SUMAMAD

People in Marginal Drylands

Managing Natural Resources to Improve Human Well-being

A policy brief based on the Sustainable Management of Marginal Drylands (SUMAMAD) project

Zafar Adeel, Caroline King, Thomas Schaaf, Richard Thomas and Brigitte Schuster

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Available from:

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ISBN 92-808-6009-7

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Foreword

The world's marginal drylands are particularly fragile ecosystems due to harsh climatic conditions and growing human pressures. And yet they also constitute some of the world's largest land reserves and provide a wide range of ecosystem goods and services that are fundamental to the livelihoods of millions of people.

The situation of marginal drylands is typically observed to be a gloomy one, in part, because they are occupied by the poorest of the poor who rely on farming, pastoralism and natural resource utilization – highly vulnerable livelihood strategies primarily dependent on land productivity. Vast areas of marginal drylands are affected by desertification and land degradation as a result of inappropriate land and water management practices. The effects of climate change are predicted to exacerbate the situation in many marginal drylands. Efforts to reduce the downward spiral of degradation and poverty in marginal drylands are often hampered by a lack of an enabling policy environment and deficient investments.

These gloomy situations can be offset by a new breed of interventions that are developed together with communities, that combine traditional and contemporary knowledge, and hold great promise for improving the well-being of communities living in these marginal areas. The Sustainable Management of Marginal Drylands (SUMAMAD) project has been a systematic effort to understand these strategies and apply them to improving livelihood conditions of dryland dwellers. Nine demonstration sites located in China, Egypt, Islamic Republic of Iran, Jordan, Pakistan, Syria, Tunisia and Uzbekistan have developed innovative community-based approaches with an emphasis on integrated natural resource management strategies. The significance of policies to integrated management in marginal drylands guided research activities and clear policy messages were developed and acted upon at all case study sites. The site-specific work significantly benefited from the active exchange of knowledge between and excellent collaboration among the researchers in participating dryland countries.

This brief report summarizes the major findings of the SUMAMAD project with a focus on providing policy-relevant information. In particular, the following five questions are addressed in this report:

Prof. Konrad Osterwalder
UNU Rector and UN Under-Secretary-General

- How can we improve strategies for sustainable management in marginal drylands?
- How can we reinforce wise management practices in marginal drylands?
- How can we increase livelihood security in marginal drylands?
- How can we share knowledge on successful management approaches in marginal drylands?
- How can we address future challenges in marginal drylands?

The findings of the SUMAMAD project emphasize the importance of livelihood diversification and empowerment of local communities as a key to environmental conservation and economic well-being in marginal drylands. The SUMAMAD project also successfully demonstrated that an active South-South network can greatly contribute to solving problems in the same bio-climatic zone. It has become clear that dryland management must be integrated within national poverty reduction strategies to ensure that dryland development needs are addressed in a holistic manner.

Children in Pakistan. Photographer: Zafar Adeel

I want to also congratulate all SUMAMAD project partners for the accomplishments achieved over the past four years. The United Nations University's International Network on Water, Environment and Health (UNU-INWEH), the Man and the Biosphere Programme of the United Nations Educational, Scientific and Cultural Organisation (UNESCO), and the International Centre on Agricultural Research in Dryland Areas (ICARDA) have demonstrated that coordinated inter-agency collaboration can successfully facilitate multi-country initiatives and yield optimum results. I am particularly grateful for the generous financial support provided by the Flemish Government of Belgium. Most importantly, the SUMAMAD project has benefited from the wealth of expertise and experience available through the national research institutions including the Chinese Academy of Sciences (China), the University of Alexandria (Egypt), the Fars Research Centre for Agriculture and Natural Resources (Iran), the Royal Society for the Conservation of Nature (Jordan), the Pakistan Council of Research in Water Resources (Pakistan), the Institut des Régions Arides (Tunisia), ICARDA (Syria), and the Academy of Sciences of Uzbekistan (Uzbekistan). Their collaboration and continued efforts have made the SUMAMAD project a true success story.

I am confident that the recommendations of this report will assist policy-makers to foster long-term livelihood security based on sustainable natural resource management in marginal drylands.

Prof. Konrad Osterwalder
UNU Rector and UN Under-Secretary-General

Summary for Decision-Makers

Change in land management practices and governmental policies is urgently needed to reverse the continuing decline of marginal drylands. Marginal drylands are fragile ecosystems that sustain the livelihoods of millions of poor people in developing countries. However, their capacity to provide these services is continuously declining due to desertification, resulting in dwindling land productivity, and affecting human well-being and development opportunities in many marginal drylands.

Integrated natural resource management is the key to reducing poverty and achieving sustainable management in marginal drylands. The complexity of challenges in marginal drylands demands that strategies must be holistic and aim to alleviate wide-spread poverty, improve human well-being, restore ecosystem services and increase agricultural productivity. Their efficiency is primarily derived from diversification of income opportunities beyond traditional livelihoods coupled with empowerment and enhanced adaptive capacity of local land users.

Application of alternative livelihoods must be central to approaches used for reversing the downward poverty-desertification spiral in marginal drylands. Innovative livelihood strategies that are minimally dependent on land productivity – such as ecotourism, solar power utilization, handicraft production, brackish water aquaculture, etc. – have the potential to reduce the pressure on the fragile resource base in marginal drylands. At the same time, these strategies proved to yield significantly higher income per investment than traditional land-based livelihoods. As demonstrated by the SUMAMAD project, this provides powerful economic incentives for both, gradually replacing previous occupations and re-investing in improved management practices of land-dependent strategies. The viability of alternative livelihoods depends on investments for building adaptive capacity and an enabling policy environment.

Participation by local stakeholders ensures sustainability of management improvements. Involvement and consultation of local people in the design of interventions and testing of management practices create a feeling of ownership among local land managers and ensure the relevance of approaches to local needs and aspirations. Inclusion of these stakeholders in scientific research allows the outcomes to build upon the wealth of locally available practical experience and expertise. Long-standing partnerships and strong mutual trust between communities and scientists form an often underestimated basis for success.

Management practices that build on the right mix of traditional knowledge, contemporary technology and innovative scientific research yield optimum results. Traditional expert knowledge of practices for soil and water conservation has evolved over time and is adapted to the harsh conditions in marginal drylands. However, improvements in materials and construction techniques as well as innovative practical know-how are available to enhance effectiveness of traditional practices for application in a contemporary context. Transfer of this new technology and knowledge to local communities has to be facilitated and its potential for future use evaluated together with local land users.

Reversing desertification is inexpensive and yields sustainable income for local communities, while reducing household expenditures. There is ample evidence that small investments in livelihood diversification and improved management practices in marginal drylands pay off quickly and generate monetary benefits for local people. A wide range of examples observed in the SUMAMAD project further demonstrate that improved resource management reduces domestic expenditures for water, food and forage supplies and leads to health improvements.

Policy formulation must be driven by a bottom-up approach of uptake of successful management at the local level. Local successes should lead to the creation of enabling policies, which are, in turn, key to successful broader uptake of integrated land management approaches. Platforms for national dialogue among researchers, local people, and decision-makers on implications of existing policies have proven to be an effective way of informing decision-makers about required policy modifications. Above all, the successful testing of management approaches at the local level provides a strong argument for policy-makers to create enabling conditions and make necessary allocations in national budgets.

International cooperation and coordination of drylands research efforts create synergistic effects and allow for

Sheep herding in Syria. Photographer: Thomas Schaaf

cross-fertilization. Sharing experiences on sustainable dryland management across national boundaries and cross-fertilization of ideas enhance knowledge on sustainable dryland management and rehabilitation. Collaboration among a wide range of pertinent research institutions allows for sharing a collective wealth of knowledge and pooling of resources for more innovative and efficient project design and implementation. A multi-country approach also helps to build an active South-South network that contributes to increasing the self-reliance of developing countries.

International investments to help create an enabling policy environment are needed to mobilize action at the global scale. The international community, but also national governments, need to place sufficient resources at the disposal of institutions to develop and enforce coherent and integrated policy approaches across different levels. These policies must be better informed by available scientific knowledge and expertise on dryland management. Compelling arguments for these investments are the multiple benefits achieved by overcoming desertification. These include improved adaptation to climate change, mitigation of biodiversity losses, as well as poverty alleviation.

Focus on Marginal Drylands

Challenges in Marginal Drylands

Drylands are remarkable ecosystems, but limited water availability and its variability impact the ability to grow crops, raise livestock and produce consumer goods. The world's dryland ecosystems comprise all terrestrial areas, where climate is classified as dry sub-humid, semi-arid, arid and hyper-arid on the basis of the Aridity Index[1]. Drylands encompass grasslands, agricultural lands, forests, and urban areas and occur on all continents. They represent more than 40% of the global land area and are home to nearly a third of the global population, 90% of whom live in developing countries (Millennium Ecosystem Assessment, 2005). While the diversity of species in drylands may be more limited than in the humid tropics, dryland species show some remarkable adaptations to their harsh surroundings. Indicators of human well-being and poverty remain significantly lower in drylands than in other regions.

A city in Tunisia's drylands. Photographer: Zafar Adeel

Desertification is one of the greatest global challenges of our times, and correlates directly to poverty, food insecurity and degradation of human well-being. Desertification is the process of land degradation in drylands and directly results in biodiversity changes and a decline in soil fertility, water availability and plant cover, which indirectly affect the livelihoods of dryland populations. Though assessments of the extent of desertification vary, conservative figures estimate the extent of desertified area ranging from 10 – 20% of all drylands (Millennium Ecosystem Assessment, 2005), while a much larger area remains at risk. Inappropriate land use practices, driven by policy, economic and social factors, cause desertification. Rapid population growth in a situation of limited livelihood options is a major factor for growing poverty.

Marginal drylands are particularly vulnerable to a range of problems associated with desertification. A significant portion of the world's drylands can be characterized as marginal. This marginality is defined in two ways: ecological – in terms of their biophysical productivity and climatic variability; and societal – in terms of poor living conditions and well-being of populations living there, often underpinned by political marginalization. Biological and economic productivity are inherently low in marginal drylands due to adverse climatic conditions (low precipitation with high variability), edaphic conditions (low organic matter and often high salinity in soils) and steep terrain slopes. People living in these areas typically suffer from poverty and are vulnerable to threats related to food security.

