquite (*Prosopis laevigata*) had a survival rate of 60%.

Useful Local Plants

Fruit trees:	Guava, orange, fig, lime, pomegranate, peach, apricot, mandarin orange and walnut
Ornamental plants:	Geraniums, Mexican geraniums, chile peppers, vines, dahlias and cacti
Medicinal plants:	Rue, thyme, mint, aloe vera, rosemary, and chamomile
Trees obtained from layerage:	Pomegranate, fig, walnut, lime and mandarin orange
Trees obtained from cuttings:	Pomegranate, fig, walnut and guava

Increasing income: *Lechuguilla* provides the raw material for the most important economic activity in El Dexthi. Its fibre is used for brushes, bath sponges and bags. Its residues are used as a household detergent and an essential base for the manufacture of shampoo, and its dry leaves are used for fuel. 25.5 ha of *lechuguilla* have been incorporated into farms around the Pilot Centre, planted in rows and in groups of three as well as in random patterns, in densities of 2,100 plants per ha. Ten ha of land were planted with aloe vera (*Aloe vera L.*), with a survival rate of 95%.

Building stonework systems to harness water and control soil erosion

Delivering community services: To encourage the cultivation of useful plants, a 15,000 seedling nursery was established on communal land with the approval of the Town General Assembly. The Pilot Centre is also located on this property, equipped with a meeting room, a small laboratory, a room for lodging guests, a warehouse and a botanical garden for native plants.

Community training: Since the Pilot Centre was established, it has held four community training workshops, benefiting 128 primary school students, 7 teachers and 130 members of the community. Subjects covered include: environmental education and natural resource management; community planning, management and conservation of natural resources; traditional cooking; and traditional crafts of the Upper Mezquital Valley. The Pilot Centre provides a vital central place where the community and visitors can meet to learn new skills and exchange ideas.

Achievements

Improved land use: The Pilot Centre's land use programmes have achieved considerable success in introducing useful and appropriate new techniques. Based on traditional knowledge as well as modern techniques introduced by specialists from partner institutions, the soil conservation systems have proved to be effective, and are considered by community members to be both useful and durable. Water catchment systems have been equally successful, but as the systems do not provide water for irrigation, the community now wants to explore the extraction of subsurface water. The promotion of useful plants has yielded a much more reliable supply of food, medicine and marketable goods. The programme has had a significant impact on the local environment; three years after work began, completely degraded areas became productive.

Expanding horizons: The programme has also brought the community into an ongoing exchange of ideas and information with a wide variety of other organizations and institutions withwhom they otherwise would have had little if any interaction, introducing them to new ideas that they have now made their own.

Community commitment: The degree to which the programme has been adopted is its cornerstone. Without the willingness of El Dexthi's inhabitants, it would have been impossible to establish and maintain an active Centre. But active it is: the Centre is a bustling physical and social structure that shelters and brings together community members under the common objectives of sustainable development and improved livelihoods, enabling groups to meet and arrive at their own decisions, plans and actions.

The Pilot Centre has clearly captured the community's enthusiasm and commitment, evidenced by their uninhibited participation during question and answer meetings, as well as their demonstrated command of a wide variety of practical development issues, from land management to plant physiology. Women have played an active role in all activities.

Increasing income and savings: All of the work is done by El Dexthi community members, who receive payment, and this has specifically benefited 40 families. The programme has also enabled an increase in community and individual farm assets from improved land use management. The market for agricultural products still needs to be expanded; this would result in substantial increases in income.

Government support and political commitment: The Mexican Government, through the Secretariat of Environment, Natural Resources and Fisheries (SEMARNAP), has contributed and will continue to contribute approximately 90% of the resources for the project, as well as lending substantial and continual moral support. The State Government of Hidalgo has also joined in this final stage to replicate the model, and is becoming increasingly involved in plant, mechanical and structural efforts to control erosion.

Agave planted on terraces to stabilize soil

Replicability and sustainability: Designed for further adoption and expansion from the beginning, the El Dexthi Pilot Programme has every possibility and prospect of being replicated successfully throughout the Upper Mezquital Valley, and in fact

similar projects are now being implemented in neighbouring localities. All of the institutions involved in the project are sound, and have worked in the area for several years. And because the community themselves decided what type of project to develop, in addition to the tangible benefits they have seen so far, sustainability is ensured.

References

State of Hidalgo(1999). Secretaría de Desarrollo Social, Programa de Atención a Zonas Erosionadas, Mexico, June 1999.

Fundación Friederich Ebert (1987)–SEDAC, Auto Didactismo Solidario, Una Experiencia en el Valle de Mezquital, Mexico.

SEMARNAP (1996). Subsecretaría de Recursos Naturales, Dirección General de Restauración y Conservación de Suelos, Programa de Validación de Estrategias Para la Conservación de Suelos, Centros Pilotos, Mexico, October 1996.

UNAM, Campus Iztacala, Laboratorio de Edafología (1997) SEMARNAP, Delegación del Estado de Hidalgo, Programa de Manejo Sustentable de Recursos, Restauración y Conservación de Suelos en El Dexthi, Alto Mezquital, Hidalgo, June 1997.

Restoring Ancient Traditions

Food security and environment protection through rehabilitation of terraces in the Lari District of Peruvian Andes

Background

The Colca Valley, a deep 100 km-long canyon carved out of the Peruvian Andes by the Colca River, is as ecologically diverse as it is picturesque, but farming its steep, unforgiving slopes is a risky enterprise at best.

The Centre for Development Studies and Promotion, DESCO, has worked in this area since 1965, devoting much of its work to help improve the livelihoods and prospects of farming communities in Peru's marginal lands. The keys to agricultural survival here in the Colca Valley are reliable supplies of water and the protection and maintenance of fragile soils. Through a project devoted to rehabilitating terraces and irrigation systems, DESCO and local communities have found a sustainable solution to the unique challenges of this often harsh environment.

Panorama of the Colca Valley

DESCO's Colca Valley Rural Development Programme set out in 1985 to help rehabilitate terraces, improve irrigation structures, and introduce agroforestry throughout the valley in order to expand cropping areas, improve soil quality and increase the availability of water. The programme has been largely successful, leading to increased agricultural productivity and a renewed sense of ecological husbandry among farmers.

The terrace rehabilitation project started in 1992 in Lari District, where dramatic water scarcity, steep slopes, frosts and low atmospheric humidity severely limited agricultural potential. Lari District covers a total area of 38,232 hectares on the right bank of the Colca valley, at altitudes between 3,200 and 4,500m. Average annual rainfall in Lari is 350 mm, 60% of which falls between January and March. There is only one cropping season each year. Average temperatures range from 7.5°C and 11.4°C. Minimum average temperatures range between -1.5°C and 4.8°C from June through August; maximum averages range from 17°C to 19°C during the Southern Hemisphere summer.

Farmers in Lari grow 16 different crops, including corn, beans, potatoes, lucerne, wheat, sweet peas, barley and *quinoa*, in very harsh conditions on small subdivided plots averaging 1.2 ha per family. The main source of water for irrigation is provided by the snow on neighbouring high peaks, which melts through two sub-basins and eventually drains into the Colca River.

The problem

Before the project began, the ancient practices of terracing and irrigation, which can transform marginal slopes into arable land by controlling erosion, improving water management, maintaining soil humidity and minimising the risk of frost, had largely been lost. Poor maintenance of terraces and irrigation systems in Lari had resulted in highly inefficient water and soil management practices, and very low agricultural productivity. The project thus set out to tackle the following problems:

The Project

Loss of productive capacity: DESCO surveys found that 30% of the agricultural land in Lari District had been lost due to degraded terraces, inefficient irrigation systems and poor soil management practices that ignored the potential of crop residues and manure to improve soil fertility.

Inefficient irrigation practices: Poor maintenance of irrigation systems over a long period in terraced land had diminished their capacity to store and distribute water.

Lost traditions: Farmers had lost, forgotten or abandoned much of their knowledge of ancestral practices such as early fallow and mulching, crop rotation, crop association and nutrient recycling through composting, in favour of schemes designed to maximize short-term production.

Deforestation: There were almost no trees in the area, due to harvesting for fuel.

In partnership with farmers and local organisations, the project therefore focused on controlling erosion, improving soil fertility, managing water more efficiently, conserving crop

UNEP's "Saving the Drylands" award winner, 1999. This project was implemented by DESCO (Centre for development studies and promotion), a Peruvian NGO, with funds from Fondo General de Contravalor, Peru, Canada and Switzerland.

diversity and introducing integrated pest management in order to:

- Increase the efficiency of production systems within the micro-basin by rehabilitating terraces and irrigation systems.
- Increase crop productivity and production through better water, soil and crop management.
- Plant trees to help control erosion and improve soil fertility.
- Strengthen local organisations, especially the local irrigation commission, and improve their managerial capacity.

Achievements

Restoring degraded terraces Three elements of Andean terraces were considered when restoring the structure and functions of this ancient system: the stone wall, the terrace itself, and the access pathway.

The main purpose of the stone wall is to support the terrace and stabilize the soil. The wall consists of five main parts: the foundation, the over-foundation, the wall itself, the slope gradient and the filling, each carefully constructed to provide stability and adequate drainage.

The terrace is normally formed out of soil from the slope, but more complex artificial terraces combine different strata: a base layer made up of large stones that act as drainage filters; an intermediate layer made up of small stones; a layer of sand and clay to regulate drainage, and a final 50-80cm layer of topsoil.

Terraces are built with slight slopes along and across them. A light longitudinal gradient parallel to the contour line slows the flow of water and reduces erosion.

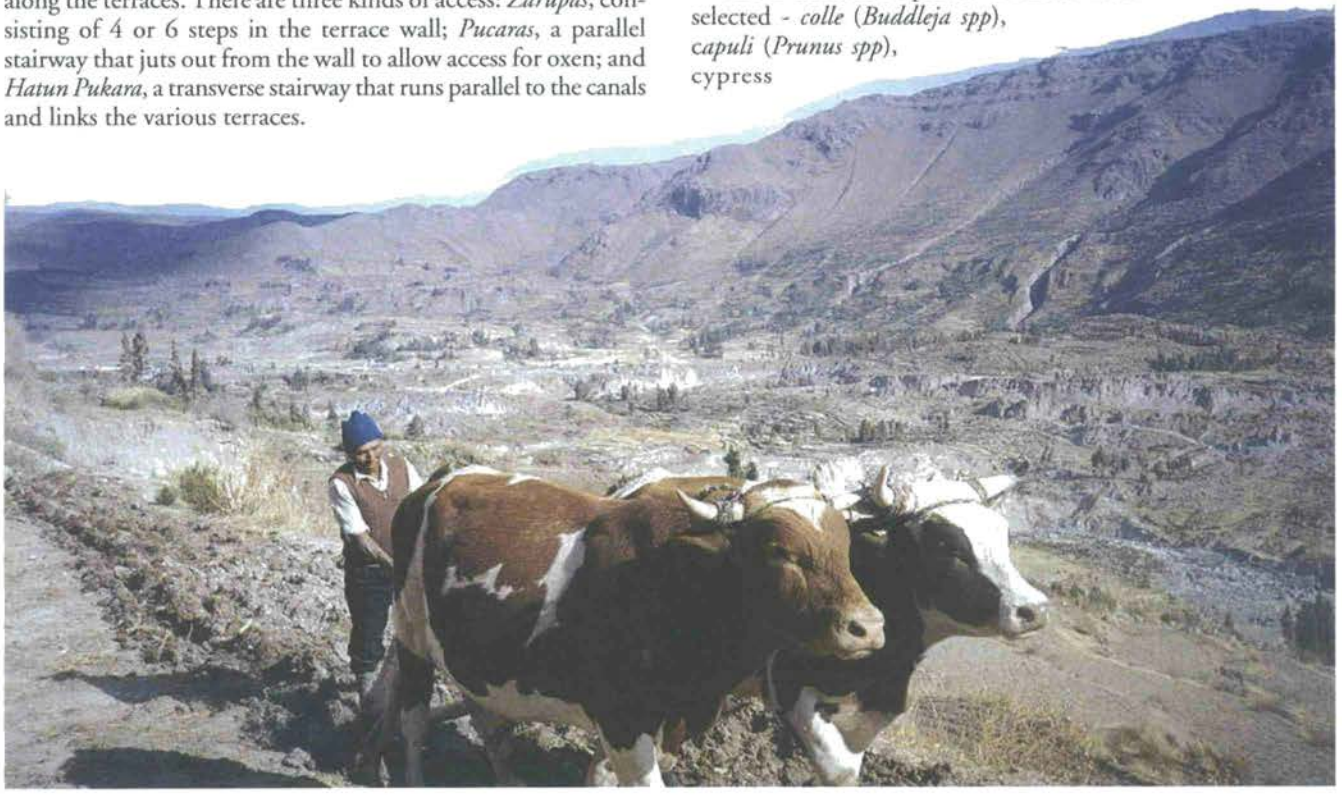
Access pathways allow for an easy movement between and along the terraces. There are three kinds of access: *Zarupas*, consisting of 4 or 6 steps in the terrace wall; *Pucaras*, a parallel stairway that juts out from the wall to allow access for oxen; and *Hatun Pukara*, a transverse stairway that runs parallel to the canals and links the various terraces.

Water management for irrigation of terraced cropping land

Rehabilitating irrigation systems: Reservoirs were constructed to collect and store snow melt and spring water and then feed this water to the terraces through four types of channels: conveying canals, irrigation ditches, waterfalls and drains. Conveying canals, made of stones and soil, conduct and distribute water to the terraces. Irrigation ditches run across the middle of each terrace, allowing irrigation of both sides. Waterfalls are used to transfer water from higher to lower terraces, while drains located at the end of a series of terraces draw off any surplus water.

Incorporating trees and crops: Agroforestry combines annual and perennial crops (multipurpose trees and shrubs planted for fruit, timber, fuel-wood and fodder), generating both economic and ecological benefits. The restoration of terraces and irrigation structures was followed by planting trees close to terrace foundations to support the walls and serve as windbreaks.

Four different species of trees were selected - *colle* (*Buddleja spp*), *capuli* (*Prunus spp*), cypress



Ploughing on terraces with oxen

(*Cupresus macrocarpa*) and pine (*Pinus spp*) - on the basis of their root growth habits, nutrient recycling capacity, and resistance to drought and frost.

Impacts

Over 5 years of careful implementation, many of the project's original goals were achieved. The results of the project can be summarized as follows:

- 317 hectares of terraces were restored and 101 hectares of previously unproductive land reclaimed, benefiting 364 families.
- Rehabilitated irrigation systems increased conveyance efficiency from 30 to 50 litres/second on average, increased accumulation capacity from 1,500 to 2,800 cubic meters, reduced water loss by 20%, and increased application efficiency by an average of 48%.
- More equitable water distribution among users ended frequent conflicts over water, and reduced the time span between irrigation cycles from 65-80 days to 45-60 days.
- 41,000 native trees were planted over 14 ha of crops and 17 ha of small woodlots.
- Increase in yields of major crops rose from 12.2 to 18.5 tons/ha for potatoes, 1.4 to 1.7 tons/ha for corn, 1 to 1.8 tons/ha for quinoa.
- Local masters were trained to build and maintain terrace and irrigation structures.
- Local irrigation commissions were strengthened as community leadership institutions.
- The role of women was enhanced through open debates on their contribution to the project.
- Tidy terraces are now seen as a potential tourism resource.
- Core components of the project were replicated in neighbouring districts, covering 755 ha.

Appropriate, indigenous and sustainable innovations: The techniques employed in this project are not exactly innovations, as they stem from ancient cultivation methods developed by the Quechua people in 700 BC. The recovery of widespread adoption of knowledge that was abandoned with the arrival of Spanish colonialists, however, is both significant and remarkable. These ancient skills are uniquely appropriate to mountainous conditions, allowing sustainable production where cultivation is otherwise very difficult.

Rehabilitation of terraces on hillsides

Seven thousand metres of rehabilitated irrigation channels, all based on original structures and built with local materials, have reduced leakage and prevented landslides and soil erosion.

Secondary channels and reservoirs have vastly increased water storage capacities, increased soil moisture and allowed the expansion of cropping areas.

The introduction of agroforestry, a relatively new practice to Lari, has allowed the recovery of natural vegetation, and has provided an important alternative to the use of native shrubs and dung for fuel. Leaf fall from shrubs and trees has improved soil structure, fertility and water retention. Early fallow systems facilitate the breakdown of organic matter and improve soil ventilation.

Terraces that have not yet been restored, by comparison, show signs of serious erosion and impaired productivity.

The people of Lari have benefited in several significant ways:

Better nutrition, higher incomes: Total agricultural production in rehabilitated areas has increased by an average of 29%; *quinoa* production has increased by 80%, potatoes by 51.6%, and sweet peas by 33%. Increases in marketed production have been estimated at 20%. One farmer reported that he had increased his corn yield by three sacks per *yuntada* (1 *yuntada* = 1,630 m^2), an average increase of eighteen sacks per hectare, yielding a significant improvement in his family's nutrition and income.

Higher property values: Rehabilitated terraces and irrigation systems, and thus greater productivity, have significantly increased the value of Lari's farm properties.

Stronger community institutions: Training and technical assistance has significantly strengthened the capacity of the local irrigation commission, the body that oversees water management and distribution. The organisation is now in a better position to improve effective water distribution and maintain the efficiency of water use on members' farms. When a farmer does not accomplish a given task, for example maintaining a leaking irrigation channel, the organisation can withhold water until the task is completed.

Less work, more water: The rehabilitation of off-farm water storage and channelling structures has resulted in better distribution, lower maintenance costs in terms of time and materials. More water is now available all year-round.