Coordination of international scientific efforts across dryland countries needs to be significantly improved. International efforts to develop an effective mechanism for the coordination of scientific contributions received little attention or support during the first decade of implementation of the United Nations Convention to Combat Desertification

[1]The Aridity Index is defined as the long-term mean of the ratio of an area's mean annual precipitation to its mean annual potential evapo-transpiration.

Rural dryland community in Pakistan. Photographer: Zafar Adeel

(UNCCD). The capacities that have been built in pioneering dryland research centres have rarely been brought together to combine forces and coordinate efforts. Knowledge from previous interventions and lessons gained from past successes and failures have not been systematically documented. These trends need to change, and are changing, through an enabling policy environment and strengthened institutions at the international level.

It is possible to overcome marginality as a constraint for the development of drylands. Marginality becomes a constraint when human activities stress dryland ecosystems beyond their carrying capacity limits, resulting in irreversible degradation of land. This situation can be avoided through integrated strategies and interventions, taking into account the natural properties of dryland environments and the capacities of dryland communities. In order to enable dryland dwellers to maximize their resource management capacities, sustainable livelihood options and political empowerment are required.

Drivers of Stresses in Marginal Drylands

Desertification and stresses in marginal drylands are influenced by a combination of local (direct) and global (indirect) drivers. Direct drivers are natural processes such as droughts and human interventions at the local level, such as inappropriate irrigation systems, deforestation, overgrazing, and land cover and quality changes through variance in land use (Geist and Lambin, 2004). The proximate causes of desertification can be clustered into agricultural activities, infrastructure development, fuel (wood) extraction and increased aridity. Global drivers are social, political and biophysical processes, such as demography, agricultural policies or climate variability that can act at local, national or global levels. The underlying causes can be clustered into climatic, demographic, policy or institutional, economic, technological and cultural. Climate change is predicted to result in drier conditions through greater rainfall variability and more droughts. Dryland managers must deal with all of these factors simultaneously.

Many agricultural development policies - like market liberalization, agricultural intensification, and land re-distribution - can inadvertently contribute to desertification. Agricultural growth is being promoted for rural development as a major pathway out of poverty (World Development Report, 2007). However, the drive to link farmers to markets can also have a negative effect on land management as farmers strive to comply with external demands for export of goods. Similarly, reforms that alter traditional land tenure arrangements and mobility of grazing animals can result in reduced management flexibility thereby increasing pressure on the land.

Use of agricultural practices unsuited to marginal drylands has led to degradation of land and water resources. The promotion of a few economically productive species of crops and livestock in marginal drylands has reduced the resilience of complex dryland ecosystems to drought, disease and degradation. In many places, increases in salinization of soil and water resources have resulted from the continual application of irrigation water, over-extraction of groundwater and improper drainage (Safriel et al., 2005). This affects both crop productivity and groundwater quality. The clearing of dryland habitats and removal of vegetative cover for agricultural and other uses has left soils vulnerable to erosion and degradation. Loss of rangelands to agriculture and urban uses has affected livelihood opportunities as well as cultures of pastoralist societies.

Dry river bed in Iran. Photographer: Zafar Adeel

Strategies for Sustainable Management of Marginal Drylands

Integrating Human Well-being with Natural Resource Management

Empowering marginal dryland inhabitants and ensuring their well-being is the key to the sustainable use of natural resources in drylands. In general, dryland communities are often marked by poverty, low literacy rates, and little political power. As a result, they are marginalized from a social, economic and political point of view. Yet, dryland communities can be important electoral groups and ethical considerations dictate the provision of equal opportunities for rural and urban areas. It is therefore important that efforts are increased in empowering marginalized dryland communities to implement sustainable land use schemes. Creating educational facilities and information and extension services in peripheral areas will permit marginalized groups to consider and implement sustainable land use options through informed decision-making.

Eggplant cultivation in Pakistan. Photographer: Thomas Schaaf

Integrated land use management schemes and diversification of income opportunities can increase the resilience of communities in marginal drylands. It is now commonly accepted that single-factor and sector-oriented solutions to combating desertification do not work, and can even be counterproductive. Contemporary integrated management schemes take into account the marginal biophysical character of drylands and their constraints, as well as the wide-spread poverty syndrome of dryland communities. These entail diversification of options on the use of natural resources and diversification of income opportunities for dryland people. As the SUMAMAD project has shown (please see Box 1), such approaches can be quite successful: the establishment of fish ponds in the case of the Pakistani sub-project is just one example. In this case study, fish farming introduced a new source of income and increased nutrition.

Income from alternative livelihoods can be used to boost overall natural resource management. Income enhancements introduced alongside improved land management can create positive feedback loops between livelihood improvements and resource conservation. When the alternative livelihoods start to yield income, two trajectories are available. In some cases, a gradual replacement of the traditional livelihoods takes place. In others, part of the income generated by the alternative livelihood is re-invested in land-based livelihoods, such that co-existence of both approaches can be maintained.

Societal capacity is an essential factor in determining the success or failure of management efforts in marginal drylands. The capacity of communities to manage environmental changes has been highlighted as the key factor determining the fate of past dryland societies (Wittfogel, 1957; Heathcote, 1983; Diamond, 2005). More recent debates in dryland management have focused on examination of the determinants of social capacity for management (Tiffen, 2003). To feed social capacity in dryland areas, new management approaches are needed; this was one of the objectives of the SUMAMAD project.

Enabling National Development to Work for Marginal Drylands

Many development policies and interventions do not sufficiently take into account the fragile nature of dryland ecosystems. Agricultural expansion into marginal drylands has been associated with centralized economic development strategies since Roman times, and remains an essential element of national efforts to drive economic development (World Development Report, 2007). However, by the year 2000, there was widespread recognition that agricultural development policies, including schemes for market liberalization, agricultural intensification, and land re-distribution have led to increased desertification in many marginal dryland areas (Nielsen and Adriansen, 2005; United Nations University, 2007) (please see Box 2). Future land use intensification for development needs to be analyzed not merely in terms of extractive output per unit of land, but

Local farmers in Pakistan. Photographer: Caroline King

Box 1: SUMAMAD Project - A Summary

The Sustainable Management of Marginal Drylands (SUMAMAD) project was implemented as a joint initiative of UNU-INWEH, UNESCO-MAB Programme, and ICARDA from 2003-2007 and was primarily funded by the Flemish Government of Belgium. The project investigated community-based strategies to combat desertification in nine study sites spanning from North Africa to East Asia. Research teams from China, Egypt, the Islamic Republic of Iran, Jordan, Pakistan, Syria, Tunisia and Uzbekistan, and involving the expertise of two Belgian universities, worked towards the overall aim to improve livelihood conditions of dryland dwellers while enhancing the sustainable management and conservation of marginal drylands using both traditional knowledge and scientific expertise.

The individual SUMAMAD project sites varied in terms of their environmental, social, economic and political characteristics. In order to allow cross-comparison between sites, a harmonized methodological approach was adopted to monitor results and share knowledge. Socio-economic surveys identified people's adaptation and traditional knowledge in coping with adverse dryland conditions. Management approaches that promote sustainability and resource conservation, in particular of soils and water, were identified and community-based rehabilitation approaches of degraded drylands were fostered.

Diversification of livelihoods was identified at an early stage as a key contribution to ensuring food security, health and economic well-being, as well as to environmental conservation at large. At each SUMAMAD project site, various alternative income-generating activities for local communities were tested, based on their perceived needs and aspirations. Some activities were quite novel to dryland people, but they are promising for replication elsewhere.

SUMAMAD placed a major emphasis on participatory processes. National seminars were conducted on an annual basis at each study site so that interactions and deliberations among the research teams, local people and government officials would lead to the formulation of practical solutions for sustainable dryland management. This was underpinned by training and capacity building to address local problems.

also in terms of output per unit of water, income per unit area and associated risks, including the cost of long-term degradation of land and water resources.

State-led dryland research and development efforts have made uneven progress in developing countries. In many developing countries where drylands are located, development efforts can likely be linked to the establishment of representative national governments from the 1950s onwards. Marginalized dryland peoples' development needs seldom determine national development policies and priorities. Lack of global attention and understanding of the development needs and capacities of dryland populations continues to reinforce their marginalization in national and international development strategies (United Nations University, 2007). Only recently has this trend shown signs of change in which national-level commitments to combat desertification have yielded some favourable results on the ground. In countries that contain a high proportion of marginal dryland areas, such as Tunisia, impressive achievements have been made in the improvement of human well-being indicators over a few decades (Sghaier and Seiwert, 1993).

Ensuring Participation as a Key to Success

Insufficient local consultation and participation has been a classic source of failure in natural resource management. Many schemes have failed to achieve desired results because they did not sufficiently include such consultation with local communities. An often cited example is a scheme for groundnut cultivation in many parts of Africa that failed to engage farmer participation, and led to reduced food security and a lost opportunity for sustainable development (Chambers, 1981).

Local participation in the design of resource management improvements ensures that the outcomes will be compatible with their needs, priorities and local expertise. Participatory approaches enable local people to contribute their valuable practical knowledge and foresight to the overall design and scope of interventions and provide incentives for their cooperation. Local momentum and ownership, secured through participatory approaches, are seen as essential to the long-term sustainability of rural development and resource management initiatives. Early

Box 2: Failed Strategies for Dryland Management: Lessons from History

Prof. Sayyed Ahang Kowsar, Fars Research Centre for Agriculture and Natural Resources, Iran

Iran is the Land of Arians, the nomads. The Arians have been occupying the Iranian rangelands for centuries and learned to adapt to the dry environment. Rather than living a sedentary life they have adopted a nomadic lifestyle following seasonally available rangelands and fresh water. Moreover, their life in tents forced them to avoid exposure to extreme temperatures. Therefore, they moved between northerly summer camp sites and pastures at higher altitudes and lower, southerly sites in winter. By doing so, they utilized hundreds of thousands of squared kilometres for grazing in order to maintain stock numbers in equilibrium with pasture productivity. Overgrazing was considered a sacrilege.

However, during the 1930s government policies increasingly forced Iranian nomads to adopt a sedentary life style. This development deprived many of these highly resourceful people of an ecologically sustainable, financially viable and socially acceptable way of life. Many tribes and clans were settled in plains with unproductive soils and insufficient water for irrigation. In addition, most of them were herders and did not know how to cultivate crops. The ill-conceived policy resulted in livestock densities beyond the carrying capacity of the limited rangelands, conversion of forests and shrublands into rain-fed cropland, and introduction of ploughs and pumps. A serious degradation of the Iranian natural resources was an inevitable outcome.

A land reform during the 1960s further exacerbated the situation for the Iranian rangelands. Each farming community was allocated twice the area of its farm fields for the grazing of livestock. However, in most instances these areas designated for grazing were ploughed with heavy machinery and used for cultivation of crops. With national policies in the late 1970s starting to foster self-sufficiency in wheat and meat, illegal expropriators were further encouraged to continue to overexploit the remaining land. In the following decades, the series of perverse policy choices as described above led to one of the most severe episodes of soil erosion worldwide, and remains a major challenge to date.

In the current policy environment in Iran, many of these policies are being reviewed. Experiences from the SUMAMAD project are providing meaningful backdrop for such a dialogue.

successful examples of such approaches include the Egyptian rural social centres of the 1950s (Johnson, 2004). Despite the general recognition of its value, debates continue with regards to the nature, modalities and degree of application necessary for participatory research (Turner, 1999; Cooke and Kothari, 2001).

Insights gained through participatory research reveal new potential for management improvements. Participatory research methods have evolved as an essential approach to ensuring the relevance of proposed management improvements in the local, social and economic context. This approach creates new challenges for scientists and development professionals to work in partnership with local people, enabling them to effectively determine the outcomes of management initiatives. Participatory research carried out by the SUMAMAD partners is placed in the context of the longstanding engagement of the research teams with the local communities. Both formal and informal consultations with local people shaped the activities that were undertaken at each site. Local consultation, and mapping and sharing of opinions were built into the project activities by each research team. These experiences were then relayed to policy-makers through national coordination workshops, and reviewed with international colleagues during annual international workshops. These interactions encouraged project teams to explore activities and options that would not previously have been foreseen within the scope of their institutional activities.

In-Situ Assessment of Sustainability

Sustainability assessment requires biophysical, social and economic indicators. Conventional assessment approaches for desertification and land degradation have relied almost exclusively on biophysical data (GLASOD, 1990; Dregne and Chou, 1992). A broad transition, from a focus on soil quality to land quality, and eventually to sustainable land management, has taken place in approaches to sustainability assessments. This approach encompasses the need for long-term preservation of the resource base for future food production with methods that are socially acceptable, economically viable and environmentally sound. It also relies more on community participation for the generation of information and less on scientifically-obtained data. The SUMAMAD project adopted site-specific participatory sustainability assessments of land management approaches, incorporating particular attention to social and economic dimensions.

The SUMAMAD approach for assessing sustainability combines environmental, social, and economic conditions with management approaches. These four axes represent areas where interventions can be designed and implemented to improve the situation. There are many measurable indicators for the biophysical environment that can be considered as the flagship indicators for a certain ecosystem service (e.g., daily intake of food in terms of its caloric value). The social or economic indicators fall in the envelope of human well-being and are often available only at the national level. It may be necessary to conduct social and/or economic surveys at the local level to determine the project-specific values of these indicators. The same is true for indicators related to management approaches.

Coordination of Research to Better Address Dryland Needs

Sharing experiences on sustainable dryland management across national boundaries and pooling of resources is the key to success. Dryland countries have differing degrees of resource availability, knowledge and expertise to cope with land degradation. While some countries, such as China, are investing tremendous amounts of funding into dryland research, in particular to combat desertification and prevent soil erosion and dust storms, many other developing countries often cannot follow suit due to resource limitations. Sharing experiences on sustainable dryland management across national boundaries and pooling the resources of pertinent institutions create synergistic effects that are more promising than single-country efforts.

A Syrian family. Photographer: Caroline King

Geographically disparate research institutions already hold a collective brain trust of knowledge on sustainable land management. A clear comparative advantage can be achieved by pooling expertise and financial resources by various project partners through their combined efforts on project design, dryland management and rehabilitation, and outreach. The SUMAMAD project placed the idea of collaboration among dryland countries up front and centre. This inter-regional initiative spanned a geographical reach from Tunisia in the west to China in the east. Although the individual SUMAMAD project sites varied greatly in terms of their environmental, social, economic and political parameters, generic lessons and approaches for dealing with dryland challenges were sought for use across these and other dryland locations. The group of international institutions and research centres brought together in the SUMAMAD project were selected for the strength of their ongoing work. Each institution brought its expertise, research facilities and resources, and direct and indirect funding to the project. Such contributions were critical to its success.

Information sharing and cross-fertilization of ideas can enhance knowledge on sustainable land management. The SUMAMAD project benefited from complementary insights from the project's core management group, which consisted of UNESCO, UNU and ICARDA. Within UNESCO, two intergovernmental scientific programmes were involved, the Man and the Biosphere (MAB) Programme and the International Hydrological Programme (IHP). Several national team leaders of the SUMAMAD project sites are members of the national committees of these two programmes. UNU is committed to carrying out pure and applied research, advanced training and capacity building, and the dissemination of knowledge on the pressing global issues facing humankind. As an autonomous academic organization under the United Nations umbrella, it is well placed to mobilize intellectual resources through worldwide networks of scholars and academic institutions. UNU was represented by its International Network on Water, Environment and Health (UNU-INWEH). ICARDA's mission is to improve the welfare of people through research and training in dry areas of the developing world, and to increase the production, productivity and nutritional quality of food, while preserving and enhancing the natural resource base.

Box 3: Research on the Conservation of Biodiversity through the Biosphere Reserve Management Approach
Prof. Boshra Salem, University of Alexandria, Egypt

Biosphere Reserves are sites recognized under UNESCO's Man and the Biosphere Programme which innovate and demonstrate approaches to conservation and sustainable development. The Madrid Action Plan (2008) states that the Biosphere Reserve concept has proven its value beyond protected areas and is increasingly embraced by scientists, planners, policy-makers and local communities to integrate biodiversity conservation with socio-economic development. Thus, Biosphere Reserves serve as learning sites for various stakeholder groups to join efforts and translate global principles of sustainable development into locally relevant praxis.

The essence of Biosphere Reserves can be seen as the effort to identify and promote site-specific management practices to maintain the capacity of an ecosystem to provide a wide range of services for human well-being. The various zones serve as places to attract new investments into hitherto neglected services (climate regulation, water purification) and improve environmental and social performance of provisioning (agriculture, forestry, fisheries) and cultural (tourism) services that may have been the principal recipients of investments to date. Active and continuing consultations between the scientific communities, policy- and decision-makers and local land users in a biosphere reserve are critical in identifying the optimal mix of ecosystem services and their management. The Biosphere Reserve concept also places a major emphasis on inter-disciplinary approaches to develop and test policies and practices to effectively address the challenges in key ecosystems, such as drylands.

The Omayed Biosphere Reserve is located in an arid ecosystem along the Mediterranean coast of Egypt, linking the Nile Delta in the east and Cyrenaica in the west. A wide range of competing human activities, including pastoralism, rain-fed and irrigated agriculture, tourism, oil production, transportation and urban development, are concentrated in a narrow 30 km stretch between the sea and the desert. Bedouin communities with urban vacationers and peasants from the Delta create an unusual mix of people with different interests and needs. The Biosphere Reserve has demonstrated considerable success in developing a consensus among these three stakeholder groups and designing a land use plan that equally satisfies the aspirations of all.

Exploration of Wise Practices for Dryland Management

Management Practices – Traditional, Contemporary and Innovative

Traditional management practices have proven their worth over the millennia, but must now adapt to contemporary conditions. Traditional practices for the capture, storage and efficient use of scarce and variable rainwater, floodwaters and groundwater resources have evolved over time to work well in dryland conditions. Some traditional technologies identified by the SUMAMAD research teams had fallen into disuse and were in need of rehabilitation. Examples of these include the Roman underground cisterns in the Western Desert of Egypt, and the tabias, check dams and jessour in the Zeuss Koutine Watershed in Tunisia. Similarly, traditional garden terracing and irrigation systems had been neglected due to socio-economic changes affecting the population of the Dana village in Jordan. The principles of traditional floodwater spreading and groundwater recharge have a long history of use in the Gareh Bygone Plain, Iran, but new practical know-how was needed to configure them for application in today's context; this is currently being achieved.

The SUMAMAD research teams demonstrated that traditional approaches can be effectively combined with new technology to achieve better results. Traditional designs for water storage cisterns and ponds in Dingarh, Pakistan, had proved their effectiveness, but had not yet incorporated available improvements in materials and construction techniques. New patterns in housing for sedentarized Bedouin in Egypt's Western Desert offered opportunities to incorporate systems for water storage and supply. Traditional grazing patterns in the rangelands of Karnab Chul, Uzbekistan, which were based on high mobility, had been altered by changes in land uses. However, these could be reordered through community organization for transportation of livestock by road. These and other opportunities to adapt traditional and innovative management practices were identified by the SUMAMAD research teams.

Engagement with local communities is essential to understanding their development needs and knowledge of management practices. The SUMAMAD project engaged local scientific and community capacities to support and contribute to the adaptation of sustainable dryland management practices. Research teams worked with local people to conduct surveys to collect local expert knowledge of practices for soil and water conservation. Observations of opportunities for the improvement and adaptation of practices, including opportunities for rehabilitation, enhancement and the introduction of innovative new techniques, were collected. These opportunities were prioritized with local communities.

Sustainable livelihood generation is a key factor in the successful adaptation and enhancement of management approaches. Dryland communities and scientists evaluated the potential of new, innovative practices that would fit local needs and environmental conditions. Box 4 presents management practices considered applicable to the context of each study site. For example, where saline water sources had been developed to support farming and agroforestry at Dingarh, Pakistan, additional alternative uses of these waters - including aquaculture and market gardening - could be introduced to further strengthen local livelihoods. In the case of the Zeuss-Koutine Watershed, Tunisia, where water management techniques were being used by local communities to grow olive trees, the waste products from olive oil processing were used to improve soil conservation, thereby avoiding the water pollution associated with other disposal methods. Cultural preferences influenced the choice of water management approaches to be explored. For example, in Omayed, Egypt, the use of well water was favoured over rooftop rainwater harvesting and storage for use as drinking water. Due to high levels of salinity, new techniques for desalination of water using solar energy were introduced.