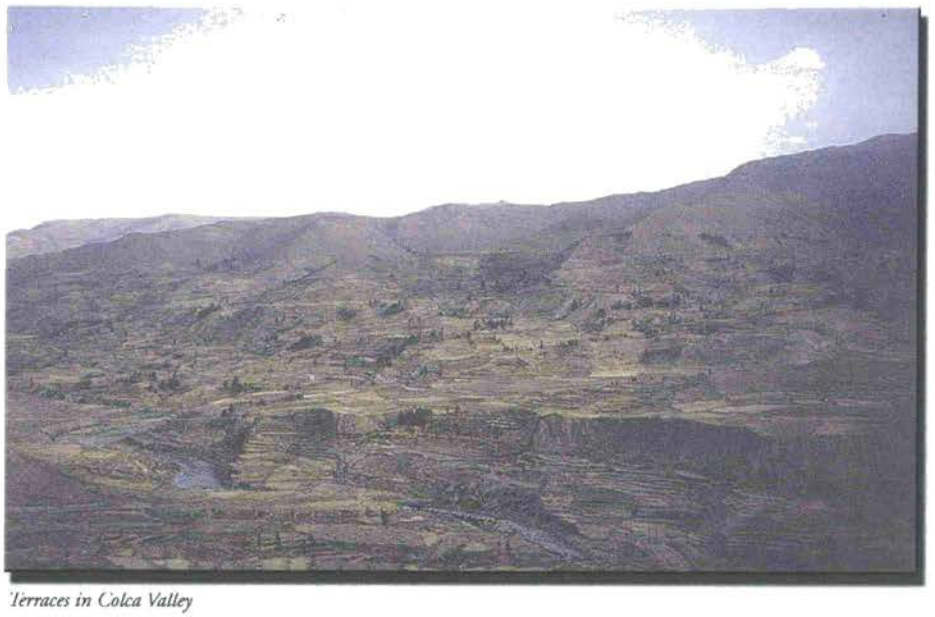
Acquired skills: Farmers who have been trained as experts in terrace rehabilitation are now contributing to rehabilitation projects in other sections of the valley and even outside the province.

More jobs: The rehabilitation process requires both skilled and manual labour, thus creating local jobs. This fact, coupled with increased farm productivity, encourages people to remain within the community instead of migrating to cities.

Cultural values: The terraces and irrigation systems in the Colca Valley were built and developed before the Inca period. Many of the present cultivation schemes are more or less the

same as those developed before the Spanish conquered ancient Peru, and the process of restoration has vindicated and reinvigorated these local traditions and skills.

Cost effectiveness: The costs of rehabilitating the terraces and water irrigation systems consisted basically of labour, meals and tools, with the community contributing 25% of the total costs. The individual farmer's contribution consisted of 4 additional workers to the 20 men and women who made up each task team. He was required to provide cooked meals for the team, as well as *chicha,* a corn and barley beverage considered a must for farm work. The project provided team members with 70% of the area's market daily salary. Weighing relatively low local costs against significant economic, social and environmental benefits to the entire community, the project can be considered very cost effective.



Terraces in Colca Valley

Community and political involvement: The community was directly involved throughout all the phases of the project, both as individual beneficiaries and through the Irrigation Commission and the community assembly.

Government support and involvement: Due in part to the success of this project, the Caylloma Provincial Mayor has given the Lari project and other DESCO activities his full political support, even inviting the NGO to coordinate the Provincial Development Council's Committee on Agricultural Development. The District Mayor, though he commands far fewer resources, also expresses a strong commitment to the project and its associated activities.

The Lari Irrigation Commission was well aware of the potential of restoring their ancient terraces and showed considerable initial interest in the project, making them an ideal partner. Once their area was selected, a comprehensive assessment was developed with the active participation of the community, mainly through the Commission. The next step was to prepare an inventory of the terraces to be rehabilitated and irrigation structures to be repaired or replaced.

An Implementing Committee, composed of two representatives of the Irrigation Commission and three community members appointed by the district assembly, organized task teams, drew up plans and time schedules with beneficiary families, managed tools and materials, and administered payments and work records.

Adoption rates: Nearly all farmers in the area adopted the project enthusiastically. 60% of the terraces over the entire right bank of the river were rehabilitated; the percentage of rehabilitated terraces within Lari district was even higher. Although most farmers adopted the package, the degree of rehabilitation varied in terms of the farm area covered, as some farmers were initially reluctant to implement the scheme over their entire farm at once, opting instead to test it out on part of the farm. Most farmers reported plans to expand rehabilitated areas.

The fact that the terrace-water system is part of ancient local traditions, and that water availability is so crucial to survival here, could explain Lari District's high adoption rates. Other possible contributing factors are strong local community institutions, a clear set of incentives, readily available resources to implement the project, and local confidence in an NGO partner, DESCO, that is both well known and respected.

Replication: The technology is now spreading throughout the districts of the right bank of the Colca river, covering an area of roughly 1,300 out of 2,000 cultivable hectares. Under a new scheme, the Araucaria Project, rehabilitation is continuing in the right bank districts and being launched anew on the left bank. Here, specifically in Yanque, work has been more intense; 5 teams totalling more than 120 people are working simultaneously, each led by specialised trained experts, whose services are now being sought from other valley districts and beyond.

*Promoting gender equality:*The project encouraged serious discussion and debate around the rights and responsibilities of both men and women. After a process of negotiation in which women presented their arguments as a group, the assembled community recognized that although energy input into project actiities was generally lower than that of men, women used the money they made far more effectively to benefit their families. The assembly decided that women would be entitled to equal pay, but limited the number of women on each team to 4 out of 24.

DESCO deliberately insisted on equal incentives for women and men from the beginning, which eventually strengthened the position of women and widened their opportunities to participate in solving other community problems. The same incentive scheme was later adopted by other valley communities.

Lessons learned

- The first step to the success of any project lies in close collaboration with strong community based organizations. If such organizations do not exist, such a project may not be possible, unless weak organizations can first be strengthened.
- Any similar project should be based on production systems that are in some way familiar to the beneficiaries. Small farmers tend to be very conservative, and as such are likely to be suspicious of new innovations. This is not strange; if an innovation fails, their livelihood will fail with it. This project built on existing production systems with deep roots in local heritage.
- Such projects should allow short-term benefits, either through direct incentives or surplus production for subsistence or marketing. The Colca project's rehabilitation work could be implemented in 3-4 days, with very little disruption of daily farm activities. Participants received a small salary for their work, and improvements in productivity were evident with the first crop.
- Community involvement in the early stages of the project encourages more active participation, enabling participants to raise and answer questions and instilling a deeper sense of ownership. The Lari project also encouraged the equal participation of women, an essential constituency in any community.
- Early sensitisation about innovations is an important part of project planning and implementation, and helps to stimulate adoption of the technology. The Lari rehabilitation project was launched in 1992, but DESCO had been working with the local organisation and sensitising the community since 1985.

Sustainability

- While the project was funded by overseas donors, it required a substantial contribution from the community, amounting to at least 25% of the total investment. The project's activities were based largely on local resources, both human and material. Community members performed most of the rehabilitation work, and the skills they learned are now being sought to help with restoration activities in other districts and other provinces.
- The project's interventions are sustainable in the long-term because benefits are tangible and maintenance of the introduced systems is both simple and cost-effective.

References

Benavides M., Maria (1986). Ethnohistorical Research for the terrace abandonment Project. In the Cultural Ecology Archeology, and History of Terracing and Terrace abandonment in the Colca Valley of South Peru. W. Denevan (ed) I: 386-389.

Cordova A., Hildegardo, Luis Gonzales I. Y., Carlos Guevara T. (1986). Agriculture in Coporaque. Denevan (ed) I: 60-87.

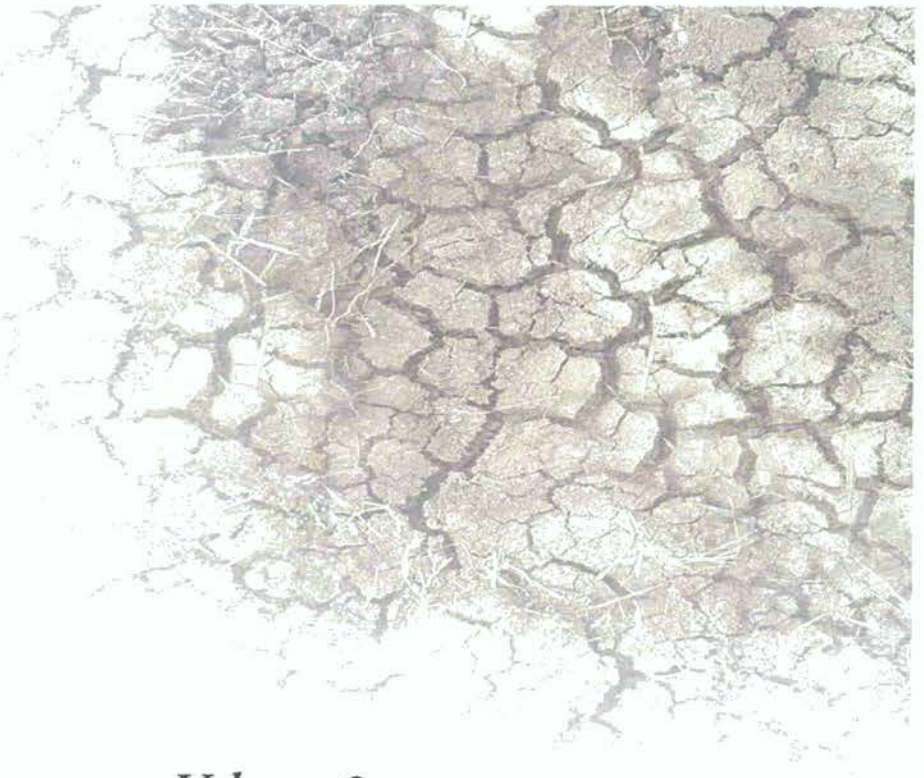
Desco - Centro de Estudios y Promocion del Desarrollo Programa Rural Valley de Colca (1999). Natural Resources Management in the Dry Puna. Arequipa.

Desco-Centro de estudios y Promocion del Desarrallo Programma R Rural Valley de Colca. (1999). Agro-forestry in Terraces Arequipa.

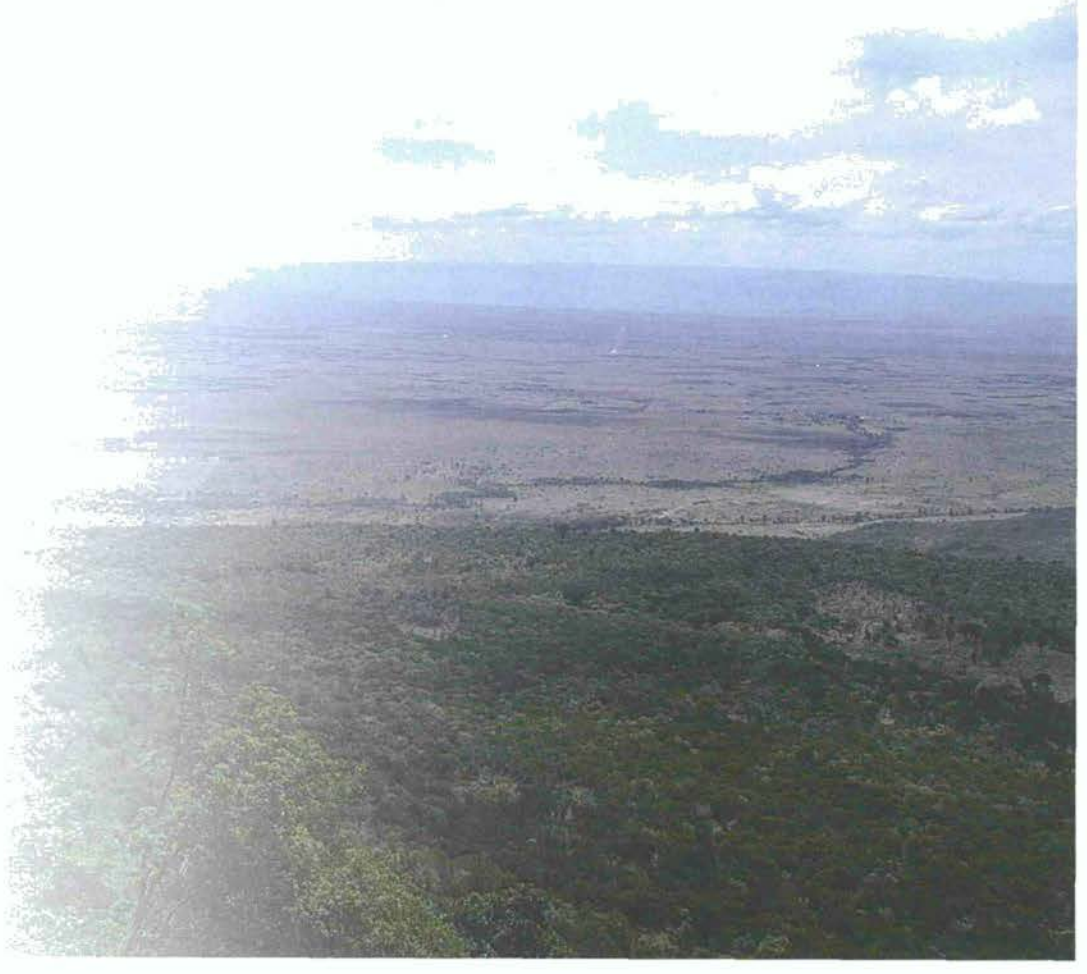
Guillet, David W. (1985). Agricultur Intensification and Desintensification in Lari, Colca Valley, Southern Peru. In: Research in Economic Anthropology. B. Isaac (ed) 8: 201-224. JAI Press.

Hurley, William (1978). Highland Peasants and Rural Development in Southern Peru. The Colca Valley and the majes project. Thesis University of Oxford.

Rubina Alberto, Salazar Carlos, Zeballos Molvina (1997). Colca. The Condor's flight. Desco. 201pp.



Volume 2
Case Studies: Report Summaries



CONTENTS

LATIN AMERICA AND THE CARRIBEANS

Protecting Degraded Dryland Forest

The Collective and Family Woodlands Project in Tiogo Forest Reserve, Burkina Faso

Country:	Burkina Faso
Continent:	Africa
Ecozone:	Semi-arid
Source of funds:	SIDA through UNSO
Number of people involved:	4,500 (1985)
Cost:	Part of a larger project costing USD 11 m. over 12 years.
Years of operation:	1984 to 1993
Area involved:	30,000 hectares
Location:	On the Mossi plateau in the central part of Sanguie province, an agricultural area producing food and cash crops.

Information meeting in Tenado with GGF members and technical staff

The Problem

Clearing of forest land for agriculture, uncontrolled bush fires, uncontrolled grazing and tree felling for urban firewood markets had contributed to severe destruction of the region's natural forest resources. This process was accelerated by drought. High population densities depending largely on fuelwood energy for their household needs led to overexploitation of forest resources. As a result, and due to lack of local village authorities, forest misuse could not be prevented.

The Solution

The solution to the problem of managing and protecting Tiogo Reserved Forest was based on the introduction and development of a clearly defined management strategy based on the principles of multiple sustained resource use, consideration of the needs of the local population, organization of user groups and the long-term financial autonomy of forest management activities.

Wood ready for transportation to market

Results/Impact

The project developed a new Forest Code and Land Reform programme, delimiting a legal framework for resource exploitation in state reserves. Forest management groups were effectively involved in preserving and developing forest resources, with the community playing a regulatory, supervisory role. The project improved forestry techniques and anti-erosion measures, and raised awareness on these issues among local forest-management groups.

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by UNDP/UNSO and local communities

Results/Impact

The project developed a new Forest Code and Land Reform programme, delimiting a legal framework for resource exploitation in state reserves. Forest management groups were effectively involved in preserving and developing forest resources, with the community playing a regulatory, supervisory role. The project improved forestry techniques and anti-erosion measures, and raised awareness on these issues among local forest-management groups.

Improved stoves

Sustainability

There is active local involvement in protection and rehabilitation activities in the Tiogo Reserved Forest. The exploitation of wood and other resources is rational in that it has been done according to generally well-mastered methods and techniques, with little negative impact on the forest.

Replicability

Replicability of this experience is possible due to the fact that project costs were low, and that techniques and skills can be transmitted without difficulty through training. Furthermore, villagers noted a clear improvement in their living conditions, and women noted reductions in the time they spent fetching wood due to the adoption of improved stoves.

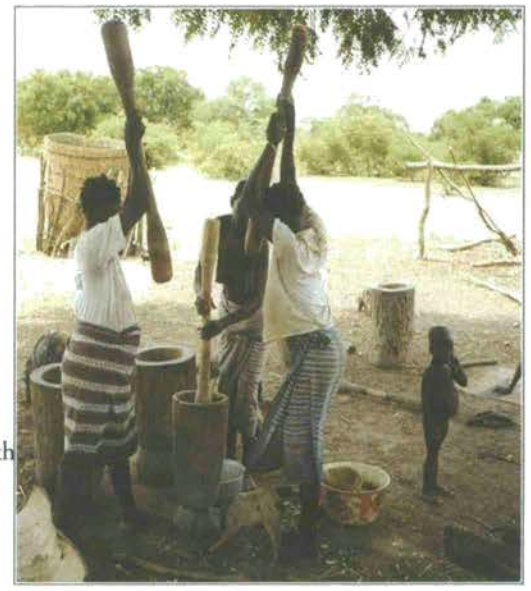
Lessons learned

- The introduction of improved stoves reduced the consumption of fuelwood and eased women's daily workloads in terms of time spent fetching firewood.
- The manufacture of improved stoves also provided an employment-generating activity for both men and women.

Enriching Soils Naturally

The Zabré Women Agro-Ecological Project on Education, Training and Food Security, Burkina Faso

Country:	Burkina Faso
Continent:	Africa
Ecozone:	Semi-arid
Source of funds:	Swiss private foundationsand New Planet
Number of people involved:	10,000 rural women organized in 300 village groups
Cost:	About USD 200,000
Years of operation:	1984 to 1994
Area involved:	about 1000 km^2
Location:	Zabré Administrative Department 180 km south



Women pounding grain

The Problem

Soils in the area had become degraded over the years, and had lost much of their water retention capacity as a result. Thirty years before, 350 mm of rain were enough to produce a crop of millet or sorghum; in recent years at least 600 mm was required. Yields had fallen dramatically, while local populations had grown. Additionally, women lacked status, and gained little return on their socio-economic activities.

The Solution

The long term overall objective of the project was to control land degradation resulting from drought and poverty, and to improve local living conditions, especially for women. In order to improve the soil fertility and thus to increase crop productivity, the project concentrated on improving soil quality by training women to produce compost.

Results/Impact

The project helped increase millet yields by 20% and significantly reduced soil erosion through composting on demonstration plots and small farms. Local infrastructure, such as schools, health facilities, savings and credit facilities, etc, were established or improved, new jobs were created, and income from crop sales and other activities increased.

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by Centre Ecologique Albert Schweitzer, Switzerland, and Zabre women groups.