Jojoba cultivation in Iran.
Photographer: Sayyed Ahang Kowsar

Ancient water storage system in Tunisia. Photographer: Boshra Salem

Box 4: Summary of Management Approaches and Examples of Practices Explored*

Site	Overall management approach	Examples of management practices explored during the SUMAMAD project
Hunshandake Sandland, China	Natural restoration of degraded sandland	• Removal of grazing pressure from reserve areas • Introduction of poultry farming • Improved processing and marketing of traditional milk products
Omayed Biosphere Reserve, Egypt	Ecological management of land, water and vegetation	• Current use of Moghra Oasis for seasonal grazing • Proposed extension of nature reserve • Desalination of groundwater for domestic use
Gareh Bygone Plain, Iran	Floodwater spreading to support '*Aquitopia*' (please see Box 6)	• Artificial recharge of groundwater • Integrated agroforestry, apiculture and aquaculture
Dana Biosphere Reserve, Jordan	Nature reserve management with local pastoralist and farming communities	• Rehabilitation of traditional spring-irrigated fruit gardens • Local use of olives and aromatic plants for soap production
Dingarh/Lal Suhanra Biosphere Reserve, Pakistan	Conservation of scarce rainwater and conjunctive uses of saline groundwater	• Fish farming with saline water and rainwater • Conjunctive use of saline water for irrigation of vegetables
Khanasser Valley Integrated Research Site, Syria	Farmers Interest Groups for Integrated Natural Resource Management	• Farmer-selected interventions and crop rotations for conservation of nutrients • Growing tomatoes in home gardens
Zeuss Koutine Watershed, Tunisia	Inter-agency cooperation for watershed management	• Traditional water harvesting and spreading • Groundwater recharge techniques • Use of olive oil by-product for soil stabilization • Restoration of degraded rangelands
Karnab Chul, Uzbekistan	Ecological management of rangelands and associated livelihoods	• Improving strategies for breeding and grazing patterns of livestock • Transplanting fodder plants and flower culture • Improvement of traditional wool products and cosmetics

*More detailed compilations of the range of management practices and approaches explored by the SUMAMAD project are presented in UNESCO, 2008. Descriptions of individual practices are reported by National Team Leaders, which are included in the Proceedings of the Annual SUMAMAD Workshops 2003-2007 (please see Annex 2).

Management improvements lead to sustainable increases in agricultural and rangeland productivity. Improved management of water and reduction of overgrazing and other pressures enables sustainable increases in dryland productivity. Increases in productivity were scientifically observed by the study teams (e.g. increased wheat production at the Gareh Bygone Plain in Iran, increased forage production at Hunshandake Sandland in China, etc). At the Khanasser Valley Integrated Research Site, Syria, experiments were carried out on tomato plants to identify the effects of different levels of water and nutrient application on fruit production.

Assessment of Management Practices through Site-Specific Testing

Involvement of local people in the design and application of testing activities enables informed decision-making and broad uptake at the local level. Observations of the effects of resource management practices on productivity were made by local people at all of the participating study sites. Methods for the collection and recording of these observations included the use of Participatory Learning Action Research approaches in Syria to engage farmers in the exploration of management improvements. At other study sites, digital databases were created to enable the integrated analysis and review of environmental and social data with local communities and decision-makers. For example, in Uzbekistan, the research team investigated the relationships between vegetation characteristics and animal pressures, creating a Geographic Information System (GIS) interface to explore, with farmers, whether smaller flocks could be more productive than large herds where grazing resources are scarce. In Egypt, a participatory GIS approach was created with local people and used to develop a range of management scenarios for local decision-making.

Box 5: Diversification of Household Income Sources in Inner Mongolian Grasslands
Prof. Jiang Gaoming, Institute of Botany, Chinese Academy of Sciences, China

In the grasslands of Inner Mongolia, cattle and sheep farming has led to severe land degradation over the past decades. Therefore, the SUMAMAD project tested chicken farming as an alternative income-generating activity involving several families. The project was able to demonstrate that the economic returns per hectare were nine times higher for chicken farming than for the traditional livelihood strategy. In order to support marketing of chicken and eggs, a business company was set up in the area. In addition, participating families were trained in entrepreneurship and business principles. In the future, the project plans to increasingly tap into markets for organic chicken and eggs. These markets are growing, both in nearby urban centres such as Beijing, and internationally. It is expected that this will yield even higher prices and will further encourage farmers to produce safer foods.

The economic incentives encouraged households to switch to the novel livelihood, gradually replacing the less sustainable sheep and cattle farming. This has allowed the natural restoration processes to take place in the grassland ecosystem. Since 2002, Hundshandake Grasslands have become increasingly popular among national and international visitors with an interest in the sandland landscape and Mongolian culture. Subsequently, ecotourism was actively promoted by the project team and local families were supported in building small-scale accommodation facilities. This has further helped to diversify household incomes in this area and strengthen the livelihood security of the local people.

Irrigation channel in Jordan.
Photographer: Brigitte Schuster

The full impact of new management approaches can often be measured only through long-term monitoring. Such long-term monitoring programmes had to be designed for many SUMAMAD project sites. For example, in the Gareh Bygone Plain, Iran, a programme was developed to monitor the effects of the new floodwater spreading on biodiversity. A new monitoring programme was also created for the Dana Biosphere Reserve, Jordan, to observe soil erosion rates. At the Moghra Oasis, Egypt, baseline studies were carried out by local students to characterize plants and other resources in order to guide the discussion of future land use proposals and their possible impacts. Analyses building on data from pre-existing monitoring of land rehabilitation programmes in the Zeuss Koutine Watershed, Tunisia, demonstrated the comparative effects of a range of different techniques on plant cover and biodiversity. Results from long-term studies on the regeneration of grasslands at Hunshandake Sandland, China, demonstrated the previously under-recognized potential of the elm (*Ulmus pumila*) sparse forest grassland ecosystem to regenerate itself through the presence of soil seed banks.

Systematic scientific assessment can enable cross-pollination of ideas across continents. The successes reported from the introduction of new techniques for aquaculture in Pakistan and for household solar desalination units in Egypt attracted considerable interest from dryland

Box 6: Using Community Mobilization and Engagement to Design Management Practices - Aquitopia: Living versus Existing
Prof. Sayyed Ahang Kowsar, Fars Research Centre for Agriculture and Natural Resources, Iran

'*Aquitopia*' was designed to facilitate collaboration of local people and scientists in the rehabilitation of degraded rangelands in the Gareh Bygone Plain, Iran. The activities focused on developing a mixed farming system in severely degraded rangelands in order to provide livelihoods for local people. Artificial recharge of depleted aquifers is undertaken in conjunction with floodwater spreading activities and integrated in a holistic model to rangeland management. Aquitopia is meant to provide an environment for firm believers in "green living" – "don't waste" is the first credo of the *Aquitopians*.

In order to test the Aquitopia model, approximately 1,000 ha of degraded rangelands located in the Gareh Bygone Plain, Iran, was selected by the Kowsar Floodwater Spreading and Aquifer Management Research, Training and Extension Station. Residents of the surrounding four villages have set up registered cooperatives for the management of the *Aquitopia* or are in the process of doing so.

Forty young couples and thirty research scientists and technicians will participate in the activities of the *Aquitopia*. Initially, each community member will be given four hectares of perennially irrigated cropland, four hectares of spate-irrigated pasture and a half-hectare of tree plantation with conjunctive use of spate and groundwater. In addition, everybody is given a grazing permit to raise ten heads of livestock. The whole community will be engaged in action research in agriculture, horticulture, aquaculture, animal husbandry, beekeeping, and conservation of natural resources.

In light of recurring and prolonged droughts, enhanced water productivity and water storage in aquifers is one of the main objectives of the *Aquitopia*. Cropping schedules are planned according to availability of water in the aquifer and the cultivation of crops that are not adapted to arid conditions has been given up. Excess water is sold to neighbouring communities.

managers in other areas within the same countries, as well as in other countries taking part in the project. The project teams reported their findings on specifications for new techniques, the environmental conditions under which they were implemented and their effects on the local environment and on human well-being. Assessments of the performance of management approaches that were compiled through hybrid and participatory scientific studies were reported in an objective scientific manner, enabling their consideration by other scientists and policy-makers working at different locations.

In many cases, decentralized policy processes can be better guided by local successes. The uptake of policy-relevant recommendations varied considerably from one location to another in the SUMAMAD project, and to a great extent, depended on the local governance structure. It was found that a centralized governance structure minimized the possibility that the findings from excellent local results will be scaled up at a regional or national level. Conversely, local success in the Gareh Bygone Plain in Iran were readily recognized, due to a decentralized governance process, and replicated nationally.

Uptake of Wise Practices at the Policy Level

Demonstration of sustainable income generation makes a compelling argument for scaling up modest investments in drylands. Estimates were generated by the Gareh Bygone Plain, Iran, for the total value of wheat and eucalyptus crops to be irrigated through floodwater spreading techniques and the use of artificial recharge water (US$120/ha). A simple cost-benefit analysis demonstrated that investment in the replication of this scheme could quickly pay off. Similarly, the income generation potential of the Hunshandake Sandland site in China increased nine-fold by switching from traditional cattle farming to a more integrated approach involving chicken farming and ecotourism (please see Box 5). Such monetary benefits are easy to monitor and are often more marketable in a political discourse, even though additional non-monetary benefits, which are also achieved, are not captured in such assessments.