Sustainability

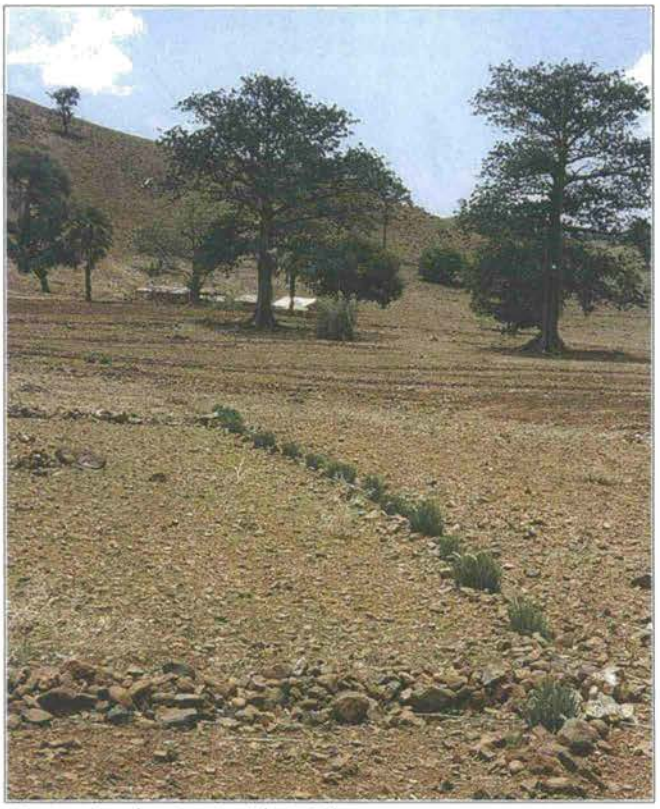
The role and awareness of women was sustainably improved. Training created awareness about environmental issues and encouraged the quest for financial autonomy. Training of trainers in management and agricultural techniques enhanced the replication and sustainability of the project.

Replicability

The rate at which membership to the association increased, bringing together as many as 11,000 active members in the project, is solid evidence of the replicability of the project. The project used simple techniques, methods and forms of organization, and applied locally available and inexpensive inputs. Non-members were invited by the project to join in various activities, such as training sessions, and experiences were exchanged with organizations in other regions.

Lessons learned

- The experience of the Zabré women shows that women are quite aware of desertification problems, and are more than capable of restoring and managing natural resources.
- There can only be lasting commitment and a real sense of accountability in the management of natural resources if tangible returns are realized on investments of labour.
- Education and training are essential keys to success.

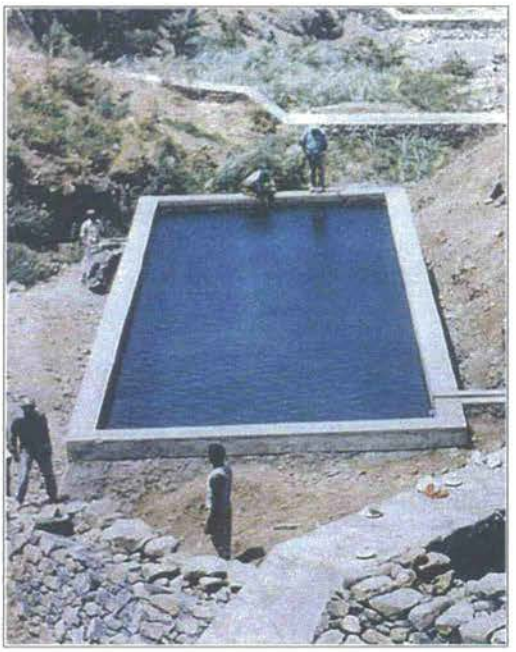


Compost pit and anti-erosion dykes in Pakoungou

Back from the Brink

Desertification Control through an Integrated River Basin Management Approach, São João Baptista Valley, Cape Verde

Country:	Cape Verde
Continent:	Africa
Ecozone:	Semi-arid
Source of funds:	UNSO (ear-marked funds fromNorway)
Number of people involved:	2,500 in eight different localities in the valley.
Cost:	USD 3m.
Years of operation:	1985-1994
Area involved:	50 km^2
Location:	S.J. Baptista Valley, Santiago Island



Construction of a catchment channel, reservoir and erosion control masonry

The Problem

The problem was two-fold: extreme aridity and extreme erosion, primarily by water. Irrigation made year-round agriculture possible, but was limited by the lack of arable land. Drought, livestock overgrazing and felling of trees for domestic use had by the mid-1970's virtually eliminated the natural vegetation.

The Solution

A large-scale, long-term programme was initiated in 1985 to plan and implement soil and water conservation measures, erosion control works and waterworks on the hill slopes and riverbeds. Working initially as paid labourers, local people were encouraged to take charge of the construction and maintenance work.

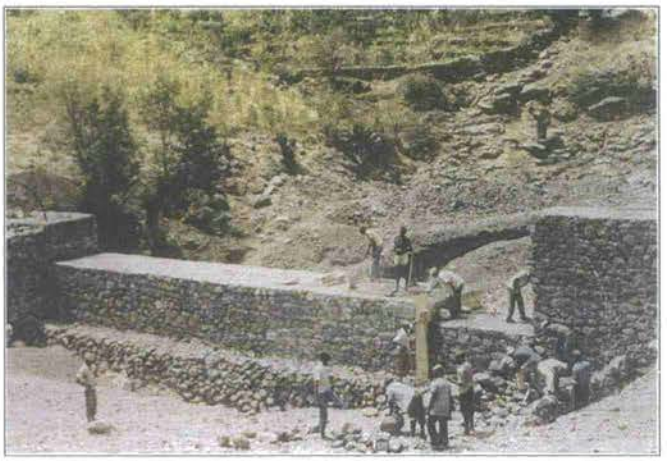
Results/Impact

A masterplan for the valley was prepared at the outset and updated after five years. Large areas were rehabilitated through the construction of 200 units of protective works, the establishment of 500 hectares of tree cover, 50 small irrigation works, one major dam and a number of access roads. Construction work created substantial income-earning opportunities for the local population. A revived cooperative and a newly-created village association were set up to manage and maintain the construction works.

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by UNDP/UNSO and local communities.

Sustainability

The reforestation and flood and erosion control measures can be considered to be highly sustainable, strengthened further by the sense of confidence engendered through economic improvements and the establishment of functional local organizations.



Construction of a major flood control dam and valley bank protection walls

Replicability

The project's integrated bio-physical approach to river basin management, and its principle of working simultaneously on flood and erosion control measures, were adopted at the national level. The project's local approach to problems and priority identification - the input of local knowledge and the contribution of local residents - generated considerable interest and admiration at regional and national levels.

Lessons learned

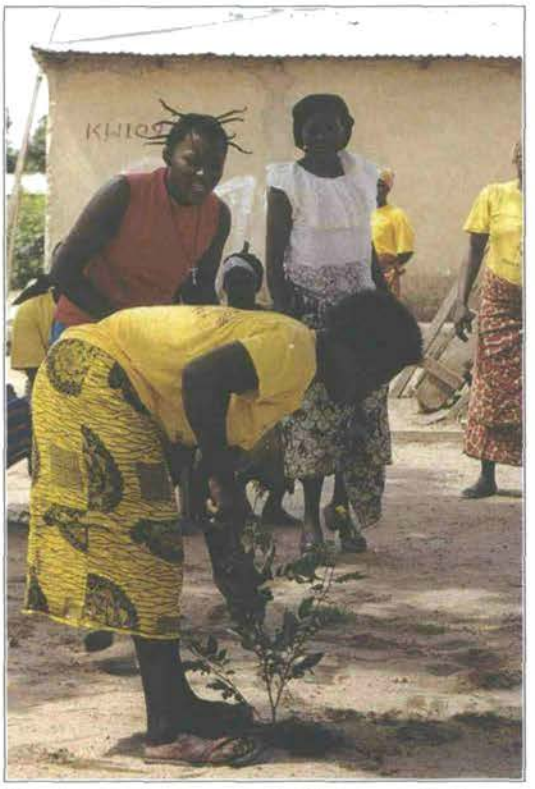
The project demonstrated that a holistic approach, combining bio-physical, socio-economic and participatory objectives, is both feasible and achievable, and has the potential to achieve significant success across all three areas.

Improved livelihoods through irrigation and flood control

Queens of Drama and Development

The Suntaa-Nuntaa Rural Women Project on Sustainable Livelihood, Environment Protection and Development, Upper West Region, Ghana

Country:	Ghana
Continent:	Africa
Ecozone:	Semi-arid
Source of funds:	Bread for the World,UNDP PHP
Number of people involved:	About 700,000 people, 76 Women's groups, 50 secondary schools
Cost:	USD 45,000
Years of operation:	1995-1997
Area involved:	18,476 km^2
Location:	Upper West Region



Drama group acting out a scene of conflict over tree planting

The Problem

The Upper West Region was one of the least developed regions in Ghana. Almost 90% of the population depend on farming for subsistence. The combination of high dependency on agriculture, erratic rainfall and dwindling vegetative cover resulted in low domestic incomes and perpetuated annual household food shortages in the rural areas. Due to population growth, fallow periods were reduced, resulting in soil degradation and a decrease in food production.

The Solution

The devastating effects of bushfires were tackled through environmental awareness and agroforestry practices. Special emphasis was placed on the involvement of women by creating and teaching women's groups. The project developed a local economics and trading system to ease household finance problems. In order to address resource management and other development issues, the project introduced a drama programme to communicate new ideas more effectively.

Results/Impact

Reforestation activities had significant tangible results. Theatre for Development programmes were established in all 76 women's groups. Suntaa-Nuntaa set up an experimental farm at its headquarters in Wa in order to demonstrate the feasibility of diversifying income-generating activities and provide training to interested individuals and groups.

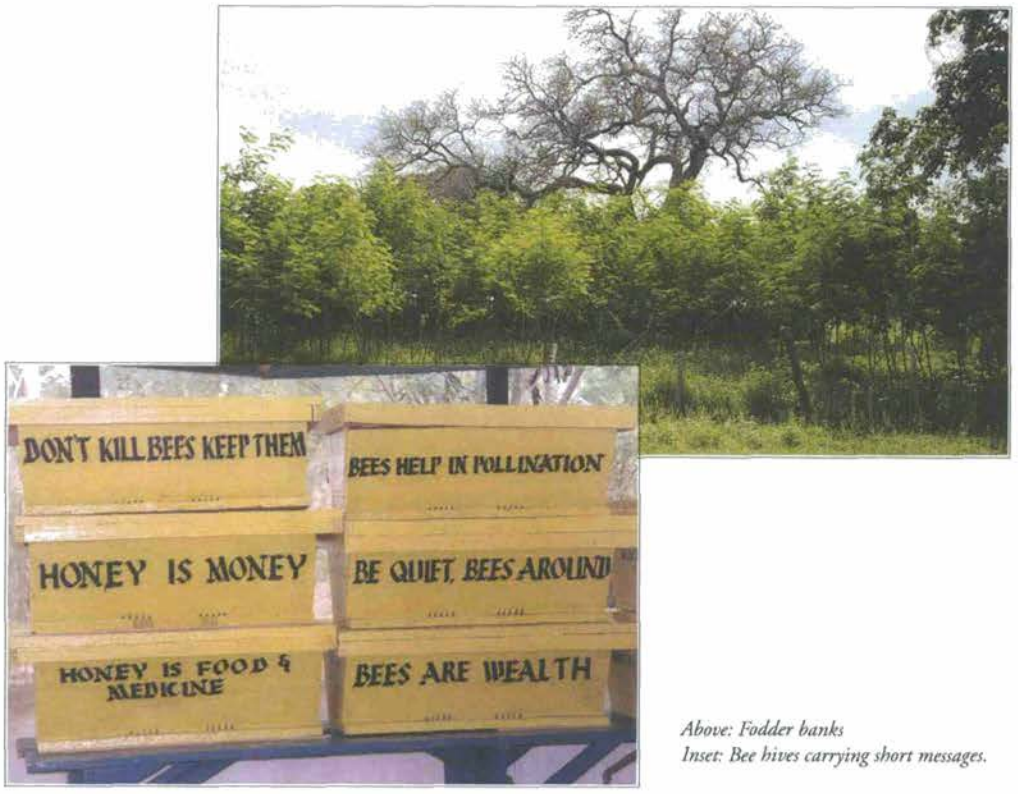
UNEP's "Saving the Drylands" award winner, 1999. This project was implemented by the Ghanaian NGO Suntaa-Nuntaa – "help one another, love one another" in Dagaari language.

Sustainability

The sustainability of activities is evident from the following elements: the introduction of income generating activities, the education of target groups for good management of new income, and the success of the drama for development due to its low cost, remarkable creativity and the new social space it has created for women.

Replicability

Prospects for replicability are high because of the growing role and importance of Suntaa-Nuntaa in the region's NGO sector, the rate of progress of women's groups supervised by Suntaa-Nuntaa, the solidarity chain of the traditional chena system, and the low cost, in time and money, of S-N's activities.



Above: Fodder banks
Inset: Bee hives carrying short messages.

Lessons learned

- Desertification control should be adapted to the conditions of stakeholders.

  Suntaa-Nuntaa managed to mobilize women by adopting formulas that respect local social values.

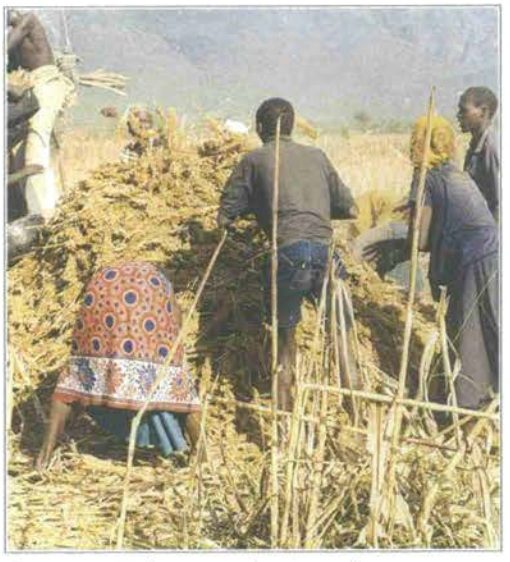
- Drama for Development was a strong lever for mobilizing and sensitizing communities with precise messages that are accessible to local people and likely to modify destructive behavior.

- State disengagement and the process of decentralization may be opportunities and not constraints in the development of local initiatives in fighting environmental degradation.

Water for Development

Building on Traditional Knowledge: The Wei Wei Integrated Development Project, Kerio Valley, Sigor, Kenya

Country:	Kenya
Continent:	Africa
Ecozone:	Semi-arid
Source of funds:	Government of Italy through the Italian Development Cooperation
Number of people involved:	1,800 people derive direct benefits
Cost:	Ksh 21 million at 1987 rates
Years of operation:	1987-1999
Area involved:	700 hectares
Location:	Sigor, West Pokot District, 510 km north of Nairobi



Community members at a sorghum harvest from irrigated land

The Problem

Based on livestock and small-scale agriculture, the local economy suffered as population growth led to severe decreases in plot sizes, in soil fertility (related to shorter regeneration cycles), and in already low agricultural incomes. The expansion of irrigated areas was limited by the low levels of technology available to farmers. Environmental degradation worsened considerably after a severe drought struck the Kerio Valley in 1984.

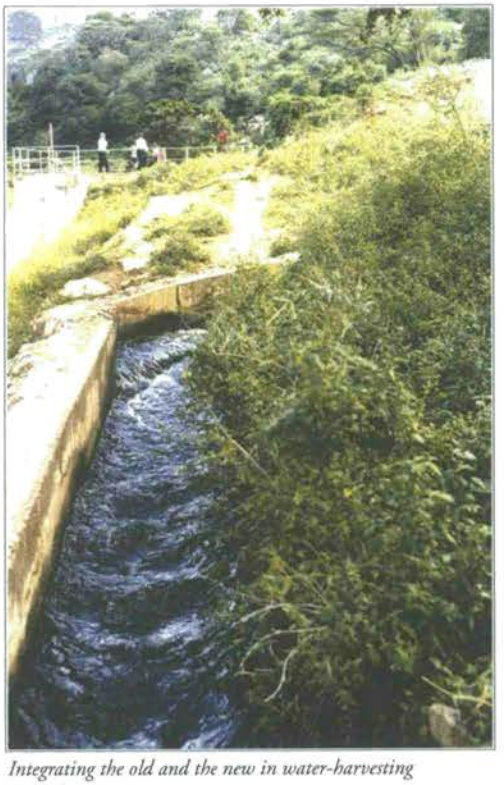
The Solution

The project set out to address these problems with the following goals:

- Extend cultivable lands through irrigation
- To intensify production systems
- To increase agricultural income
- to improve local living conditions

Results/Impact

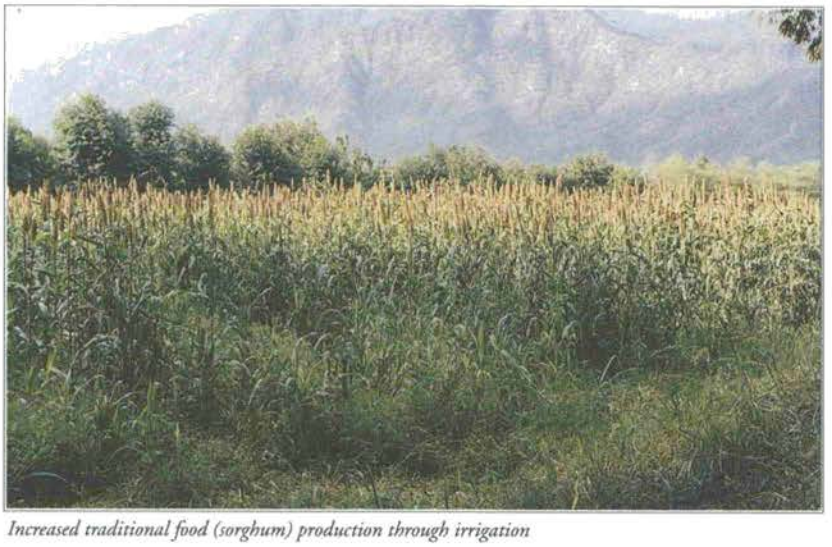
The project constructed an intake weir on the Wei Wei River, laid an underground pipeline network to distribute water through gravity fed sprinkler irrigation units, and set up a pilot farm to provide logistical support, equipment and other inputs to project farmers. Seven hundred



Integrating the old and the new in water-harvesting technologies

UNEP's "Saving the Drylands" award winner, 1999. The project was a co-operation venture between the Government of Kenya and the Italian Development Co-operation. It was planned and implemented by Lodagri (an Italian contracting and project management firm) and the Kerio Valley Development Authority.

hectares of land were reclaimed and improved, and 540 individual plots of 1 ha each were allocated and developed as small farms.



Increased traditional food (sorghum) production through irrigation

Sustainability

The project showed strong potential for long-term sustainability. The simple irrigation technology needs no external inputs, maintenance costs are minimal and there was little wastage of water from seepage and evaporation. There was also an unmistakable sense of ownership of natural resources among the farmers, which is critical for sustainability.

Replicability

The project also demonstrated excellent potential for replicability. Farmers in the project area were expanding their plots, while others outside of the project established their own irrigated plots in the vicinity of the scheme. The innovative gravity-fed sprinkler irrigation technology is cost-effective, as it requires little maintenance, and makes replicability a strong possibility in other districts of Kenya.

Lessons learned

- Communities become motivated to participate in a project if there are easily understood and tangible economic benefits to be derived from participating.
- There must be a balance of economic and environmental benefits.
- Project beneficiaries in Sigor have realised major social and economic benefits, which has fuelled their enthusiasm and attracted interest from neighbours.
- Environmental conservation came as a secondary benefit, but has also been readily accepted as a positive development.
- Projects that build on indigenous knowledge and practices also stand a better chance of achieving success.

Dryland Ranching Made Sustainable

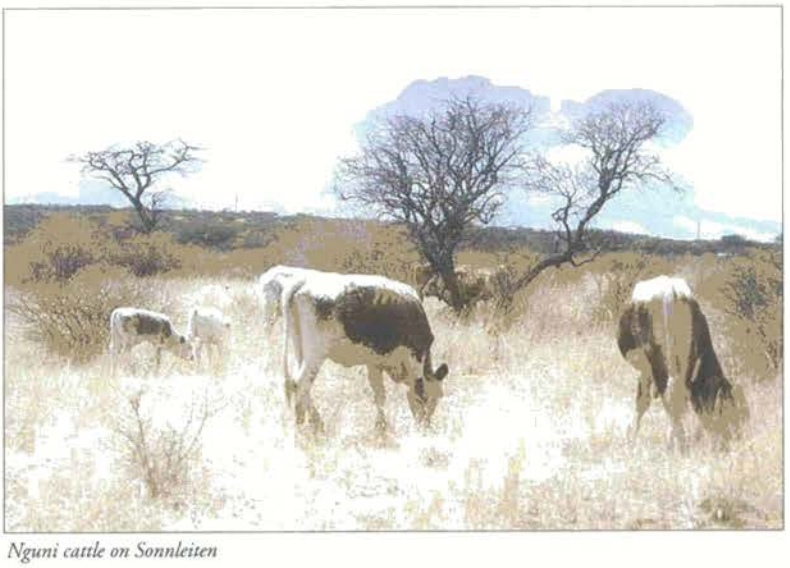
A Holistic Approach to Land Management, Sonnleiten Ranch, Namibia

Country:	Namibia
Continent:	Africa
Ecozone:	Semi-arid
Source of Funds:	Pivate
Number of people involved:	Rust family (6); Namibia Centre for Holistic Resource Management (50 members)
Costs:	data not available
Years of operation:	1983-1993
Area involved:	4,600 hectares
Location:	40 km east of the capital Windhoek

Grazea paddocks after the rains

The Problem

The grasses, soils, and water flows on the ranch had been deteriorating every year since 1967 because the traditional management system of large numbers of cattle resulted in soil erosion and reduced infiltration and seed germination in compacted soils. The family faced declining productivity and increasing debt.



Nguni cattle on Sonnleiten

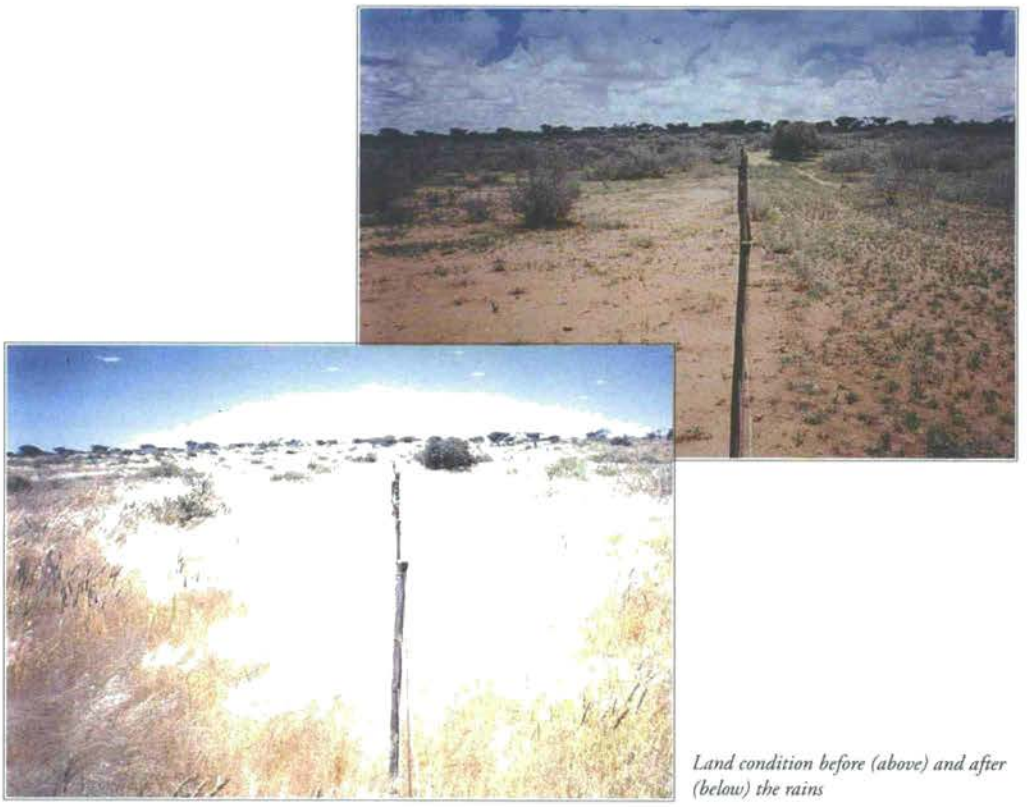
The Solution

In the late 1970s, the farm's owner learned about Holistic Resource Management (HRM) and decided to divide the land into smaller paddocks, grazed for only a few days at a time to avoid too much pressure on the fragile ecosystem. In order to ensure year-round breeding, he kept mixed herds crossed with the indigenous Nguni cattle, which helped to chip the soil. All operations to improve production were agro-chemical free.

UNEP's "Saving the Drylands" award winner, 1995. This private ranch project was implemented by the owners, Argo Rust family.

Results/Impact

Following the principles of HRM, the farmer moved from slow rotation of herds between large paddocks to rapid rotations on smaller areas. This resulted in better soil surface conditions for grass seed germination in the rainy season, greater retention of vegetation in the dry season, better distribution of manure and a sharp reduction in parasite problems. Net farm income per hectare increased by 200-1,000%.



Land condition before (above) and after (below) the rains

Sustainability

The general environmental state of the farm improved, with less soil erosion and gullying and greater diversity of flora and fauna. The whole operation was run in an environmentally-friendly manner.

Replicability

HRM is easily replicable for commercial ranches in similar environments. Accepted communal land rights are a necessary condition for the success of the farming methodology.

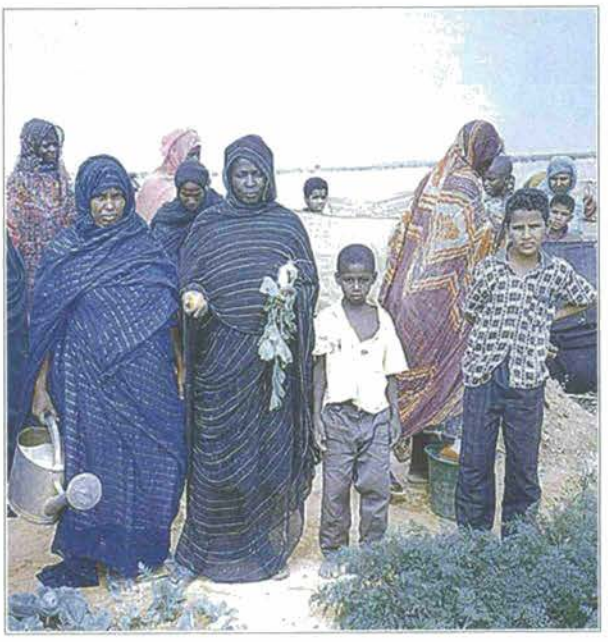
Lessons learned

- The passage of animal over ground can have a healing, regenerative effect.
- Dry environments require their soil surface to be disturbed by animal trampling so that decomposition of old plant material is accelerated.
- Overgrazing does not occur if the vegetation is grazed once and the animals moved, only to return after the grass has completely regrown.
- The ecological system must be treated as a whole.

Halting Encroaching Sands

The Sand Encroachment Control and Agropastoral Development Project, Mauritania

Country:	Mauritania
Continent:	Africa
Ecozone:	Arid
Source of funds:	Danida, UNDP/UNSO, WFP and the Government
Number of people involved:	Data not available
Costs:	
Years of operation:	1984-1992
Area involved:	8 "willayas" (regions)
Location:	Central Mauritania



Women and children watering a community garden

The Problem

Of the Sahelian countries, Mauritania is undoubtedly one of the most threatened by desertification, which dangerously affects the rural agropastoral economy and causes a vast rural exodus to towns and riverine areas. Desertification has increased the movement of sand dunes, threatening roads and human settlements as well as scarce pasture lands and oases.

The Solution

The project set out to develop techniques for mechanical and biological dune stabilization in the affected zones, and to train communities to control dune encroachment and desertification.

Results/Impact

The project succeeded in protecting agricultural and grazing lands, oases and infrastructure against sand encroachment through sand dune fixation, the establishment of windbreaks and village re-afforestation. Extensive soil and water conservation measures were undertaken. People moved back to abandoned villages, and there were significant improvements in the status of women, in access to markets, and in nutrition.

UNEP's "Saving the Drylands" award winner, 1997. This project was implemented by UNDP/UNSO and local communities .

A greenbelt windbreak halting sand dune encroachment

Sustainability

The project gave hope to populations who had abandoned their villages but were subsequently able to return as they mastered techniques of combating sand encroachment. This knowledge, as well as a strong sense of communal responsibility for the land, became deeply ingrained in local communities.

Replicability

Many villages not directly affected by the project's activities were encouraged to replicate dune fixation work, and often sought advice from project staff. The project developed a system with excellent potential for replication in other countries.

Green belt of trees protects a village from encroaching sands.

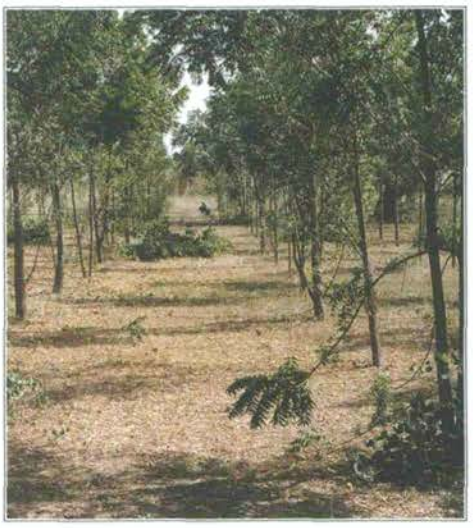
Lessons learned

Through a participatory approach, the project helped local women to organize themselves into independent production and management units, which proved extremely effective in spreading knowledge, enthusiasm and results throughout entire villages.

Greening Through Social Forestry

The Community Afforestation Project in Kano and Jigawa States, Nigeria

Country:	Nigeria
Continent:	Africa
Ecozone:	Semi-arid
Source of Funds:	World Bank and Federal Government of Nigeria
Number of people involved:	200,000 involved, but 8.4 million affected
Cost:	US$ 11.4 million
Years of operation:	1987-1994
Area involved:	no data available
Location:	Kano-Jigawa States



Individual neem woodlot

The Problem

The arid zone of Nigeria presents a very good picture of "The Encroaching Sahara": progressive declines in crop yields, increasing crop failures, increasing erosion, reduced percolation, shifting sand, falling biological diversity, dropping watertables and insufficient fodder. A decline in tree stocks in the zone was accompanied by the attendant problems of erosion and losses in soil carrying capacity.

The Solution

The main objectives of the project were: 1) to strengthen the forestry sub-sector through research, improved policies and training; 2) to encourage protective and rehabilitative forestry, and 3) to mobilize local communities to plant trees and conserve fuelwood.

Results/Impact

The project established 541 km of shelterbelts, 2,639 tree nurseries, 2,842 hectares of woodlots, 493 ha of orchards, 3,600 ha of natural regeneration sites and 737 km of roadside planting. On the social forestry side, the project mobilized 119,300 contact farmers, 2,104 self-help community organizations and 2,656 schools and forestry clubs. The benefits included better soil conservation, improved soil fertility, increased crop yields and supplies of fuelwood, fodder and poles, new jobs, increased awareness of the benefits of afforestation and improved nutrition through fruit production.

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by the Nigerian Government (FORMECU) and local communities.

Sustainability

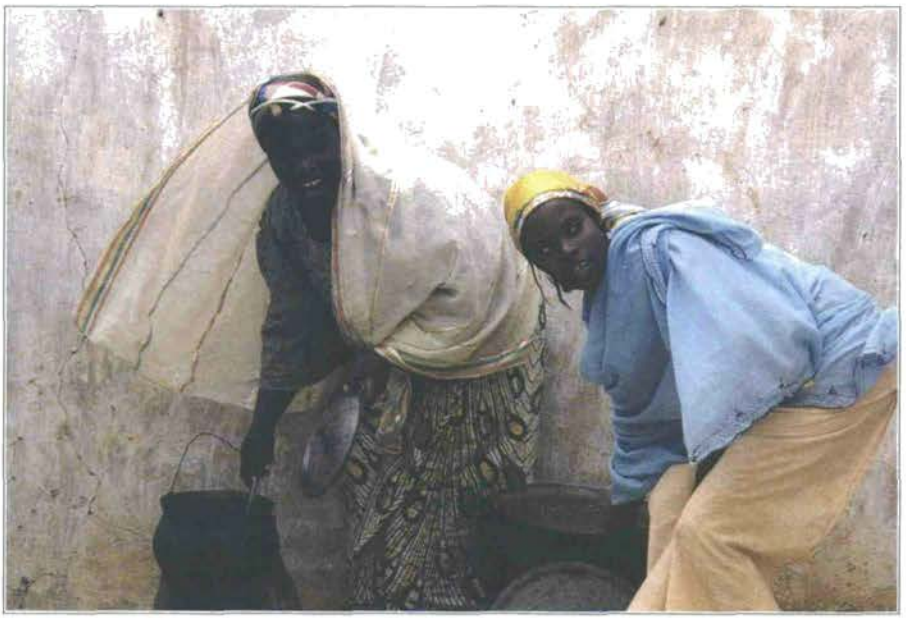
Although there was an observed lack of community participation in the initial stages of the project, in the final analysis the commitment of policy makers, implementers, individuals and the local community was very high. Sustainability is assured by the high level of awareness among stakeholders about the causes of desertification and the means to control it.

Replicability

Many neighbouring farmers adopted the practice of planting trees, and women outside the project area started using fuel-efficient stoves and planting orchards. The project is replicable in other countries with similar land-use, vegetation, cultures and climate.

Lessons learned

- It is important to identify and involve stakeholders in the planning and implementation of afforestation projects in order to create a sense of ownership.
- Providing cash and material incentives for participation is not necessarily effective in ensuring lasting farmer support.



Women demonstrate how to light a fire with efficient stoves

Restoring Hope

Environmental Protection and Rehabilitation in Louga, Northern Senegal

Country:	Senegal
Continent:	Africa
Ecozone:	Semi-arid
Source of funds:	RA 2000/UNDP WVI, Senegal
Number of people involved:	560 rural people
Cost:	52 boreholes:USD 52,000 USD 40,000 Agroforestry activities
Years of operation:	1989- 1993
Area involved:	1,700 hectares of bare sandy plains
Location:	Louga, Village: Land at Par Cisse and Keur Sidy Mbenque, 200 km north of Dakar

Salan shrub fencing for erosion control

The Problem

The Louga Region suffered from severe ecological imbalance as a result of repeated droughts, pest plagues, the unsustainable practice of shifting monoculture groundnut plantations, overexploitation of natural resources by political leaders and inappropriate agricultural policies. This resulted in chronic degradation of soils, the gradual desertification of land, mass rural exodus and the impoverishment of pasture land.

Solution

The project sought to revive the traditional Tokeur system of land management, and to provide training programmes on environmental protection and conservation, income generation, and literacy, especially for girls and women.

Sand encroachment

UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by World Vision International (WVI), Senegal and local communities.

Results/Impact

Access to more abundant and lasting groundwater improved considerably, and cash incomes from potato production rose dramatically. Farmers gradually covered the whole of the area with small family-sized agroforestry sites, containing thousands of protected young *Acacia albida* trees.

Trees planted on community land

Sustainability

The development of small private holdings stopped the practice of shifting agriculture and slowed the advance of desertification. The continuity of activities is assured by networks of bush consultants and technicians who were trained and equipped by the project.

Replicability

Replicability of the project's achievements is possible, though with certain financial limitations. Records of financial inputs were unavailable, and no cost-benefit analysis could be carried out. However, information gathered from adjacent villages indicates that many area farmers want to become part of the project's assistance scheme.

Lessons learned

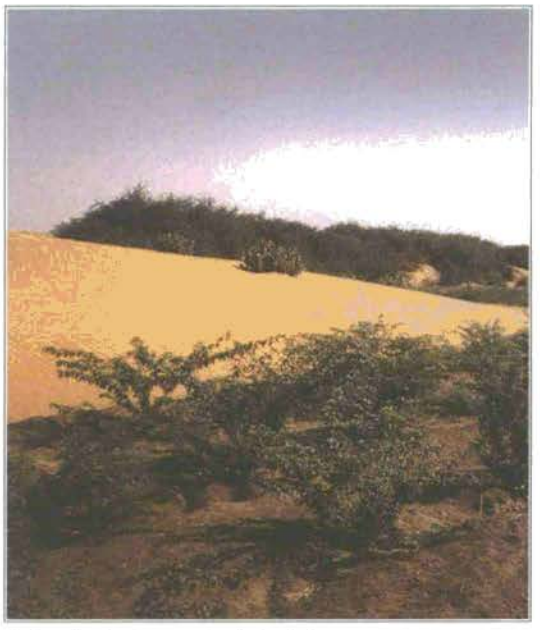
The success of this project is largely due to an approach that helped people to recognize resources within themselves and their communities, used bottom-up approaches and techniques, and stimulated community involvement, support and accountability.