Local consultation in China. Photographer: Jiang Gaoming

Improving Livelihoods through Participatory Approaches

Introducing Livelihood Alternatives to Communities

Stresses on marginal drylands can be reduced by creating innovative and sustainable livelihood options for communities. It is generally accepted that proactive management approaches fare better in all kinds of economic conditions observed in drylands (Millennium Ecosystem Assessment, 2005). Furthermore, traditional land-based livelihoods can be used and/or alternative livelihoods can be introduced to maintain a steady-state sustainable consumption pattern. The former poses a greater challenge because the competition for finite resources will inevitably and continually push towards desertification. Conversely, the reliance on alternative livelihoods – such as solar-energy production, ecotourism, and brackish-water aquaculture – take advantage of the unique dryland attributes and reduce stress. By definition, an alternative dryland livelihood has minimal dependence on land primary productivity, yet it typically generates greater income per investment of local resources and diversifies local economies (Méndez, 1993; Adeel and Safriel, 2008).

Local products from the Dana Reserve in Jordan. Photographer: Brigitte Schuster

Alternative livelihoods pose a surmountable challenge in terms of their social and economic adaptability. A common feature of alternative livelihoods is that their viability often requires capital investment and trade-related infrastructure, which in turn depend on enabling policies and effective governance at the local and national levels. These enabling conditions are also instrumental for effective implementation of innovations for attaining sustainability of livelihoods based on land productivity. Such enabling conditions often do not exist in many developing countries with drylands (Safriel et al., 2005). The first step to be taken on the path to dryland sustainable development is therefore to invest in societal, policy and governance changes, building capacity, and creating an enabling environment that can support innovations. This would pave the way for emerging alternative livelihoods.

Better processing and marketing can significantly increase income generation from alternative livelihoods. Cost-benefit calculations were undertaken in the SUMAMAD project sites for the selected alternative income-generating activities. Processing of milk products, rather than direct selling, enabled increases in income generation in the Hunshandake Sandland, China. The added value was around 20%, although this activity was found to be labour intensive. Income generation from dryland honey collection in Iran was reported to be either the equivalent of USD 3 per kg wholesale, or USD 8 retail, with additional revenue possible for eco-labelled honey. Traditional wool products were explored by a number of the research teams. In the Gareh Bygone Plain, Iran, these activities were not selected for further development due to an observed lack of marketing opportunities, whereas in Karnab Chul, Uzbekistan, local markets for wool-based handicrafts were identified in hotels and tourist attractions. In Dana Biosphere Reserve, Jordan, expenditures on local market research were included in the calculation of the development costs for alternative income generation from olive oil soap production, resulting in effective marketing.

Measured Improvements in Local Livelihoods

Assessments of the potential contribution to household income from alternative activities showed considerable returns on small investments when compared to previous occupations. For example, EGP 30-35 (or USD 6.5) invested to purchase sewing machines for Bedouin women generated a reported income of EGP 330 (or USD 62) per month. Researchers in Uzbekistan demonstrated that the seedlings of olive and cypress trees, which were distributed to local families, would be worth a value equal to that of one lamb, following investments only of time and water. Income generated from poultry-raising was far more than had been previously generated through cattle-raising in Hunshandake Sandland, China, enabling the removal of cattle-grazing and the creation of a nature reserve.

Saline aquaculture in Pakistan. Photographer: Zafar Adeel

Improved resource management can reduce household expenditures on basic food and water supplies. For example, investment in the installation of solar-powered units for the desalination of water in Egypt effectively removed the cost from household expenditures of buying water privately, and also led to health improvements through better water quality. Expenditures for animal forage at Hunshandake Sandland were reduced by replacing grazing with other income-generating activities. Household expenditures on food were reduced and improvements in nutrition reported from Dingarh, Pakistan, following the introduction of aquaculture and vegetable-growing. Fruit and vegetable gardening had been observed as a traditional strategy to supplement the local livelihoods in the Dana village, Jordan. This practice was revived through local organization to rehabilitate the hillside gardens and to improve the irrigation systems.

Box 7: Informing Rural Communities about Marketing Ecotourism Products
Mongi Sghaier & Mohamed Ouessar, Institut des Régions Arides, Tunisia

In southeast Tunisia, ecotourism facilities were established in order to create economic opportunities for local people in an environment where agricultural production is limited by water availability and livelihoods largely depend on natural resources. The project is being supported by the Institut des Régions Arides and a number of local NGOs that showed great enthusiasm for contributing actively to the improvement of the local, natural, as well as socio-economic environments in which they operate.

Drylands ecotourism was identified as a highly promising income generating activity that depends less on land productivity, but would support livelihood security of rural communities. The region has a lot to offer tourists - a rich history and interesting archeological sites as well as a pristine landscape with attractive drylands vegetation.

Deployment of the ecotourist "resort" has been largely successful and appreciated by the community. It has required and will continually need development of the community's capacity – through training, exchange visits, extension services, etc. – to fully utilize the tourism potential of the area. Engagement with and contributions from local NGOs have been a key element of success in participating within respective communities.

Benefits Beyond Income Generation: Community Empowerment

At the community-level, alternative income-generating activities strengthen local partnerships and social capital. Limited access to credit and unfavourable terms for lending in marginal dryland communities were identified at the outset of the project as factors preventing investments in land management and setting in motion resource degrading patterns of land and water exploitation. A rotating credit scheme enabled local women in Omayed, Egypt, to purchase sewing machines and fabric to produce dresses over a period of one year. The following year, additional members of the community were able to join the same scheme. In Karnab Chul, Uzbekistan, demonstrations of the potential for marketing handicraft products to tourists led to the development of business partnerships between local hotels and families. In China, the creation of a local cooperative by the project team enabled the management of new socio-economic activities by local people in Bayin Hushu Gacha, while in Egypt, Iran and Tunisia new NGOs were created to support the introduction of alternative income-generating activities across the community.

Tourism site in Tunisia. Photographer: Mohamed Ouessar

Family units can be strengthened through the creation of opportunities for under-employed members. The SUMAMAD research teams emphasized opportunities which helped strengthen family ties. In Karnab Chul, Uzbekistan, as in many other marginal dryland areas, families have been affected by the need for some members to migrate to earn money. The creation of new local businesses provided activities that family members could engage in jointly, as well as offering alternatives to migration.

Knowledge Sharing through Networks

Network Building to Improve Management and Research in Marginal Drylands

Network development – through both formal and informal groupings – has been demonstrated as being a very effective South-South knowledge sharing approach. The project facilitated participation of dryland communities through training and the creation of networks such as farmer interest groups (Khanasser), a commercial company (Hunshandake) and a village cooperative (Gareh Bygone Reserve). This enabled different stakeholders to engage in discussions on decision-making processes. In Syria, this resulted in the establishment of four different stakeholder committees that deliberated on different aspects of the management of the environment around a Ramsar-listed wetland site.

Creating networks with diversity in regional, disciplinary and institutional perspectives can benefit all. The exchange of findings among diverse groups of interdisciplinary research teams and development practitioners took various forms during the SUMAMAD project: national coordination workshops, training and outreach activities, international workshops and research visits, presentations to international conferences, written publications and use of other media. Blind spots and issues overlooked in the studies could be identified through discussion amongst colleagues from different professional backgrounds and national perspectives. For example, study teams considering the planting of eucalyptus trees received advice from other project members on the pros and cons and long-term sustainability and impacts of similar species elsewhere.

Box 8: Influencing National Policy through Communication of Scientific Findings
Prof. Jiang Gaoming, Institute of Botany, Chinese Academy of Sciences, China

The model of "using the land to nurse the land itself", which was developed and tested in the Hunshandake Sandland, China, has proven to be very effective in terms of supporting natural restoration processes in the grassland ecosystem of Inner Mongolia. Despite the obvious achievements at the study site, great efforts in disseminating the success story were required to convince policy-makers of its significance.

Over 200 articles and interviews were published in top national newspapers such as the People's Daily and Guangming Daily. Furthermore, several national television programmes and international news agencies, including the New York Times, Chicago Tribune News and NOVA Powderhouse Productions, reported on the achievements in Hunshandake. Additionally, the project team published two books as well as several articles and scientific papers. Through some 150 lectures in 25 Chinese provinces by the project leader, the findings were also disseminated to numerous universities and schools and reached officials from various Chinese provinces. National workshops held on an annual basis have also been quite instrumental. By bringing together scientists, national and local decision- and policy-makers and local people these workshops provided an excellent platform for discussions and establishing partnerships.

Communicating the achievements at the project site both to national and international audiences proved to be critical in raising awareness and drawing the attention of decision-makers on the significance of the project findings in Inner Mongolia. A number of top officials, including the Vice-President of the State Council, the Minster of Water Resources, the President of Inner Mongolia and the Vice-Chairperson of the National People's Congress, visited the project sites. The suggestions from the project team, disseminated via the Xinhua News Agency, were officially adopted by Mr. Hui Liangyu, the Vice-Premier of the State Council. The Ministry of Agriculture of the People's Republic of China has subsequently allocated 27.4 billion Yuan (approximately US$3.9 million) towards the replication of the Hunshandake model in other Chinese provinces. Professor Dr. Jiang Gaoming, team leader of the Hunshandake case study site, is among the experts guiding this immense project.

Networking in Iran. Photographer: Zafar Adeel

SUMAMAD site visit in Pakistan. Photographer: Caroline King

Collaborative knowledge generation involving young scientists and community members encourages innovation at all levels. Local students taking part in the SUMAMAD project made a substantial contribution to the scientific findings obtained and ensured the effectiveness of outreach activities. Through the SUMAMAD project, the combination of international scientific expertise and farmers' local know-how led to the generation of knowledge that was both locally applicable and internationally transferable. Young dryland farmers and university students taking part in the project received material support for formal studies, including Master's and Doctoral degrees, as well as guidance, mentoring and feedback from other project participants.

Using Networks to Promote Science-Policy Connections

Networks that aim to influence policies at an early stage are more likely to be successful. The SUMAMAD project team had recognized the significance of policies at local and national scales for the success of resource management approaches in marginal drylands. Therefore, the project design deliberately aimed to inform the decision-making processes as an essential component of the project. This was in contrast to the more common pattern in research initiatives where policy influence usually becomes an afterthought.

Involvement of local Pakistani community. Photographer: Zafar Adeel

Box 9: Community Response and Engagement in Project Activities

Prof. Boshra Salem, University of Alexandria, Egypt

The community response to activities of any project cannot be achieved without the mutual trust between scientists and the local community. Through SUMAMAD, and based on previous work in the same area, this trust was developed. This trust was vital to the achievement of the SUMAMAD goals at this project site.

Examples of trust-building exercises include development of a participatory GIS map that equally involved men and women, and even children. This map summarized gender-based information on optimal land use zones for grazing, cultivation, fuel wood collection and water catchment. Local people appreciated being consulted in this process and a strong team spirit emerged among all participants.

In the community dialogue, it became clear that women were facing three major challenges including: 1) travelling long distances to obtain fresh drinking water for domestic consumption; 2) lack of an income-generating activity that could be conducted from home; and 3) lack of identity cards for women and their children that would entitle them to access social services. Identifying these needs was a critical step in order to design relevant project activities. The responses included solar-powered desalination units that enabled domestic use of brackish groundwater, and provision of sewing machines that enabled women to earn extra income. The community response was overwhelming and positive. Women composed poems and songs to express their happiness and called the solar desalination site "the new hope".

Synthesis of complex work processes into easy-to-understand messages can ensure wide dissemination and policy-level uptake. The emphasis on national and international dissemination of findings through effective communication of results and policy-relevance led to the identification of clear recommendations for policy improvements. Within the short timeframe of the project, these messages had clearly been delivered and acted upon in a number of participating countries. The global perspective gained through exchanges in international forums was reflected back into the scientists' work in their own countries and their efforts to communicate with national policy-makers.

Strategies for the Future: Addressing New Challenges

Capturing Knowledge and Wisdom from a Multi-Country Project

The SUMAMAD project has brought to the fore a wealth of scientific knowledge and experience for sustainable dryland management. This has been captured in the annual international workshop publications (SUMAMAD 2002 - 2005; 2007) and the final SUMAMAD publication (SUMAMAD, 2008). Beyond the compilation of scientific knowledge for application in a generic global dryland context, the project also presents more fundamental lessons through the comparison of experiences of coping with dryland challenges in different cultural settings.

Scientific collaboration across national boundaries not only increases knowledge of sustainable dryland management but also enhances mutual respect for other cultures. Faced with dryland challenges in a specific spatial context, scientists may be successful in working out possible solutions. However, if the dryland *problematique* is considered from a different social, economic and cultural angle by experiencing alternative options in other dryland regions, the level of consciousness may be greatly enhanced through novel and fresh ideas that have already been successfully tested elsewhere. Learning from other cultures adds to the knowledge and wisdom of individual researchers and instils mutual understanding and respect among dryland experts. Sharing knowledge with international colleagues also enables dryland experts to consider the wider significance of their work, and to receive recognition, both at home and abroad, for their contributions to science at the international level.

Sharing knowledge, Egypt. Photographer: Zafar Adeel

South-South collaboration contributes to self-reliance among developing countries. North-South dependencies have often been blamed for diverting the full development potential of poverty-ridden nations. Most of the world's drylands occur in developing countries. When efforts are pooled to collectively address and resolve dryland challenges among developing countries, as was demonstrated in the SUMAMAD project, self-reliance within and among such countries is likely to increase. The SUMAMAD project included experts from both North and South, contributing experiences of working in the dryland environments of the South. The focus on South-South exchanges of knowledge ensured that one source of knowledge was no less valued than another, and that exchanges were recognized to benefit all who took part in them.

Dryland research is a cost-effective way to achieve large-scale improvements in human well-being in drylands. As demonstrated by the SUMAMAD project, the costs of dryland research are low and impacts on dryland communities can be large. Considerable scope for research to enhance management techniques in drylands remains. Over the past fifty years, knowledge on dryland ecosystems and their management has greatly increased, but many uncertainties in the fields of dryland research and environmental conservation still prevail (Hutchinson and Herrmann, 2008). Interdisciplinary research efforts to improve the livelihoods and well-being of dryland communities can outperform both conventional

Children roaming alongside grazing cattle, Syria. Photographer: Caroline King

forms of project-based assistance, and conventional agricultural research approaches (Thirtle et al., 2003).

International solidarity is essential to coping with desertification and land degradation in drylands. Such international solidarity has been evidenced by the SUMAMAD project, which has received substantial financial support from the North through the Flemish Government of Belgium, as well as from other donor agencies and national institutions, including Southern partners, who supported complementary work at study sites. Moreover, the inputs provided collectively to the project by large organizations (UNESCO, UNU and ICARDA) demonstrated that international solidarity can be coordinated and effectively practiced.

Revitalization of Traditional Knowledge

Efforts are still needed to stop the erosion of traditional cultures, livelihoods and management practices. Efforts to achieve development and modernization in marginal drylands have included the introduction of changes to traditional ways of life, including the sedentarization of nomadic communities, and the privatization of their lands. These changes have led to the loss of detailed knowledge of local plant and animal species, availability of minerals and water sources and climatic processes that once enabled these societies to survive. The transition to a cash economy and the effects of rising inflation have left many marginalized dryland dwellers still living below the poverty line, without access to the natural resources that once provided for their well-being. Resource stewardship and the transfer of traditional management knowledge from generation to generation have been affected by the accelerating pace and reach of socio-economic change. Institutions for state-led technology transfer have come and gone with political changes in numerous countries. Increasing dependence on external assistance and vulnerability to exploitation by moneylenders, employers and politicians, has increased the effects of socio-economic marginalization in many dryland communities (SUMAMAD, 2003).

Traditional folklore, Pakistan. Photographer: Zafar Adeel

A broad approach to generating knowledge is essential for identifying solutions that effectively address the problems in marginal drylands. In the SUMAMAD project, interdisciplinary research activities and field studies were combined with assessment of traditional practices through participatory research processes. These local knowledge generation activities were further informed by cross-country learning processes. The synthesis and integration of different knowledge sources, including locally available traditional knowledge bases, proved to be effective for tackling the social, environmental, economic, institutional and policy challenges in an integrated manner. Different approaches were explored during the SUMAMAD project to access traditional knowledge, including ethnographic work by outsiders, as well as observations by local research teams with a history of working with traditional knowledge.

Emerging community-based strategies in marginal drylands should build on both traditional and scientific knowledge streams to create societal resilience. Often ignored in scientific projects, traditional adaption strategies in marginal drylands have been systematically reviewed and evaluated in terms of their long-term sustainability through the SUMAMAD project. Since local knowledge alone cannot address the contemporary challenges in marginal drylands, it is critical to merge traditional experience with cutting-edge scientific research and technology. The challenge to develop the right mix between the various knowledge systems rests on the design of research activities. The capacity constraints of the SUMAMAD research teams demonstrate the clear need for further improvement in participatory research approaches in order to maximize use of the diverse knowledge streams available.

Syrian dryland. Photographer: Caroline King

Enabling Policies are Key to Future Solutions

The divide between research and policy-making communities must be bridged in order to address pressing global challenges like desertification and poverty in marginal drylands. Policies, whether implemented at the national or international level, are failing to take full account of the challenges faced by communities living in marginal drylands. Some forces of globalization, while striving to reduce economic inequality and eliminate poverty, are contributing to exacerbating desertification. Perverse agricultural subsidies are one such example. Research communities have an essential role to play in policy formulation, both in ensuring the scientific basis for favoured management approaches, and also in faithfully representing the demonstrated needs of dryland communities.

Sufficient resources must be placed at the disposal of national and local institutions to develop coherent, cohesive and integrated policy approaches. National governments typically do not have sufficient resources to address the management issues, leading to ineffective policy integration. This is often further exacerbated by poor implementation at the local level due to lack of capacity and societal motivation. To counter these effects, we have at our disposal today immense human, technological, institutional and even financial resources. These resources can be allotted to building capacities in developing countries to monitor, analyze and solve their own local problems. Global efforts for data gathering and synthesis must also be reinforced, so that policy arguments at the local and national levels can connect to those at the international arena.

Box 10: Examples of Policy Recommendations from the SUMAMAD Project Adopted at the National Level

A number of practices and approaches demonstrated by the SUMAMAD project teams have been adopted by policy-makers for replication across a wider scale:

- *China*: Following a demonstration of the potential of natural restoration in grasslands and its contribution to local livelihoods, the Chinese State Council adopted the “Using land to nurse itself” approach in June 2006 for replication in Inner Mongolia, Xinjiang, Ningxia, Qinghai and Tibet Province. An investment of USD 4 billion was made available for the programme.
- *Egypt*: The Egyptian Government Sakr Industrial Company has started manufacturing solar-powered desalination units, as developed by the SUMAMAD project, for introduction into other parts of Egypt. The national SUMAMAD team leader was invited to contribute to the National Desalination Strategy for 2025.
- *Iran*: The Iranian Government has decided to replicate the aquifer management activities tested at the SUMAMAD project site on 1.5 million ha of marginal drylands from 2006-11.
- *Pakistan*: The Punjab Province Fishery Department has offered subsidies and technical guidance to foster uptake of dryland fish farming in communities.
- *Syria*: The Syrian Government decided to replicate the integrated approach to natural resource management used by the SUMAMAD project in a number of additional marginal dryland regions in Syria. Furthermore, the project team provided advice to the Head of State Planning Commission in terms of development scenarios.
- *Tunisia*: A local action plan for combating desertification was developed for the community of Béni Khédache, drawing on research findings emerging from the SUMAMAD project. The same approach was proposed to be adopted in two additional communities.

Many factors affect the development of policies at the national level. Nevertheless, the scientific findings provided by the SUMAMAD project significantly supported decision-making processes. Furthermore, in demonstrating the viability of the management approaches, the study teams were able to advocate for policy changes.

Enlightened development policies, sustainable agricultural practices and alternative livelihoods must take aim at reversing the decline of drylands, allowing us to meet the Millennium Development Goals by 2015. The SUMAMAD project has demonstrated a range of measures to protect soils from erosion, salinization and other forms of degradation. The complementary role of land use management policies to protect existing vegetative cover from overgrazing, over-exploitation, trampling and unsustainable irrigation practices has also been demonstrated. These policies can further be strengthened by creating viable livelihood alternatives for dryland populations and directly linking them to national strategies for poverty reduction and meeting the Millennium Development Goals.