Fruit production at the village level

The Fertile Desert

The Community Forestry Project, Ed Debba, Sudan

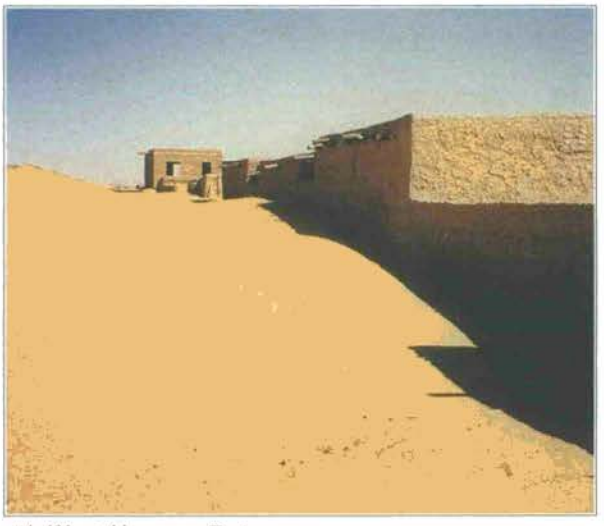
Country:	Sudan
Continent:	Africa
Ecozone:	Arid
Source of Funds:	IFAD, Rotary 3H, Dutch Government
Number of people involved:	28,600 in 23 villages
Cost:	UK £ 1, 215,000
Years of operation:	1988-1995
Area involved:	2,800 hectares of farmland
Location:	On the banks of the Nile, near Ed Debba, Northern Province



A dune fixed using mesquite shelter belt

The Problem

Several of the highly fertile areas along this stretch of the Nile were gradually being buried by encroaching desert sand. Mobile dunes crept forward onto cultivated land, damaging crops and machinery, filling wells and canals and burying houses. The process of desert encroachment was exacerbated by tree cutting, overgrazing and the control of river flooding.



A half-buried house near Tegris

Solution

In order to fix dunes, rehabilitate land and conserve soil and water, comprehensive protection measures were introduced around cultivated areas and settlements to reduce wind velocity. By building on indigenous knowledge and experience, the project attempted to introduce sustainable and cost-effective solutions.

UNEP's "Saving the Drylands" award winner, 1996. This project was implemented by SOS Sahel and local communities.

Results/Impact

Shelterbelts and windbreaks stabilized mobile dunes, protecting farmland and homes and demonstrating to communities that they can protect their environment. The project's extension programme was successful in raising awareness of the benefits of trees among all sectors of the community.

Sustainability

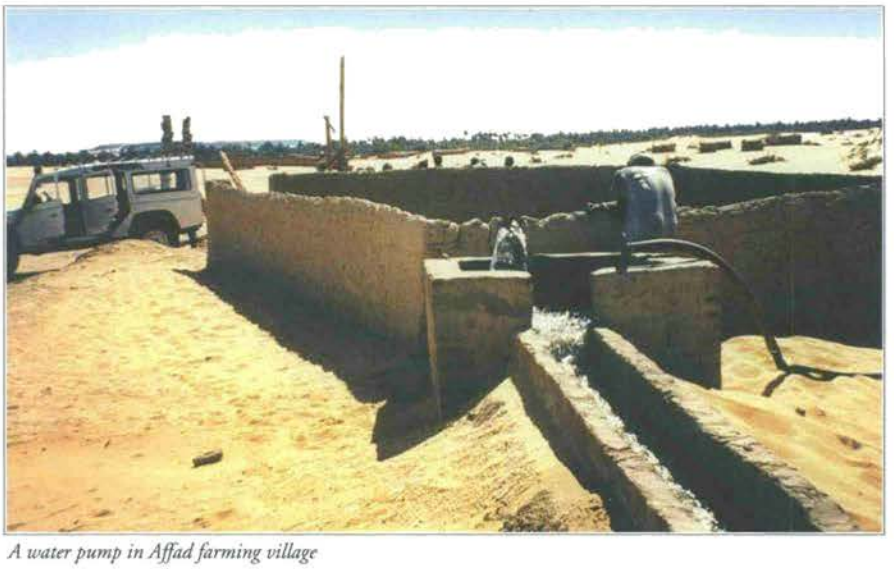
The people themselves dug the wells and planted and protected the trees in order to stabilize the dunes. They valued and protected what they have achieved. The effects of the project will last long after the project has ended.

Replicability

SOS Sahel worked in close co-operation with the Sudanese Ministry of Agriculture and the Forestry Department (FNC), and senior staff were seconded to the project from the FNC. The experience of participatory extension techniques they have gained from the project will be valuable input into their future work, and that of the FNC as a whole.

Lessons learned

- Both biophysical and socio-economic solutions appear to be the most cost-effective way of dealing with environmental problems such as desert encroachment.
- A participatory approach to development, with donors and communities working together closely, is the surest way of achieving viability of projects, as the target group's priorities may change when disasters strike.
- In rural Africa, conservation, rural development and political empowerment are inseparable.

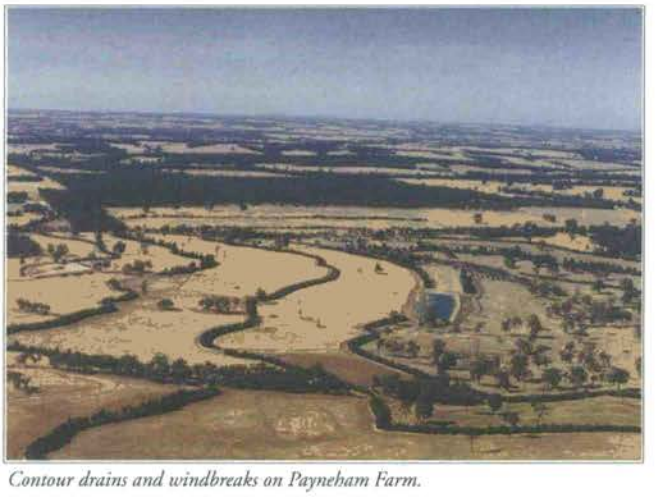


A water pump in Affad farming village

Farming Within the Environment

The Whole Catchment Approach to Land-Use and Management in Southwestern Australia

Country:	Australia
Continent:	Australia
Ecozone:	Semi-arid
Source of funds:	Private
Number of people involved:	One family
Cost:	Not available
Years of operation:	11 years
Area involved:	540 hectares
Location:	Frankland, Western Australia



Contour drains and windbreaks on Payneham Farm.

The Problem

The project area suffered from soil degradation and the combined effects of waterlogging, salinity, acidity, nutrient imbalance, wind and water erosion and loss of fertility, resulting in poor water quality, reduced biological diversity and declining farm incomes.

Payneham Farm before the holistic approach treatment

The Solution

A 'whole farm' plan was designed to reduce winds and remove surplus water in order to improve soil structure, slow soil erosion and prevent waterlogging and salinity. The aim was to determine the causes of land degradation on the farm and reduce their influence by implementing a comprehensive series of inter-related land management practices.

Results/Impact

The project improved access to a secure, quality water supply through the construction of 10 km of deep drains and capacity dams. It expanded the range of crops and increased overall yields. Natural barriers, such as planted windbreaks, protect livestock and crops from wind and heat.

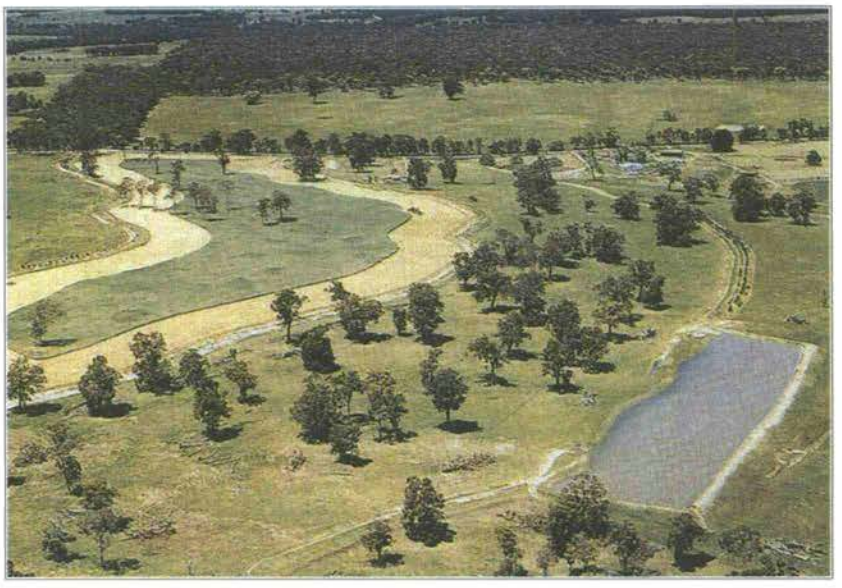
UNEP's "Saving the Drylands" award winner, 1995; UNEP's Global 500 Winner, 1996. This private ranch project was implemented by the owners, Ron and Suzanne Watkins.

Sustainability

The whole farm management system is both innovative in its approach and appropriate to local problems. Specific aspects of the system, such as windbreaks and dams, are fixed assets that will add value to the farm and improve its output for many years to come. Sustainability was guaranteed because of ownership of the intervention.

Replicability

The project was replicated by more than 20 farmers in Western Australia, with a waiting list for basic training in the method. The concept is adaptable for manual labour in developing country situations.



A contour check dam stores water for irrigation

Lessons learned

The causes of land degradation problems are very complex, including a wide range of interacting geological, geographical and hydrological factors that must be addressed in a holistic manner.

Reclaiming Wasteland

Harnessing Summer Floods for Afforestation and Salinity Control Using the Tamarix Bush in Western China

Country:	China
Continent:	Asia
Ecozone:	Arid
Source of Funds:	People's Government Xinjiang Autonomous Region
Number of people involved:	120,000 in eight villages
Cost:	USD 205,000
Years of operation:	1983-1990
Area involved:	160,000 hectares
Location:	Cele County, on the southern fringe of the Taklimakan Desert

Preparation of ditches for Tamarix cultivation under flooding

The Problem

Cele County was threatened by an invasion of drifting sand from the north. Rapid population growth and excessive cutting of natural forests sped the process of desertification. 100,000 mu of farmland was abandoned, resulting in massive financial losses and serious social upheaval.

The Solution

The major objectives of the project were to control the forward movement of the dunes that were threatening to inundate Cele, to reclaim 60 ha of agricultural land, and to rehabilitate 4,000 ha of degraded forest on the periphery of the Cele oasis. The project employed voluntary labour from the beneficiary communities to encourage a sense of ownership of the project.

Results/Impact

Through water conservation measures, the creation of irrigation canals, and the planting of extensive windbreaks of fast-growing trees, 10,000 mu of desertified land was recovered from the desert. Large quantities of fuelwood, fodder, fruits and grain were being produced on a sustainable basis. Agricultural and livestock yields more than doubled. The situation of "desert advances, man retreats" was reversed.

UNEP's "Saving the Drylands" award winner, 1995; UNEP's Global 500 Winner, 1996. This project was implemented by the Xinjiang Institute of Biology, Pedology and Desert Research and local communities.

Sustainability

The project introduced long-term sustainable management systems for rehabilitating forest areas and agricultural lands. Strong local community involvement in the maintenance and repair of project works further encourages sustainability.

Replicability

A Comprehensive Protection System model was developed specifically for the environmental conditions in Cele County. While the complete model had not been replicated in other areas, components of this system, such as the rehabilitation of land for agricultural use between parallel windbreaks, were applied in other similar localities.

Fuelwood from Tamarix plantations

Lessons learned

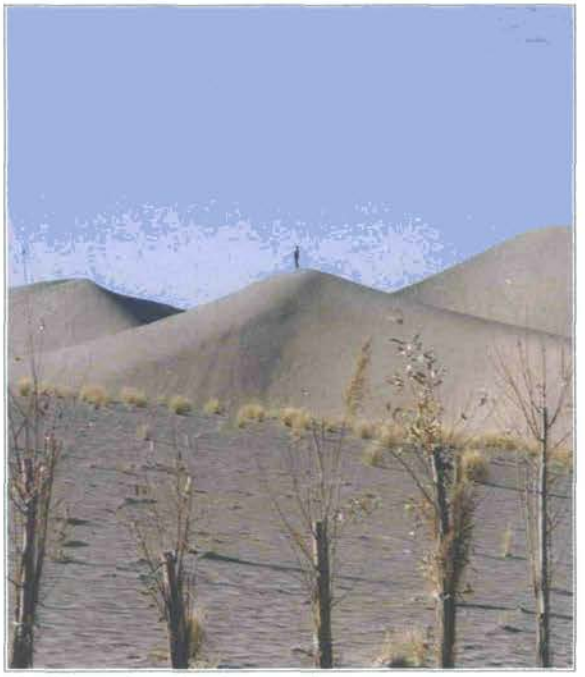
- The chances of success improve tremendously when field-level technical staff are given consistent support by scientific staff.
- Replicating the project requires an adaptation of the applied technologies to specific physical, financial and social conditions.
- Local institutions must be capable of convincing the local people of the benefits of participating in the project.
- In order to win the enthusiastic support of local people, it is important that project benefits are not confined to environmental protection alone.

Products manufactured from Tamarix

Shifting Sands

Controlling Drifting Sand in Cele County, Western China

Country:	China
Continent:	Asia
Ecozone:	Semi-arid
Source of Funds:	Local Communities with
Number of people involved:	420
Cost:	5,000 RMBY
Years of operation:	1986-1995
Area involved:	1,800 hectares
Location:	Naimanqui Banner



Sand dunes and windbreak vegetation barriers

The Problem

Due to heavy pressure on environmental resources from soil erosion, overgrazing of livestock, unsustainable rates of fuelwood collection and a growing population, the vegetation in the area had been largely destroyed. More than 85% of the total area of the village was desertified; 76.9% was dominated by mobile sand dunes. Cultivated land and rural roads were covered by shifting sand. Crops were often destroyed by severe winds. The project village was one of the poorest in Naimanqui Banner.

Solution

The project sought to help farmers to develop agricultural practices better suited to the fragile ecosystem, and to refine traditional practices in land degradation control. Goat farming, for example, was banned because of the animals' destructive browsing habits.

Results/Impact

After years of difficult farming in desertified conditions, farmers in the project area managed to improve their living conditions and financial situations by adopting a wider variety of crops and diversifying animal husbandry. Significant improvements included better soil surface conditions, more retention of vegetative cover in the dry season, wider distribution of manure, and more efficient use of water.

Sustainability

UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by the Xinjiang Institute of Biology, Pedology and Desert Research and local communities.

The long-term sustainability of the experiment will be determined by the environmental impact of possible water pollution from agro-chemicals. The increasing use of chemical fertilizers and pesticides could lead to the build up of residues in this delicate eco-system.

Replicability

Sustainability and replicability were limited by weak participation of the local people in the design, implementation and evaluation of the interventions. There had been no participatory planning prior to implementation.

Lessons learned

One of the most important factors that contributed to the limited success of the project was the linkage that was developed between the research team and the township administration on the one hand, and between township officials and village leaders on the other.

Biological barriers against encroaching sand

Grass barriers reduce wind velocity near the ground surface

Increasing Productivity on Fragile Soils

Comprehensive Desertification Control in Naimanqui Banner County, China

Country:	China
Continent:	Asia
Ecozone:	Arid
Source of Funds:	Xinjiang Uygur Autonomous Region and local government
Number of people involved:	200,000 farmers and 30 scientists and technicians
Costs:	USD 3,376,800
Years of operation:	1986-1992
Area involved:	40,000 hectares
Location:	Three counties in Hotan Prefec-ture, in the south-west of Xinjiang Uygur Autonomous Region, western China and in Jiashi County.

Impact of wind erosion on forest plantations

The Problem

Communities in the Tarim Basin, Xinjiang, depended largely on desert vegetation for their daily fuel needs. Thus much of the natural vegetation had been destroyed, particularly the Tamarix shrub forest, allowing wind, sand and increasing levels of soil salinity to cause further damage.

The Solution

After close consultation and cooperation with local forestry authorities and communities, the sandy and saline soils were replanted with hardy, drought-resistant and salt-tolerant Tamarix shrubs.

Results/Impact

Tamarix shrub forests were established on over 40,000 hectares of sand and heavily saline soil in Cele, Yutian, Mingfeng and Jiashi Counties over a period of 7 years. Damage caused by wind, sand and salinity was reduced, the fuelwood problem eased and local ecological and economic situations became dramatically healthier.

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by the Institute of Desert research, Lanzhou and local communities.

Sustainability

Factors that contributed to the success of the project, and suggest long-term sustainability, include the planting system's technical simplicity and effectiveness, an overall cost-benefit ratio of about 1:10, the existence of well organized local institutions into which all households were integrated, and the established rural practice of households contributing voluntary labour for work with a communal benefit.

Replicability

The technology employed by the project was adopted in 50 counties throughout Xinjiang, as well as in the counties of Anxi and Dunhuang in neighbouring Gansu Province.

Establishment of rice paddy on sand dunes

Lessons learned

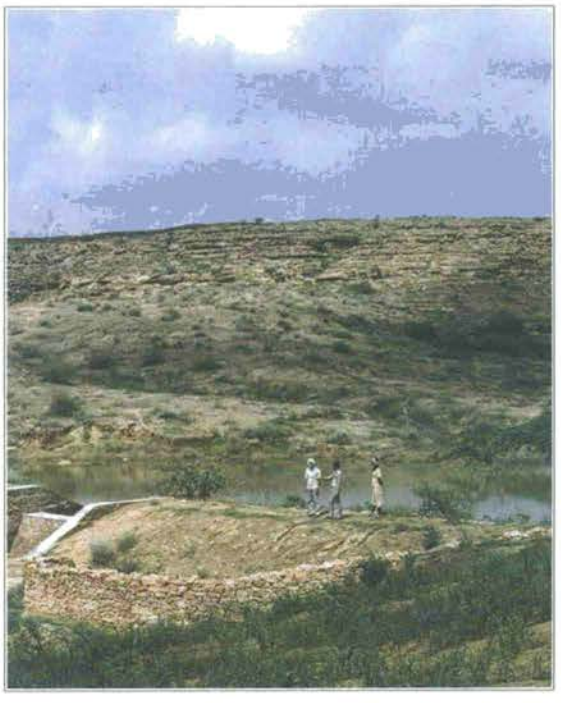
- The technology must be simple enough to be easily understood and implemented by local people and technicians.
- Any given technology is more attractive when there is sufficient flexibility to adapt it to local physical conditions and available financial resources.
- In order to win the enthusiastic support of local people, economic improvement must be a core goal.