Overcoming desertification in marginal drylands is inexpensive and can yield multiple benefits at local and global levels. Solutions to address desertification are an essential element of adaptation to climate change and mitigation of global biodiversity losses, as well as a necessary underpinning for local economic development plans. International investments should be designed to catalyze and leverage further investment from both national and local sources. This can be achieved through ground-breaking research combined with scientific demonstration of sustained impacts from promising techniques. Where these initiatives prove successful, new partnerships can be fostered to scale up the demonstrated approaches.

Natural restoration in China. Photographer: Jiang Gaoming

A Constellation of Dryland Centres

ZKW: **Zeuss-Koutine Watershed,** *TUNISIA*

OBR: **Omayed Biosphere Reserve,** *EGYPT*

DBR: **Dana Biosphere Reserve,** *JORDAN*

KVIRS: **Khanasser Valley Integrated Research Site,** *SYRIA*

GBP: **Gareh Bygone Plain,** *ISLAMIC REPUBLIC OF IRAN*

D/LSBR: **Dingarh/Lal Sohanra Biosphere Reserve,** *PAKISTAN*

KC: **Karnab Chul,** *UZBEKISTAN*

HRB: **Heihe River Basin,** *CHINA*

HS: **Hunshandake Sandland,** *CHINA*

Hunshandake Sandland *China*

Photographer: Xiaoxia Jia

Overview

Located in the middle of Xilin Gol Plateau, Inner Mongolia, and close to the Xilin Gol Biosphere Reserve, Hunshandake is one of the ten major sandlands in China. It is well known as a source area for the dust storms that blow in from the north towards Beijing and Tianjin. Project activities focused on environmental monitoring, sand dune fixation, natural re-growth of grasslands, and the creation of employment opportunities that aim to minimize environmental degradation and the creation of protected areas, all in an integrated and holistic framework.

Institutional arrangements

Lead institution: Institute of Botany, Chinese Academy of Sciences, Xiangshan, Beijing, China

Team leader: Prof. Jiang Gaoming

Partner institutions:
Chinese Man and the Biosphere (MAB) National Committee; Environmental School of Beijing University; Inner Mongolia University; Institute of Zoology at the Chinese Academy of Science; Agriculture University of Mongolia.

Environmental conditions

Hunshandake is located in a semi-arid grassland ecosystem encompassing a wide range of habitats such as sparse elm forests, lowlands, hills and wetlands. The main soil type is Aeolian sandy soil. In the Hunshandake area, monthly temperatures range from –18.3 °C in January to +18.5 °C in July. Most of the annual precipitation (250 to 400 mm) falls during the summer months with little inter-annual variability between the years.

Socio-economic conditions

Hunshandake has a population of 128,000 people, 40% of whom are Mongolian. About two thirds of the population live in rural areas and depend mainly on livestock production for their livelihoods. The animals raised in the area comprise cattle, sheep and, in recent years, increasingly goats.

Main challenges

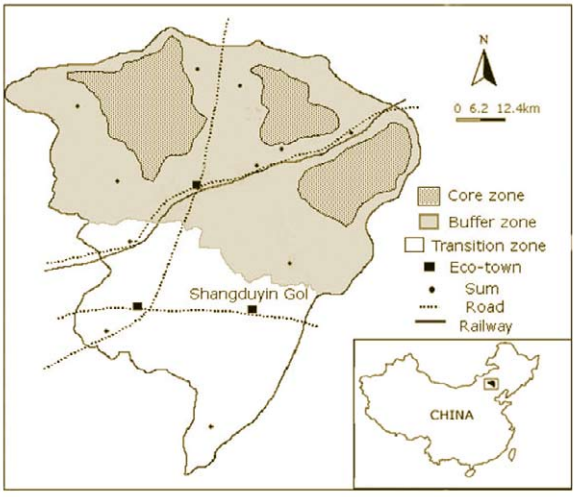
At the Hunshandake Sandland site, the major challenges included the following:

- Severe sand- and grassland degradation, resulting in severe dust storms with effects in areas far away from the source;
- Land degradation caused by overgrazing of cattle, goats and sheep.

Major achievements

The project team in China was able to achieve the following:

- Remarkable natural restoration of severely degraded sandlands;
- Introduction of chicken farming as an alternative livelihood to cattle farming, yielding a nine-fold increase in economic return;
- Outstanding uptake of policy recommendations provided by the study site;
- Successful advocacy for substantial investments in enhancing local road infrastructure;
- Publication of twelve scientific research papers;
- High attention of national and international media.



Heihe River Basin *China*

Photographer: Nagata Hitoshi

Overview

The Heihe River is the second largest inland river (circa 820 km long) in the arid region of northwest China and its basin covers a total area of 128,000 km^2. In the past, the extraction rates of river water have continuously been beyond the estimated sustainable threshold. As a result, lakes and river branches disappeared in the lower reaches of the river and the river flow has become unreliable.

Institutional arrangements

Lead institution: Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, China

Team leader: Dr. Wang Tao

Partner institutions:
Zhanye City Government; Banner Government of Sunan and Linze in Gansu Province; Ejina Banner Government in Inner Mongolia; Water Resources Bureau and Agricultural Extension Station of Gansu Province.

Environmental conditions

The river originates in a mountainous area with elevations as high as 5,500 m and flows on a length of approximately 450 km through the Gobi desert, where it ends in an inland delta at an elevation of 1,000 m. The great topographic difference, along with the continuous decrease in annual precipitation from up to 500 mm in the mountains to less than 50 mm in the Gobi desert, has created a diverse and gradual mosaic of vegetation zones.

Socio-economic conditions

Altogether, the Heihe River Basin is home to almost 200 million people from various ethnic groups. In the upper reaches of the Heihe River Basin, animal husbandry is the predominant economic production system, while in the middle section irrigated production of crops including maize, sunflower and sugar beet prevails. Due to very arid conditions in the lower river basin, pastoralism has been practiced by nomads in the past. However, in recent years, through government directives, nomads have given up their traditional lifestyles. In general, the average Gross Domestic Product (GDP) per capita in the Heihe River Basin is relatively high and approximates 80% of the national GDP average.

Main challenges

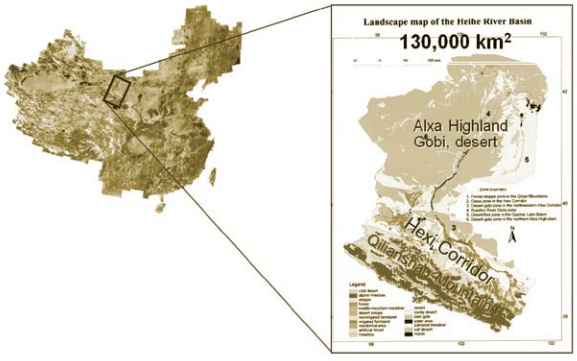
In the Heihe River Basin, SUMAMAD project activities were designed to address the following major challenges:

- Unsustainable extraction rates from the Heihe River caused by rapid population growth coupled with expansion of irrigated land;
- Eco-environmental changes, desertification and soil salinization in the middle reaches, and vegetation degradation in the upper reaches of Heihe River Basin;
- Wind erosion in the lower reaches of Heihe River Basin.

Major Achievements

The project team was able to achieve the following:

- The establishment of Water Users Associations has resulted in enhanced water delivery services, improved system maintenance and reduced conflict among farmers;
- Highly effective water saving measures resulted in an increase of water productivity of the irrigation system;
- Land rehabilitation and soil conservation measures were successfully tested and significantly increased productivity of the grasslands;
- Newly introduced stall-feeding of animals has increased income for farmers;
- Technical staff from local governments and local farmers were trained;
- Demonstration sites have become a scientific classroom for farmers and herders.



Omayed Biosphere Reserve *Egypt*

Photographer: Boshra Salem

Overview

The Omayed Biosphere Reserve (OBR) is located in the western part of Egypt and stretches along the Mediterranean coast on a length of 35 km. Covering a total area of 75,800 ha and ranging from 0 to 110 m, the site was designated as a UNESCO biosphere reserve in 1981, and extended in 1998. The project focused on a wide variety of activities, including ecosystem studies, generating employment opportunities for local communities and establishing solar-powered desalination plants to generate safe drinking water.

Institutional arrangements

Lead institution: Department of Environmental Sciences, University of Alexandria, Alexandria, Egypt

Team Leader: Prof. Boshra Salem

Partner institutions:
Egyptian National Commission of UNESCO; Egyptian National MAB Committee; Omayed Biosphere Reserve; Institute of Social Research of Tanta University; Clear Water Solutions; Mubarak Scientific City at Burg El Arab.

Environmental conditions

The OBR is located in a warm desert and semi-desert ecosystem. Habitats range from littoral calcareous dunes to inland ridges with skeletal shallow soils, saline marshy and non-saline depressions, an inland plateau, pasture land and fig plantations. Its climate has been described as “sub-deserted warm temperate climate” with a rainy season in winter and dry, hot summers. Water resources in the area are very scarce.

Socio-economic conditions

The OBR is home to about 5,500 people, mainly nomadic and semi-nomadic Bedouins, though in some areas the people have become sedentary in recent decades. In general, living standards of Bedouin communities are low due to water scarcity, limited access to social services and lack of infrastructure. For their livelihoods people depend on raising sheep, intensive quarrying and some rain-fed cultivation of grain crops (barley), vegetables and orchards. Irrigated agriculture has become an option, since a canal links the region with the Nile Delta. Animal husbandry, i.e. raising of sheep, generates the highest economic revenues.

Major challenges

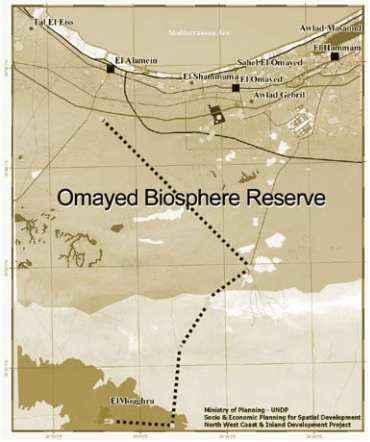
In Egypt, SUMAMAD project activities were designed to address the following major challenges:

- Development of tourism infrastructure affecting fresh water aquifers;
- Groundwater pollution caused by seawater intrusion and by sewage from septic tanks;
- Rangelands degradation and destruction of wildlife habitats caused by overgrazing, woodcutting, soil salinization and introduction and/or expansion of agroforestry systems; and
- Shift from traditional nomadic patterns to sedentary lifestyles coupled with overall population growth.