Use of grass and shrubs to stabilize sand dunes

Rehabilitating Vital Watersheds

Integrated Management of Jhanwar Watershed, Shiwalik Hills, India

Country:	India
Continent:	Asia
Ecozone:	Arid
Source of Funds:	Government of India under DPAP/ Desert Development Programme
Number of people involved:	148 families in 4 villages
Cost:	Rs 1.7 million
Years of operation:	1987-88 to 1992-93
Area involved:	4,600 hectares
Location:	Western Rajasthan, 25 km south-west of Jodhpur



Community water dam

The Problem

Due to population growth and land allocation, plot sizes were small, and harsh biophysical conditions translated into very low crop yields. Overstocking was degrading communal grazing land. An acute scarcity of fodder and fuelwood prevailed.

Winter cropping

Solution

The project focused on engineering solutions, new dryland agricultural techniques and strong community participation to introduce an integrated sustainable production system over the entire watershed.

UNEP's "Saving the Drylands" award winner, 1996. This project was implemented CAZRI , the Sate Department of Soil Conservation and local communities.

Results/Impact

Multi-purpose shelter belts protected against wind and water erosion and provided fencing material, fuelwood and fodder. Water storage capacities were increased and community grazing land rehabilitated. There was a dramatic increase in crop yields, livestock productivity, and local incomes.

Sustainability

Besides the project's positive sustainable influence on the agricultural and socio-economic situation in the area, it had a considerable impact on policy, as evidenced by the adoption of integrated watershed management in national land use plans.

Replicability

The technological interventions of the project have high replicability under similar agro-ecological situations. More than 100 watershed development projects were under development in Rajasthan and Gujarat states.

Community water dam

Lessons learned

No fixed package of development should be thrust upon the inhabitants of a project area. Rather, various technology options should be made available so that people can select and adapt the most attractive and appropriate solutions for their particular situation.

Returning Forests to Communities

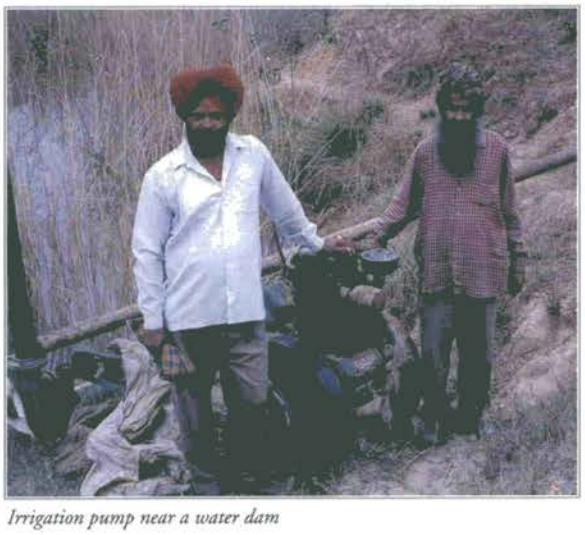
The National Joint Forest Management Project, Haryana Province, India

Country:	India
Continent:	Asia
Ecozone:	Sub-tropical
Source of Funds:	Ford Foundation; Government of Haryana India
Number of people involved:	65 villages
Cost:	Not available
Years of operation:	1990-1996
Area involved:	20,000 hectares
Location:	Haryana State

Dam used for water harvesting and pisciculture

The Problem

The main problem was uncontrolled exploitation of forest resources, which play a vital role in the socio-economic well-being of the rural population. Intense, uncontrolled grazing pressure, consequent loss of vegetation and severe soil erosion and decreased agricultural productivity all led to increased pressure on forests.



Irrigation pump near a water dam

The Solution

Community participation was elicited for voluntary protection, regeneration and sustainable management of degraded forest by adopting various strategies and incentive mechanisms. Training and capacity-building at the community and Forest Departments levels addressed issues of equity, gender sensitivity and other institutional measures.

Results/Impact

Some of the positive outcomes attributable to the project include tree regeneration, increased yields of non-wood forest produce, reductions in surface run-off and recouping of biodiversity. Additionally, yields of the commercial grass bhabbar and other forage grasses and tree stocking increased. Soil quality improved.

UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by Tata Energy Research institute (TERI) and local communities.

Sustainability

Forest productivity increased with protection offered by the community. The continuity of the communities' involvement in protection was ensured through incentives and benefits at the household level. Empowerment of marginalised sections of society, and especially women, was very sustainable.

Replicability

The JPFM was being implemented in 17 other states across the country, covering nearly two million hectares of degraded forest areas.

Lessons learned

The following contributed to the success of the project:

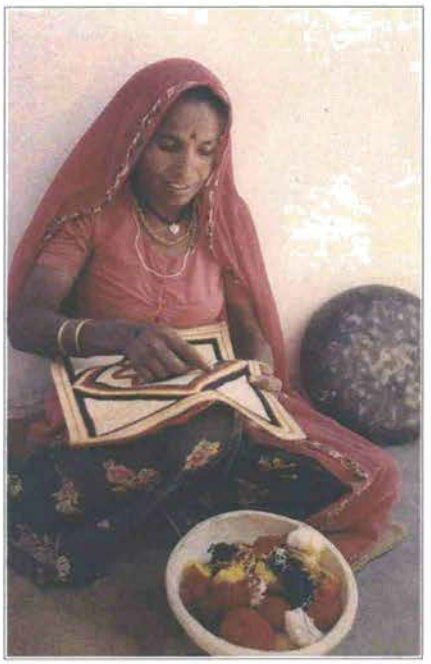
- Effective collaboration involving the community, the State Authority and TERI, a facilitating agency.
- Provision of key incentives, which linked economic interests to sustainable development.
- Equitable distribution of benefits.

Above and below: Sustainable fuelwood and fodder harvesting

The Barefoot College

Integrated, People-focused Approach to Environment Conservation and Development - The Social Work and Research Centre, Rajasthan, India

Country:	India
Continent:	Asia
Ecozone:	Semi-arid
Source of Funds:	Foreign sources and Government of India (50/50)
Number of people involved:	100,000 people in 110 Villages
Cost:	USD 4.2 illion
Years of operation:	10 years
Area involved:	82,349 km^2
Location:	Tilonia Village in the desert State of Rajasthan



Community craft-making

The Problem

The area was affected by severe degradation of natural resources, high levels of illiteracy and poor health facilities for lower castes and women. The project initally faced resistance and hostility from local people who were opposed to change.

Solar panels provide lighting and power the telephone exchange

The Solution

The long-term solution was to demystify helpful new technologies and knowledge through education, as well as strengthening the position of women. In order to stop the erosion of natural resources, wastelands were to be reclaimed with trees and pasture.

Results/Impact

Founded in 1972, the Barefoot College established strong programmes in water, education, health, social forestry, agriculture, animal husbandry, gender, communications, rural industries, and literacy. New income possibilities and markets were provided and quality water secured through storage tanks and pipes.

UNEP's "Saving the Drylands" award winner, 1998. This project was implemented by the Barefoot College, Tilonia, and the local communities .

Sustainability

The Barefoot approach is sustainable because it depended from the very beginning on the skills, knowledge and practical wisdom of the local people themselves rather than urban experts.

Underground water storage at the SWRC compound

Replicability

Many Barefoot College programmes have been replicated in communities all over India. Worthy of specific mention are the Education Programme, the Solar Energy Programme, the Women Programme and the Rural Drinking Water Supply Programme.

Lessons learned

- Conversion from water pumps to piped water systems vastly improves quality of life for the poor.
- Sustainable innovations that use locally available resources tend to have much higher adoption rates.
- The community must be accessible to ensure the development of a responsive institutional framework.

Constructing a water storage tank

Solar power for water heating

Piped water for communities

Integrated Wasteland Development

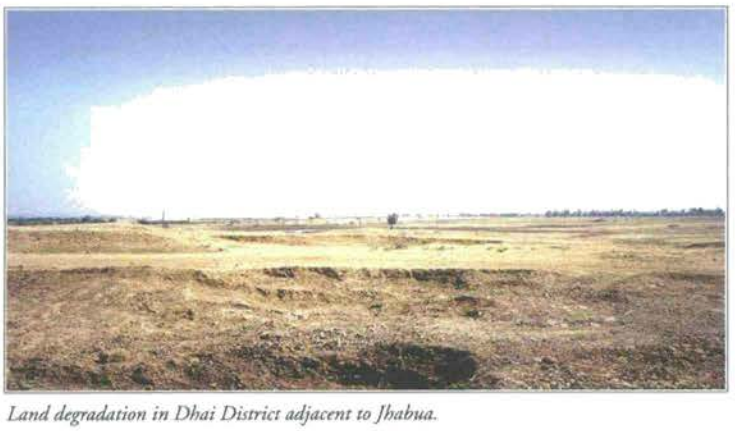
The NCHSE Experience in Madhya Pradesh, India

Country:	India
Continent:	Asia
Ecozone:	Semi-arid
Source of fund:	Government of India, National Tree Growers Federation of india, Gas Company of India
Number of people involved:	3,084 people in 6 villages
Cost:	USD 129,710
Years of operation:	1991-1994
Area involved:	Total watershed area: 2,421 ha Degraded wastelands to be treated: 507 ha
Location:	Madhya Pradesh, Jhabua District, 350 km west of Bhopal

Fodder for household use

The Problem

Until the 1950s, the area was heavily covered by teak and bamboo forest. The indigenous tribal population subsisted largely on forest resources and remained relatively isolated from wider Indian society. As a result of an intense and prolonged period of deforestation, there was a severe and dramatic change in local ecosystems and climate, with an equally drastic impact on the population. The district suffered from the effects of severe soil erosion, overgrazing and inappropriate land-use practices. Climate had changed from sub-humid to semi-arid.



Land degradation in Dhai District adjacent to Jhabua.

The Solution

The project sought to create 247 ha of forest on community land, rehabilitate 120 ha of community pasture land, assist in creating 50 ha of plantations on private land, distribute free seedlings and encourage water conservation in three villages.

Results/Impact

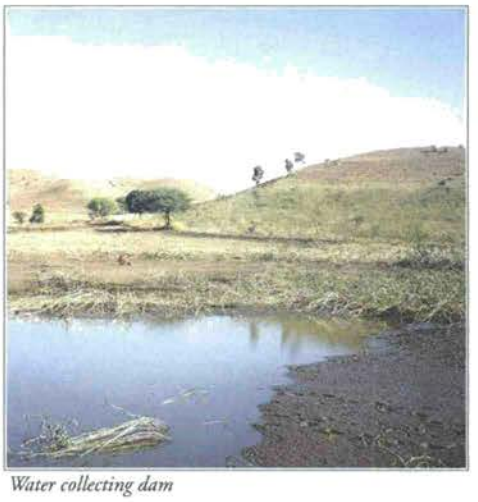
The project was largely successful in its objective of restoring agricultural land, controlling soil erosion and increasing water supply from water harvesting. Rehabilitated communal pastures gave better yields,

UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by the National Centre for Human Settlements and environment (NCHSE)and local communities.

increasing incomes from the sale of fodder grass, bamboo and eucalyptus poles. Two hundred and forty-seven hectares of land were reforested with indigenous trees. Locally-manufactured fuel-efficient stoves cut fuel requirements in half.

Sustainability

In both design and practice the project took into account the social and economic needs of the community, and as time went on, it was gradually taken over by community members who were eager to expand the improvements on their land.



Water collecting dam

Replicability

Madhya Pradesh has the largest tribal population of any Indian state, and is the leader on "minority issues" in the sub-continent. If projects such as these are successful here, there is a strong likelihood that they can serve as a practical model for similar projects in other parts of the country. The applied techniques were already being replicated by private farmers in neighbouring states.

Lessons learned

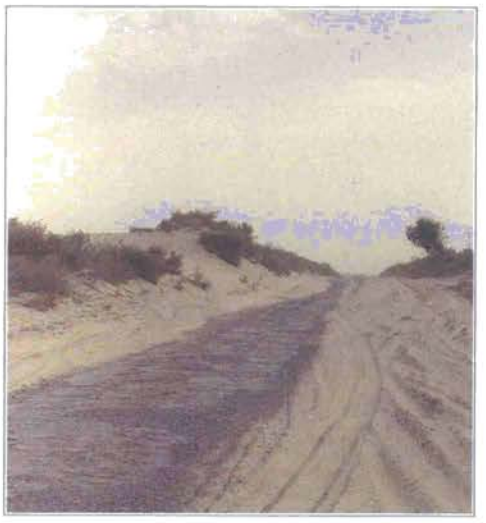
- The strength of the project's design lies in its broad-based, integrated approach, premised on the need to fully understand the target communities, their resources and local land-use potential.
- A central goal of the project was to inform itself about the area, and this process of data-collection and information gathering helped transform the project from one that imposed top-down solutions to one that embraced a strong needs-based approach.

Water conservation and afforestation in Jhabua

Reclaiming the Desert

Using shelterbelts in Thal, Pakistan

Country:	Pakistan
Continent:	Asia
Ecozone:	Arid
Source of Funds:	Government of Pakistan and local farmers
Number of people involved:	50 villages
Cost:	Not available
Years of operation:	15 years
Area involved:	20,000 hectares
Location:	Thal Desert, Punjab



Encroachment of moving sand onto roads

The Problem

The Thal is a tropical sandy desert spread over 2 million hectares. More than 90% of the area consists of varying depths of sand. Strong winds blow in different directions throughout the year, moving large amounts of sand. Indiscriminate grazing of livestock and ruthless cutting of trees and shrubs exacerbated the situation.

Cropping between planted windbreaks

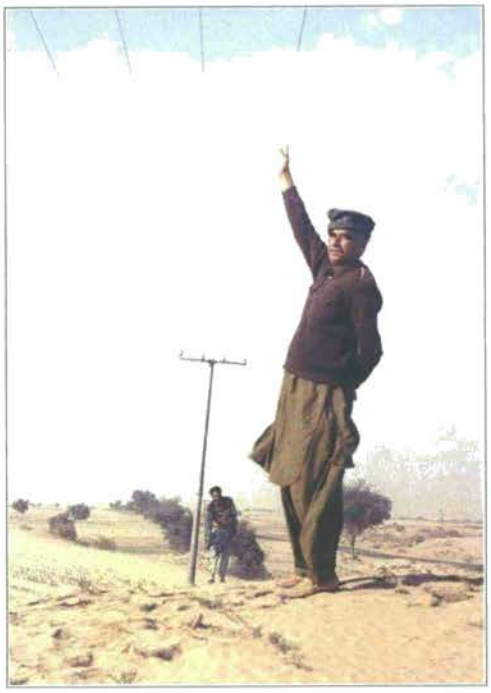
The Solution

The project sought to establish tree windbreaks and woodlots to protect crops and infrastructure from scorching, sand-laden winds. Canals and tube wells were designed to increase access to irrigation water. The project used tax incentives to encourage the uptake of conservation activities.

Results/Impact

About 20,000 ha of desert was reclaimed and is now under cultivation. A wide variety of crops, including wheat, barley, pulses and even vegetables were being grown. The intensity of sand storms decreased. Reclamation also made the area suitable for the production of timber and fuelwood, which increased farmer incomes dramatically.

UNEP's "Saving the Drylands" award winner, 1995. This project was implemented by Pakistan's Rangelands Research Institute and local communities.



Telephone poles gradually buried by sand

Sustainability

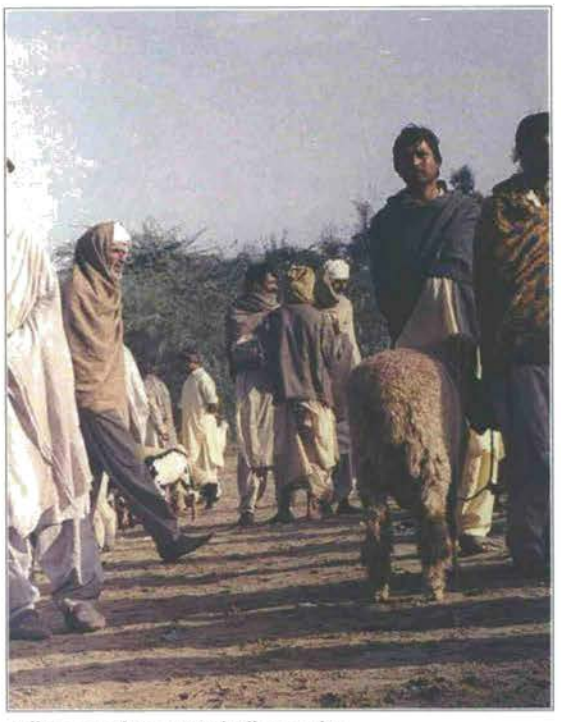
The project converted a desert-ecosystem into an agriculturally productive ecosystem by using simple but efficient technologies. This helped to decrease the work load of community members and of women in particular. There was good lateral transfer of technology and knowledge from smallholder farmer to smallholder farmer. Nonetheless, the sustainability of the achievements was threatened by serious problems of waterlogging and salinity, which had yet to be addressed in a satisfactory manner.

Replicability

The approach and techniques of the project were being replicated beyond the project area, mainly due to quick economic returns.

Lessons learned

- Land reclamation in desert areas by tree planting is possible, provided that water for irrigation is easily accessible.
- Farmers respond positively to adopting new innovations that have tangible benefits.
- This project has shown that a good project need not be expensive, or require significant inputs.

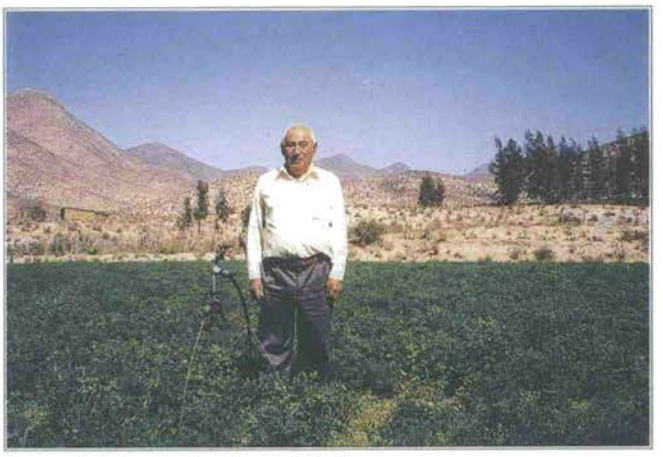


Selling animals in a typical village market

Community-Led Dryland Development

Combating Desertification in Coquimbo, Chile

Country:	Chile
Continent:	South America
Ecozone:	Semi-arid
Source of funds:	European Community (EC)
Number of people involved:	5,000
Cost:	USD 500,000
Years of operation:	6 years
Area involved:	40,656.3 km^2
Location:	The IV Region of Coquimbo-Chile is located 400 km from Santiago. The project concentrated its efforts in the province of Elqui, particularly in the agricultural community of "Quebrada el Taica".



Improved food production through irrigation

The Problem

The problems of the region were many and varied, including a lack of public support for sustainable agricultural development, overexploitation of grasslands, abuse of soil ecosystems and neglect of soil carrying capacities, unsustainable agricultural and herding techniques, inadequate education, excessive pressure on biomass for fuel, an absence of environmental legislation on desertification and soil protection, and weak implementation of existing laws.

The Solution

The project introduced training in grasslands and cattle management, techniques to collect water, afforestation activities and the manufacture of solar stoves. The project also initiated environmental education and public awareness programmes.

Results/Impact

The specific achievements of the project are impressive. Agricultural productivity improved, water and energy supplies became more reliable, a book on desertification was published, a radio programme established, and the vulnerability of women was considerably reduced.

UNEP's "Saving the Drylands" award winner, 1999. The IV Region project was implemented by CODEFF (Comité de Defensa de la Flora y la Fauna), Santiago, Chile.

Sustainability

Actions designed to support better farming, herding and fuelwood collection techniques were successful because they became deeply ingrained in local community life.

Replicability

The connectivity among all of the components of the multi-sectoral strategy implemented by the project staff raises genuine doubts about the replicability of this strategy under different environmental and institutional conditions. Any replication effort would need to employ a similar approach in order to manage financial resources efficiently.

Fog-trapping nets capture moisture from the air

Solar ovens reduced demands for woodfuel

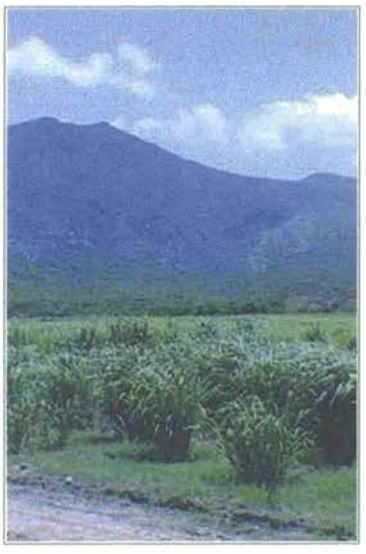
Lessons learned

- Poorly planned long-term projects often succumb to droughts, causing communities to lose faith.
- Projects work better if they are coordinated in such a way that all actions come together and are implemented effectively.
- Chosen project areas must be located where target groups will have easy access.
- Women are a determining factor in the community structure, even though men often maintain community organization control, but a project can reduce the vulnerability of women if training and education are provided.
- Desertification processes continue where inaction or resistance is the usual response, and where farming and herding practices are unsustainable.

Demonstrating Success

A Regional Development Programme on Food Security, Urban Migration Control and Natural Resources Protection in Guantánamo, Cuba

Country:	Cuba
Continent:	South America
Ecozone:	Arid
Source of funds:	Cuban Government; Cuba solar; Humbolt University, Germany; Eurosolar, Italy; SODEPAZ, Spain
Number of people involved:	325,000
Cost:	Not available
Years of operation:	no data available
Area involved:	6,184km^2
Location:	Southern and Western ßGuantanamo Province



King grass growing along a roadside

The Problem

The main problems arose from the area's harsh environment. The southern part of Guantanamo has a hot, arid climate and prolonged droughts. Powerful tropical storms endanger the population and damage crops and land, which was severely eroded. The water table had a high concentration of salts, which limited fresh water supplies to surface watercourses. But added to persistent drought, erratic rainfall, cyclones and salinization, there were also human induced causes of degradation, such as livestock overgrazing and inappropriate agricultural techniques. In the coastal area, extensive logging to make and sell charcoal led to the loss of vegetation cover and biodiversity, as well as erosion. There was heavy rural-urban migration.

Land degradation from water erosion

Solution

The project was structured around three main goals: to achieve regional food sufficiency; to encourage people to refrain from migrating to towns and cities, and to conserve and regenerate natural resources in general. Rural-urban migration was to be reduced by upgrading quality of life and guaranteeing local food security by introducing modern and traditional appropriate technologies. To raise awareness, the project designed a strategy for communication, education and training.

Results/Impact

The project implemented comprehensive disaster contingency plans, and as a result no one died during the 1998 floods. It established meteorological stations and a soil laboratory, and installed three demonstration projects, each located in a different area. In the Guantanamo Valley demonstration farm, which had been severely affected by salinization, a comprehensive soil treatment programme reclaimed previously uncultivable areas. In the coastal area, the most arid region, extensive areas were reforested. Communication programmes reached 60% of the area population.

UNEP's "Saving the Drylands" award winner, 1999. This project was implemented in collaboration with various agencies of the Cuban Government with the participation of non-governmental and grassroots organizations under the coordination of the Ministry of Science, Technology and Environment of Cuba.

Sustainability

The programme was planned for expansion and long-term relevance, based on more than 20 years of previous work and strong community institutions.

Replicability

The rate at which new techniques were being adopted and the response to the first dissemination and training efforts seem to indicate that the experience would rapidly become widespread at the local level. On the national level the linkage of the basin organization and relevant ministries provide appropriate conditions for replication on a wider scale. Several technological aspects, the formulation of more precise and committed legal frameworks, new communication schemes and the linkage of research with field activities, among other factors, are applicable internationally.

Irrigated banana plantation

Lessons learned

There are significant benefits in including anti-desertification activities in regional sustainable development programmes, with strong links to the national level. The inclusion of opinion, political and social leaders greatly favours the dissemination of innovations and also contributes to building social capital in terms of confidence and mobilization.

Living Fences, Productive Slopes

Conserving Eroded Slopes with Opuntia fences and mixed cropping in Loja, Ecuador

Country:	Ecuador
Continent:	South America
Ecozone:	Semi-arid
Source of funds:	Provincial Council of Loja
Number of people involved:	220,000 inhabitants
Cost:	USD 40,000 per year
Years of operation:	1991 to date
Area involved:	700,000 hectares
Location:	The province of Loja lies in the southern part of Ecuador, in the frontier region north of Peru.

Stabilizing soil erosion with opuntia on steep slopes

The Problem

Soil erosion had decreased crop yields and diminished the economic potential of the agricultural families living on the slopes. There was no possibility of earning income during long periods of drought, and as such there were high rates of rural flight to the provincial capital and other areas of the country.

Solution

Local communities of the region had maintained some of their pre-Columbian agricultural traditions, as well as extensive knowledge of the local flora and fauna. This was true especially in the case of the opuntia or nopal (*Opuntia ficus-indica*) and the insect cochineal (*Dactilopius coccus*). Farming of opuntia and cochineal in association with basic crops (maize, beans, yucca, peanuts) helped to slow the desertification process and improve soil fertility.

Results/Impact

The project helped to reintroduce traditional knowledge related to the traditional management of natural resources stemming from the oldest peasants. It demonstrated that it is possible to innovate using ancestral skills.

UNEP's "Saving the Drylands" award winner, 1999. This project was implemented by the National University of Loja - Department of Agricultural Sciences, Loja, Ecuador.

Sustainability

The sustainability of the project is evident in a variety of ways. The applied farming techniques helped to reclaim degraded land and facilitate the recuperation of eroded soils. From a socio-cultural point of view, the technology helped to validate ancestral traditions and skills. The project was accepted by the local authorities, very important in making local development viable. The project succeeded in creating a development model with environmentally sustainable parameters, allowing the recuperation of very degraded areas and the prevention of soil degradation in other areas of intense use of natural resources.

Replicability

There were very good conditions for replicating the project. The technology is simple, in harmony with the local culture and climate, and increases local incomes. The innovations of the project would be replicable around the country and in other regions of the world with similar conditions.

Above:Mixed tree cropping and opuntia live fencing to control land degradation
Below: A local farmer shows off his opuntia burrows

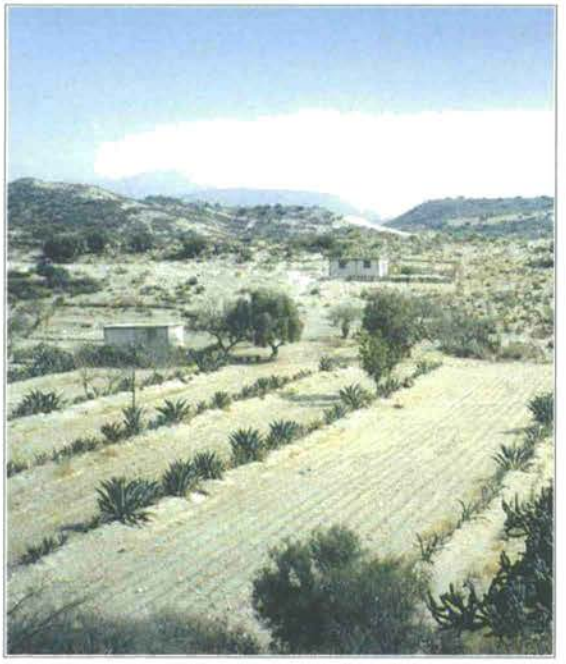
Lessons learned

- Projects that are rooted in deep local convictions, cultural values and ancestral skills already have an excellent head start.
- Extensive opuntia and cochineal farming on land slopes in association with other crops offers a way to reclaim degraded land and facilitate the recuperation of eroded soils.
- The project succeeded in spreading practical and information about its approach among peasants, NGOs and entrepreneurs, and was able to communicate both the environmental and economic benefits, by keeping its message simple and clear.

Enriching Local Knowledge

A Pilot Project by the Soil Conservation and Rural Development Centre, El Dexthi, Mexico

Country:	Mexico
Continent:	South America
Ecozone:	Semi-arid
Source of funds	National Autonomous University of Mexico (UNAM); Upper Mezquital Association of Lechuguilla Growers of the Social Solidarity Association; Secretariat of Environment, Natural Resources and Fisheries (SEMARNAP); Secretariat of Social Development of the State of Hidalgo
Number of people involved:	600
Cost:	Not Available
Years of operation:	1996-2000
Area involved:	3,025 hectares
Location:	Alto Valle del Mezquital, in the northern high plateau in Central Mexico.



Agroforestry system with indigenous shrubs and *Agave spp*

The Problem

The project area faced severe disruption of its pristine vegetation due to overgrazing. Thin layers of young soils were prone to intensive erosion. Plots were very small and the food quality was poor. Poverty was endemic and there were high rates of rural-urban migration.

The Solution

Proposed solutions focused on actions to stop, reduce and prevent soil degradation and restore the ecosystem, supported by academic, institutional and civil society participation.

Results/Impact

The project improved the living standards of many families, concentrating on the role of women, and helped stop the degradation of soils by encouraging traditional practices of reforestation and plant growth. A pilot centre provided research facilities, environmental education and community training.

UNEP's "Saving the Drylands" award winner, 1999. This project was implemented by the Pilot Centre, developed by the National Autonomous University of Mexico (UNAM), Iztacala Campus, and the Upper Mezquital Association of Lechuguilla Growers of the Social Solidarity Association (LAMSSS). It was established by the Secretariat of Environment, Natural Resources and Fisheries (SEMARNAP), together with the Secretariat of Social Development of the State of Hildago, Mexico.

Sustainability

The programme was designed with a view to expansion, incorporating short, medium and long-term strategies. Peasant-farmers and academic teachers decided what type of project to develop and chose the elements that would cover their food and employment needs. Projects were successful in terms of ecological protection, increased production and community participation. All of the institutions on which the project is based were sound and had served the area for several years.

Replicability

The El Dexthi Pilot Programme has every possibility and prospect of being replicated successfully in this region. Similar projects were already being implemented in neighbouring localities. The Pilot Centre was one of a set of country experiences in the National Programme to Validate Technological Strategies for Soil Conservation.

Lessons learned

The programme owes its success to the following characteristics:

- The willingness of the Upper Mezquital Association to participate fully, as well as its high levels of social, labour and commercial organization. Members have good command of the raw material production and processing techniques for products they sell, not only to the local market but to other states as well.
- The integration of federal, state and municipal institutions, together with academic professors and the local community, in the diagnostic, planning and implementation stages of the different projects.
- The coordination of different public policies that worked for the productive conversion of arid zones to administer programming funds from different federal secretariats and their state delegations.

Building stonework systems to harness water

Restoring Ancient Traditions

Community rehabilitation of terraces in the Peruvian Andes

Country:	Peru
Continent:	South America
Ecozone:	Semi-arid
Source of funds:	Fondo General de Contravalor,Peru, Canada and Switzerland
Number of people involved:	5,280
Cost:	USD 866,500
Years of operation:	1995-1999
Area involved:	18,800 hectares
Location:	Lari District, northeast Arequipa Region, 3,400 metres above sea level.

Ploughing on terraces with oxen

Panorama of the Colca Valley

The Problem

There was a loss of farm production capacities due to the degradation of terraces, inefficient irrigation and water conveyance systems, and a loss of soil fertility resulting from poor management. Deforestation for fuelwood was also a serious problem. The extremely steep terrain was carved into small, highly fragmented plots.

The Solution

Solutions were designed from an integrated perspective that viewed natural resources and local people as interrelated elements of a micro-region. From this standpoint, the project focused on erosion control, improvement of soil fertility, efficient water use and management, conservation of crop diversity and the introduction of integrated pest management. The main components of the project focused on terrace restoration, improvement and rehabilitation of irrigation systems and the development of agroforestry techniques.

UNEP's "Saving the Drylands" award winner, 1999. This project was implemented by DESCO (Centre for Development Studies and Promotion), a Peruvian NGO.

Results/Impact

Achievements include the expansion of land under crops, an improvement of soil quality and an increase in water availability. Communities were trained in effective terrace construction and rehabilitation and soil and water conservation technologies. 317 hectares of terraces were restored. Crop yields increased, with a 20% increment in marketed production. 364 families were settled on 101 hectares of rehabilitated agricultural land.

Sustainability

Most of the project's activities and outputs are sustainable in the long term. The technologies are simple and cost-effective. The organisation and its operations were strong and well-established, and tangible benefits realized by the community encouraged continuation with little external support.

Replicability

The project was replicated in other Colca valley districts where works on terrace rehabilitation have been required. The model could be replicated where similar mountainous conditions prevail as is the case with other Andean countries.

Lessons learned

- A project should be based on production systems that beneficiaries are already familiar with.
- The project should allow short-term benefits, either through direct incentives or through surplus production for subsistence and/or marketing.
- The first step to success relies on the existence of a strong community-based organization.

Annex 1: Methodology in the Evaluation of Success Stories in Land Degradation/Desertification Control

A. Criteria/Indicators

❒ Land-use:

- Appropriateness of the innovations;
- Effectiveness and long-term durability of soil and water conservation measures;
- Suitability of actions to protect and rehabilitate the vegetation cover and measure of its biological diversity;
- Level of use of biological methods to improve soil fertility and control pests;
- Innovations that have significantly improved water availability and quality;
- Sustainability of exploitation of the natural resource base and of the improved livelihoods of the community.

❒ Social and economic aspects:

- Level of economic and social benefits accrued;
- Cost effectiveness in labour time and maintenance of innovations;
- Community involvement in activity planning and implementation;
- Community contribution to activities in labour time and inputs;
- Rate and degree of adoption of innovations at community level;
- Social capital enhancement;
- Contribution to strengthening of local social structures;
- Extent of adoptions of approach innovations and by surrounding communities;
- Sustainable benefits accruing to the wider community in terms of infrastructure, facilities, organizations and social development;
- Project contribution to community empowerment in economic and social spheres;
- Degree of community commitment to sustainable resource development e.g. taking ownership and responsibility for resource management;
- Rate of progress in land adjudication and resolving land tenure issues and the effect on local community action;
- Project effects on local shelter, sanitation, water supply and health.

❒ Policy related issues:

- Degree of government support and commitment for project activities and their replication;
- Establishment of enabling institutional frameworks at local level;
- Effectiveness of existing institutional frameworks in resolving land and tenure issues;
- Degree of adoption of public policy that decentralizes control and eliminates undue interference in the individual's management of his/her natural resources;
- Degree of influence over positive changes in national land use policy development.

B. Assessment of Success

Assessing the success of a project/initiative is carried out by applying the following approach:

Step 1: Determine parameters for success
Step 2: Apply a rating scale for each parameter
Step 3: Arrive at a final score for the project
Step 4: Make the judgment based on the final score

It is important to note that each step is linked to the preceding step.

Parameters for success:

Three parameters are considered in evaluating success:

- **Project impact**
- **Sustainability**
- **Replicability**

The assessment of project/initiative impact must include a minimum of 6 criteria as follows:

1. Income and savings created by the project
2. Employment generated by the project
3. Production of crops, livestock, forest and other commodities
4. Aspects of community empowerment including the role of women
5. Resource (land, water, trees and other) use and conservation aspects

Applying rating scale:

Once the above three areas of assessments have been made, a 5-point rating scale is then applied to each of the three parameters mentioned above. If it is felt that any of the three parameters is weak, then a score of '1' is assigned to that parameter. Similarly, the '5' indicates the excellent rating.

Determining final score:

Once the results of the rating in respect of each of the three areas are known, then a final score for the project can be worked out. The maximum points in respect of the three areas mentioned above are as follows:

Impact:	6 criteria x 5 points = 30
Sustainability:	3 criteria x 5 points = 15
Replicability:	3 criteria x 5 points = 15
Total (maximum) points:	**= 60**

The sustainability of a project/initiative must be assessed in respect of three criteria namely, sustainability of the interventions employed by the project/initiative, sustainability of the impact (6 areas mentioned above) created and the life span of the institutions created and/or strengthened by the project/initiative. The breakeven point to measure the sustainability is the time when project/initiative funding has stopped or withdrawn. Finally, the replicability must be measured in other areas. Also considered and assessed in the evaluation is the replicability of the interventions within the locality, other parts of the country as well as in other regions.

Judging Success:

Accordingly, the maximum score that a real success story could generate is 60 while a totally failed project could get the lowest score of 0. Of course, there could be a score ranging from 0 to 60 by different projects. It is this final score which is used to indicate the success of the project being evaluated. It must be noted that this score makes inter-country and inter-regional comparisons possible, which is a positive feature of this scoring system.

Annex 2: Contact Addresses of Project Implementing Organizations

A. Africa Region

1. ***Project Title: The Collective and Family woodland in Tiogo Forest Reserve, Mossi Plateau, Burkina Faso***
(Projet des Parcelle Boisées Familiales et Collectives, Tiogo BURKINA FASO)

Contact:
Direction Regionale de l'Environnement et des Eaux et Forêts du Centre Ouest (Koudougou)
BP 62 Koudougou, Burkina Faso
Fax: (226) 44 03 76
Tel: (226) 44 07 72 or 44 60 28

Submitor of case study: *Ms. Chahkar-Farhang Scheila, UNDP/UNSO, New York*
Evaluation Consultants and contributors to case study development: *Racine Kane (Senegal), Henri Mathieu Lo (Senegal)*

2. ***Project Title:The Zabré Women Agro-ecological Project, Burkina Faso***

Contact:
Directeur du CEAS-BF
09 BP 335 Ouagadougou 09
Tél: (226) 36 34 00
s/c Fax: (226) 31 24 21
Ceas-rb@fasonet.bf ceas-rb@cenatrin.bf http://www.ceas-ong.net/burkina1.html
Or
ASSOCIATION DES FEMMES PAG-LA-YIRI
Zabré
Province du Boulgou, Burkina Faso
Tél: (226) 71 42 04
Or
CEAS
Céline Perrenoud
Rue de la Côte 2-2000 Neuchâtel Suisse
Tél: (41) 32 725 08 36
Fax: (41) 32 725 15 07
Ceas.ne@bluewin.ch

Submitor of case study: *Mr Pascal de Pury, Director, CEAS*
Evaluation Consultants and contributors to case study development: *Racine Kane (Senegal), Henri Mathieu Lo (Senegal)*

3. ***Project Title: Desertification Control in the S.J. Baptista Valley, Cape Verde***

Contact:
DGASP
C.P. 66 Praia
Cape Verde
Tel: (238)616418, Fax: (238)616554/5,
dgasp@cvtelecom.cv

Submitor of case study: *Ms. Chahkar-Farhang Scheila, UNDP/UNSO, New York*
Evaluation Consultants and contributors to case study development: *Jacqueline Wolfe (Canada), Elisabeth Toe (Burkina Faso)*

4. ***Project Title: The Suntaa Nuntaa Agroforestry and Land Degradation Control Project, Upper West Region of Ghana***

Contact:
Mr. Robert Loggah, Director
Suntaa Nuntaa
P.O. Box 207
Wa UWR GHANA
Tel: (233)(0)756 22215
Fax: (233)(0)756 22225
E-Mail: suntaa@africaonline.com.gh
Website: http://www.suntaa-nuntaa.myweb.nl/
Submitor of case: Mr. Robert Loggah
Evaluation Consultants and contributors to case study development: *Racine Kane (Senegal) , Henri Mathieu Lo (Senegal)*

5.

Project Title: The Wei Wei Integrated Development Project, Sigor, Kerio Valley, Kenya

Contact:
Director,
Kerio Valley Development Authority,
P.O. Box 68258,
Nairobi
Tel: (254) 2-713163

Or
H. E The Ambassador,
Permanent Mission of Italy to UNEP
P.O Box 30107
Nairobi, Kenya
Tel: +254-2-337356/7
Fax: +254-2-337056

Submitor of case study: *Eugenio Francescon, Consultant, Lodagri, in collaboration with Italian Embassy, Nairobi, Kenya*
Project Evaluation Consultants and contributors to case study development: *ITDG, Zimbabwe: Alex Mugova (Zimbabwe) and Jeanlinda Mavunga (Zimbabwe)*

6.

Project Title: The Sand Encroachment Control and Agropastoral Development Project, Mauritania

Contact:
Directeur
Direction de l'environnement et de l'aménagement rural
BP 170 Nouakchott
Mauritanie.
Tel: (222)525-91-83
Fax: (222)525-07-41

Submitor of case study: *Mr. Jean Edeline, UNDP, Mauritania*
Evaluation Consultants and contributors to case study development: *Pathé Diagne (Gambia), Diao Balde (Senegal), Moustapha Sarr (Senegal)*

7.

Project Title: The Sonnleiten Ranch Project, Namibia - A holistic Approach to Land Management

Contact:
Mr. Ulf-Dieter Voigts
President, Namibia Centre for Holostic Resource Management,
P.O Box 5182, Windhoek 9000
Namibia
Fax: (264) 61 22888

Submitor of case study: *Mr. Ulf-Dieter Voigts*
Evaluation Consultants and contributors to case study development: *Patrick J.B. Duffy (Canada) and Joseph Mwangi (Kenya)*

8.

Project Title: The Community Afforestation Project, Kano and Jigawa States, Nigeria

Contact:
Director,
Forestry Management Evaluation and Coordinating Unit (FORMECU)
Block 27, Nouakchott Street
Wuse, Zone 1, P.M.B. 226
Abuja, Nigeria
Tel: (234)(0) 9 5232637, 5230685
Fax: (234)(0) 9 5232637

Submitor of case study: *Mr. Peter Papka, Head, FORMECU*
Evaluation Consultants and contributors to case study development: *Clare Westaneys (Canada) and Ellen Woodley (Canada)*

B. Asia and the South Pacific Region

9.

Project Title: Environmental Restoration and Protection, in the Louga, Northern Senegal

Contact:
Programme Planning Unit Manager,
World Vision International,
B.P 51, Thies,
Senegal
Fax: (221) 512472

Submitor of case study: *A. Johnson, WVI, Senegal*
Evaluation Consultant and contributors to case study development: *Margareth Hammer (Germany) and Alphonse Gombe (Congo)*

10.

Project Title: The SOS Sahel Community Forest Project, Ed Debba, Sudan
Contact:
Programme Director
P.O. Box 1387
Khartoum, Sudan
Tel: (249) 11 77 70 27

or:
Director,
SOS Sahel International, UK,
1 Tolpuddle Street, London N1 OXT,
United Kingdom
Tel: (44-20) 78379129
Fax: (44-20) 78370856
E-mail@sahel.org.uk

Submitor of case study: *Ms. Mary Coburn, SOS Sahel, UK*
Evaluation Consultants and contributors to case study development: *Farai Terence Mutsambiwa (Zimbabwe), Gaafar el Faki Ali (Sudan) and Isam Haq el Tahir (Sudan)*

11.

Project Title: A Whole Catchment Approach to Land Use and Management- An Integrated Whole Farm Plan, Frankland, Western Australia

Contact:
Suzanne and Ron Watkins
Haynesdale Road, Frankland
Western Australia 6396
Tel: (61)(08) 9826 7013
Fax: (61)(08) 9826 7001
RGWatkins_Co@BigPond.com

Submitor of case study: *Susan and Ron Watkins*
Evaluation Consultants and contributors to case study development: *UniQuest Ltd University of Queensland - Tony O'Brien (Auistralia) and Michael Whereat (Australia)*

12.

Project Title: Afforestation and Salinity Control Using Tamarix in Western China

Contact:
Xinjiang Institute of Biology, Pedology and Desert Research,
Xinjiang
Urumqi City
Beijing South Road 40-3
E-mail: cui@ms.xjb.ac.cn

Submitor of case study: Prof. *Liu Ming-ting*
Evaluation Consultants and contributors to case study development: *J.V. Alexander (Australia) and Anura S. Widanapathirana (New Zealand)*

13.

Project Title: Comprehensive project on Desertification
Control in Naimanqui Banner County, China

Contact:
Chinese Academy of Sciences (Academia Sinica), Desert Control Group
Dr. Wang Tao
Director, Institute of Desert Research
174 Donggang West Road, Lanzhou,
Gansu 730 000
Tel: 86 (931) 882-6720, 888-9950
Fax: 86 (931) 888-9950
Telex: 72149 ICERD CN Cable 3097
Lanzhou

Submitor of case study: *Mr. Liu Xinmin, Directo general Instiutte of desert Reserach, Lanzhou*
Evaluation Consultants and contributors to case study development: *Anura S. Widanapathirana (New Zealand) and Patrick J.B. Duffy (Canada)*

14.

Project Title: Controlling Drifting Sand at Cele County, Western China

Contact:
Xinjiang Institute of Biology, Pedology and Desert Research,
Xinjiang
Urumqi City
Beijing South Road 40-3
E-mail: cui@ms.xjb.ac.cn

Submitor of case study: *Mr. Zhang Henian*
Evaluation Consultants and contributors to case study development: *J.V. Alexander(Australia) and Anura S. Widanapathirana (New Zealand)*

15.

Project Title: Jhanwar Watershed Project, Shiwalik Hills, India

Contact:
Director,Central Arid Zone Research Institute
Indian Council of Agricultural Research
Light Industrial Area
Jodhpur- 342003
Rajasthan, India
Tel: (91) 291 740584
Fax: (91) 291 740706

Submitor of case study: *Dr. R.P. Dhir, CAZRI*
Project personnel contributing to case study development: *H.S. Daulay, T.K. Bhati and A.S. Faroda*
Evaluation Consultants and contributors to case study development: *Alex Mugova (Zimbabwe)and Mutsa Chasi (Zimbabwe)*

16.

Project Title: Joint Participatory Forest Management, Shiwalik Hills Haryana Province, India

Contact:
Dr. Singh
Director, TERI Graduate School
Darbari Seth Block, Habitat Place,
Lodhi Road
New Delhi
11 0003 INDIA
Tel:(91) (11) 468 2100/ 468 2111
Fax:(91) (11) 468 2144 / 468 2145
mailbox@teri.res.in http://www.teriin.org/case/jfm.htm

Submitor of case study: *Dr. R.K. Pachauri, Director General, TERI*
Evaluation Consultants and contributors to case study development: *ITDG Zimbambwe - Alan Sparrow (Zimbabwe) and Farai Mutsambiwa*

C. Latin America and the Caribbeans

17. ***Project Title: The Barefoot College Project, Tilona, Rajasthan, India***

Contact:
Bunker Roy, Director,
The Social Work and Research Centre (SWRC)
The Barefoot College,
Village Tilonia, via Madanganj, District Ajmer
Rajasthan 305816, INDIA
Tel: (91)(1463) 88204,
Fax: (91)(1463) 88206
"bunker" bunker@del2.vsnl.net.in http://www.barefootcollege.org/

Submitor of case study: *Bunker Roy, Director, Barefoot College*
Evaluation Consultants and contributors to case study development: *Mutsa Chasi (Zimbabwe) and Edith Mussukuya (Kenya)*

18. ***Project Title: The Integrated Wasteland Development Programme, Jhabua District, Madhya Pradesh, India***

Contact:
Director General
NCHSE,
E-5/A, GIRISH KUNJ,
ARERA COLONY,
BHOPAL-16, INDIA.
Tel: (91) 755-563731, 565306
Fax: (91) 755-565651
nchsbpl@mp.nic.in or nchse@nchse.ren.nic.in

Submitor of case study: *Dr. Hans Kumar Jain*
Evaluation Consultants and contributors to case study development: *Sarah Jones (Britain) and Kolade Adeyoju (Nigeria)*

19. ***Project Title: Desert Reclamation Using Shelterbelts in Thal, Pakistan***

Contact:
Director,
Rangeland Research Institute
PARC, Pakistan
Fax: (92) 51 240909

Submitor of case study: *Dr Noor Mohammad (Late), Director, PARC*
Evaluation Consultants and contributors to case study development: *Abul Gasim Seif el Din (Sudan) and Anne M. Parrish (USA)*

20. ***Project Title: Combating Desertification in the IV Region of Coquimbo, Chile***

Contact:
Director,
CODEFF
Calle Luis Uribe 2620
Ñuñoa
Santiago, Chile
Tel: (56) 2 274 7431 / 7461 / 7162
Fax: (56) 2 274 7159
Secretaria@codeff.cl http://www.codeff.cl

Submitor of case study: *Jose Miguel Torrico, CODEFF, Chile*
Evaluation Consultants and contributors to case study development: *Fernando Casas-Castañeda (Colombia) and Heitor Matallo Jr (Brazil)*

21. *Project Title: Combating desertification and disasters in Guantá namo, Cuba*

Contact:
International Co-operation Department
Ministry of Science, Technology and Environment
Prado y San José
CP 11300
Capitolio Nacional Havana 10200
Cuba
Tel: (53)7-67-0606
fax: (53)7-33-8054

Submitor of case study: *Elido Lugo Gonzalez*
Evaluation Consultants and contributors to case study development: *Gonzalo Chapela (Mexico) and Salvador Bautista (Argentina)*

22. ***Project Title: Conserving Eroded Slopes Through Use of Opuntia Live Fences and Mixed Cropping in Loja, Ecuador***

Contact:
Carlos Valarezo Manosalvas
Universidad Nacional de Loja
Casilla 385
LOJA - ECUADOR
Phone: 593-7-574054
Or
Ciudad Universitaria, Sector La Argelia
Loja Ecuador
Tel: (593) 570252
Fax: (593) 573075
rector@unl.edu.ec http://www.unl.edu.ec

Submitor of case study: *Ing. Hernan Manuel Ruiz, Loja, Ecuador*
Evaluation Consultants and contributors to case study development: *Fernando Casas-Castañeda (Colombia) and Heitor Matallo Jr. (Brazil)*

23. ***Project Title: Community Rehabilitation of Terraces in the Peruvian Andes***

Contact:
Rodolfo Marquina
DESCO AREQUIPA
Unidad de Planificacion
Cooperativa Victor Andres Belaunde K-7
Umacollo
Yanahuara, Arequipa
PERU
Fax: (51) 54-257043/(51) 54-270144
descolca@terra.com.pe
descoaqp@terra.com.pe http://www.desco.org.pe/

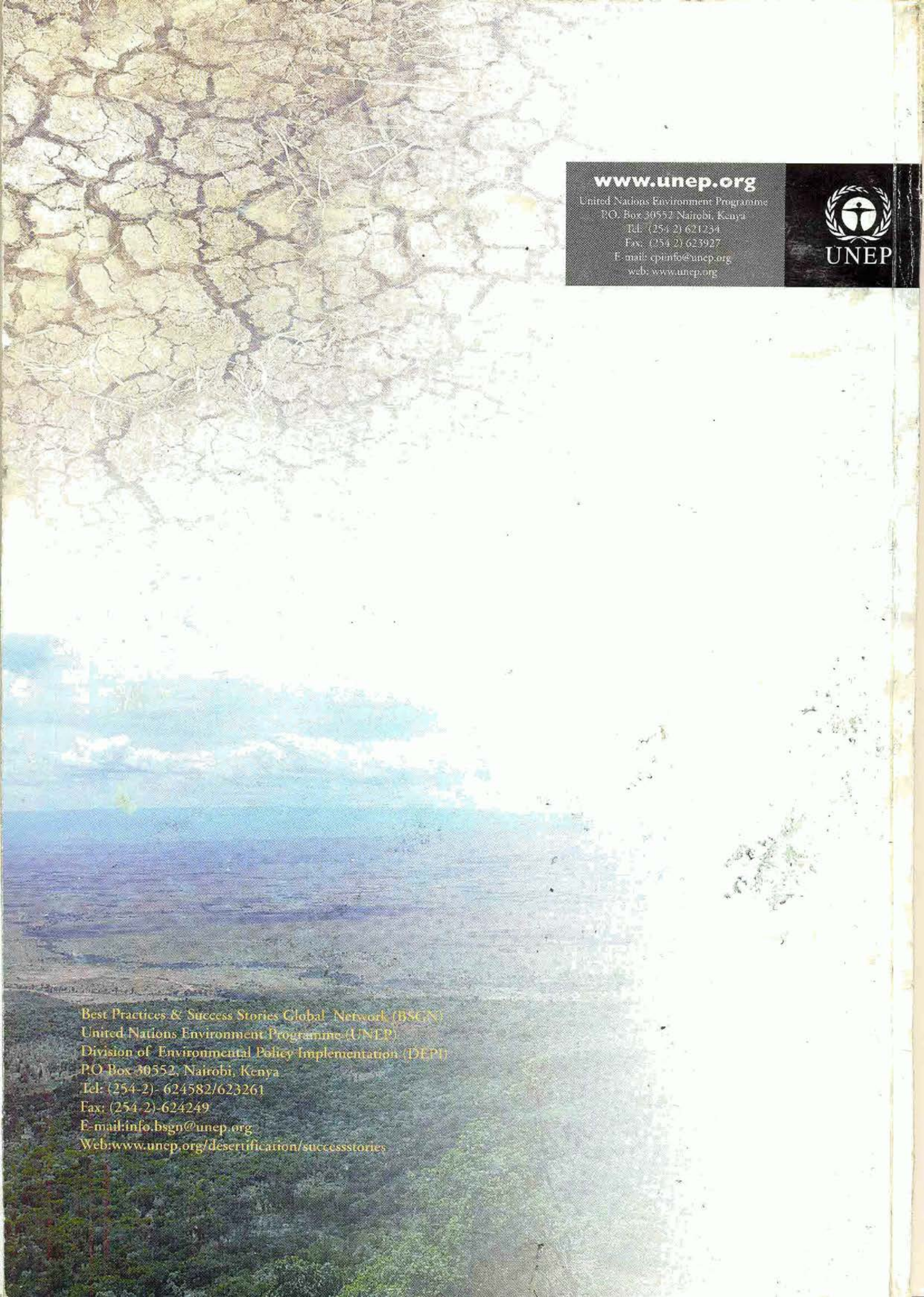
Submitor of case study: *Oscar Toro Quinto*
Evaluation Consultants and contributors to case study development: *José Miguel Torrico (Chile) and Francisco Brzovic Parilo (Chile)*

24. *Project Title: El Dexthi Pilot Centre for the Conservation of Soil and Rural Development, municipality of Ixmiquilpan, Hidalgo, Mexico*

Contact:
Biol.Francisco López Galindo
Avenida de los Barrios Sin Número
Los Reyes Ixtacala
Tlalnepantla, Estado de México.
Tel: (52) 5 56 23 11 33
Fax: (52) 5 66 23 12 25
lopezgf@servidor.unam.mx or edafixta@servidor.unam.mx

Submitor of case study: *Dr Victor Olave*
Evaluation Consultant and contributors to case study development: *Claudio Fabiano B.*

For more information on the Desertification Control Success Stories Please contact:
Co-ordinator, Best Practices & Success Stories Global Network (BSGN)
United Nations Environment Programme (UNEP)
Division of Environmental Policy Implementation (DEPI)
P.O Box 30552, Nairobi, Kenya
Tel: (254-2)- 624582/623261
Fax: (254-2)-624249
E-mail:info.bsgn@unep.org
Web:www.unep.org/desertification/successstories



www.unep.org
United Nations Environment Programme
P.O. Box 30552 Nairobi, Kenya
Tel: (254-2) 621234
Fax: (254-2) 623927
E-mail: cpiinfo@unep.org
web: www.unep.org

UNEP

Best Practices & Success Stories Global Network (BSGN)
United Nations Environment Programme (UNEP)
Division of Environmental Policy Implementation (DEPI)
P.O Box 30552, Nairobi, Kenya
Tel: (254-2)- 624582/623261
Fax: (254-2)-624249
E-mail:info.bsgn@unep.org
Web:www.unep.org/desertification/successstories