Main achievements

The Egyptian team was able to achieve the following:

- Participatory GIS database of OBR identifies use zones for the benefit of the local community;
- An assessment of natural resources in the Moghra Oasis adjacent to the OBR provides the basis for an extension of the Biosphere Reserve;
- A solar powered desalination unit provides drinking water to one of the poorest communities in OBR;
- A microcredit scheme allowed Bedouin women to engage in income-generating activities based on sewing;
- Issuing of identity cards enabled more than 150 Bedouin women access to social rights and health services;
- Creation of an NGO established by graduate students of the University of Alexandria which supported SUMAMAD project activities;
- Postgraduate training for members of the SUMAMAD team.



Gareh Bygone Plain *Iran*

Photographer: Zafar Adeel

Overview

The undulating area southwest of the Gareh Bygone Plain is a marginal rangeland used by nomadic farmers. While floodwaters frequently occur, no efforts have been made to manage or retain them for future usage.

Institutional arrangements

Lead institution: Fars Research Centre for Agriculture and Natural Resources, Shiraz, Iran

Team Leader: Prof. Sayyed Ahang Kowsar

Partner institutions:
University of Shiraz; Shiraz Medical University.

Environmental conditions

The Gareh Bygone Plain is situated in an arid region with a mean annual precipitation of 250 mm and high temporal and spatial variation of rainfall. A few brackish water holes provide water for wildlife and livestock. Aridisols and Entisols consisting mainly of loose sand are predominant. Phyto-geographically, the Gareh Bygone Plain is located between two major habitats of Irano-Turanian domain and the Persian Gulf-Oman group.

Socio-economic conditions

There are four villages in the Gareh Bygone Plain with a total population of 2,127 people, who are mainly transhumant nomads (figures from 2003). About two thirds of the households in the Gareh Bygone Plain live below the poverty line, while the rest is not much better off. Most of the people depend on agriculture for their livelihoods. The bulk of the income is generated through agro-pastoral land uses comprising the cultivation of wheat, barley, cotton, sugar beets, alfalfa, tomatoes, cantaloupe and watermelons, as well as herding of sheep and goats. Beekeeping is becoming increasingly important.

Main Challenges

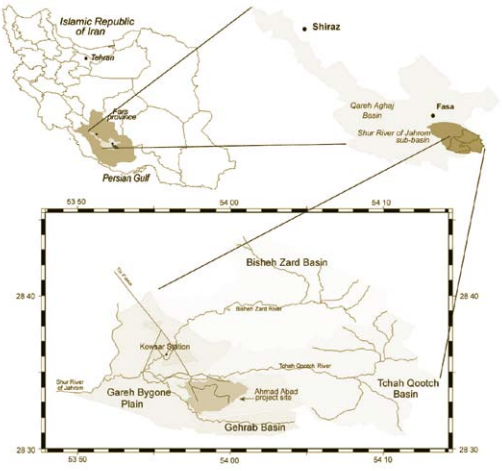
In Iran, SUMAMAD project activities were designed to address the following major challenges:

- Recurring droughts and declining freshwater resources resulting in food security challenges;
- Overgrazing, fuel wood collection, unsustainable hunting levels and application of inappropriate technologies causing rangeland degradation;
- Salt water intrusion in alluvial aquifers;
- Soil salinisation problems caused by irrigation with saline water;
- Out-migration of people from areas affected by dust storms to urban centres.

Major Achievements

The Iranian team was able to achieve the following:

- Policy-makers allocated funds for scaling up the aquifer management and recharge technologies tested by the SUMAMAD team on 1.5 million ha of degraded rangeland;
- The artificial recharge of aquifers and enhanced water-use efficiency provided the basis for an eight-fold increase in the area of perennially irrigated farm fields;
- Marketing of honey provides additional income to local people, while eco-labelling is being pursued for added value;
- Enhanced carbon sequestration by spate-irrigated tree plantations;
- Enhanced forage yield (five–fold increase) by introducing spate-irrigation to rangelands.



Dana Biosphere Reserve
Jordan

Photographer: Brigitte Schuster

Overview

The Dana Biosphere Reserve is situated in a hilly to mountainous region with the Dana valley being the major landmark. Covering an area of 30,800 ha and ranging from 100 to 1,500m in altitude, the Dana Biosphere Reserve was designated as a biosphere reserve in 1998. Project activities focused on integrating conservation of nature with socio-economic programs, including income-generating activities.

Institutional arrangements

Lead institution: The Royal Society for the Conservation of Nature, Amman, Jordan

Team Leader: Mr. Mohammad Al-Qawabah

Environmental conditions

The Dana Biosphere Reserve is located in an arid to semi-arid ecosystem and comprises a wide range of habitats including semi-arid forests, mid-altitude steppe with shrubs, Acacia subtropical habitats and sand-dune deserts. The climate in the Dana Reserve varies from the eastern high lands, where altitudes reach 1,600 m, to the western lowlands with an altitude of only 100 m. The climate in the high lands is characterized by cold winters and average monthly temperatures ranging from -10 °C to +15 °C. Annual rainfall varies from 100 to 350 mm.

Socio-economic conditions

24,900 people live adjacent to the reserve area. Farming activities, government jobs and employment in nearby factories are the major sources of income for the villagers settled around the reserve. The Bedouins concentrated in the western lower areas around the reserve still depend on livestock grazing and use the reserve as a grazing area for their animals. Dana Reserve has also created limited employment opportunities for local communities related to tourism development.

Main challenges

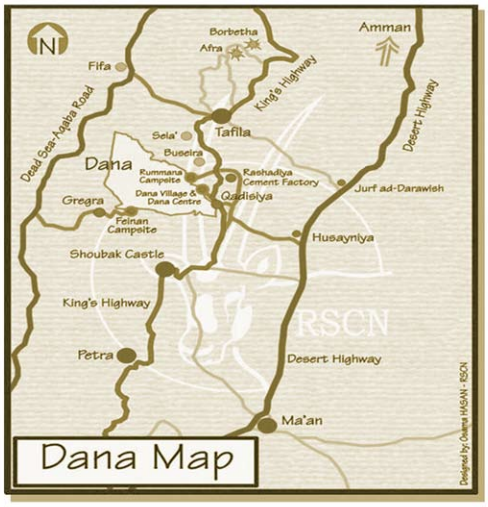
In Jordan, SUMAMAD project activities were designed to address the following major challenges:

- Overexploitation of natural resources including overgrazing, wood collection, and hunting;
- Large areas of unsuitable drylands used for agriculture;
- Over-pumping of water causing continued decline in the level of aquifers and increased soil salinity;
- Overuse of chemical fertilizers.

Major achievements

The research team in Jordan was able to achieve the following:

- Professional marketing and packaging of traditionally produced olive oil soaps increasing the income of olive oil farmers and women involved in the production;
- Eco-tourism lodge in the Dana Biosphere Reserve is almost entirely managed by local people and has created additional employment opportunities;
- A water-efficient irrigation system has enhanced the productivity in village orchards established on traditional stone terraces.



Dingarh/Lal Sohanra Biosphere Reserve *Pakistan*

Photographer: Zafar Adeel

Overview

Covering a total area of 65,791 ha, the site was internationally recognized as a biosphere reserve in 1977. In the adjacent Cholistan desert and research sites, project activities focused on soil and water conservation and the establishment of saline fish ponds to diversify income opportunities for dryland communities.

Institutional arrangements

Lead institution: Pakistan Council of Research in Water Resources, Bahawalpur, Pakistan

Team Leader: Dr. Muhammad Akram Kahlown

Environmental conditions

Lal Sohanra Biosphere Reserve is located in a warm desert and semi-desert ecosystem. The vegetation in the project area is adapted to the arid conditions and grows sparsely in subtropical thorn forests and the Cholistan desert habitat. There is also a limited number of freshwater wetlands in the reserve. The soils are moderately calcareous and predominantly consist of sandy deposits. Severe salinity and sodicity problems exist. The climate of the area is arid subtropical and continental, characterized by low and sporadic rainfall, and high temperature. The study area is one of the driest and hottest areas in Pakistan. The annual rainfall varies between 100 and 250 mm.

Socio-economic conditions

The human population residing in and adjacent to the Lal Sohanra Biosphere Reserve encompasses many different ethnicities with different characteristics, languages and customs. Total human population of the project site is more than 4,000 people, whose main livelihood (70%) is livestock rearing, particularly of sheep, goats, cattle and camels. Off-farm work, marketing of local handicrafts and farming on the periphery of the desert represent additional sources of income.

Main challenges

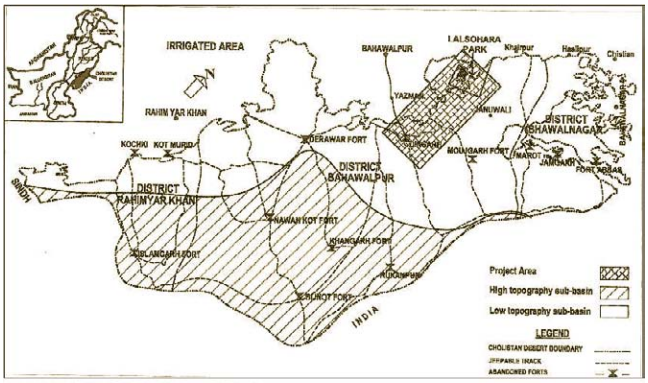
In Pakistan, SUMAMAD project activities were designed to address the following major challenges:

- Extreme water scarcity limiting the area of irrigated agriculture;
- Rangelands degradation caused by uncontrolled grazing systems;
- Limited access to markets and processing industry for livestock products (e.g. milk, hides, meat, leather, wool);
- Limited infrastructure for communication and transportation;
- Lack of alternative livelihoods other than livestock rearing.

Major Achievements

The research team in Pakistan was able to achieve the following:

- Saline fish farming proved to be an economically successful, alternative livelihood for local communities that uses the largely untapped potential of available brackish water resources;
- Cultivation of vegetables using rainwater and saline groundwater provides additional income to local people;
- A combination of rainwater harvesting and sand filter technology enhances the availability of fresh water both for human consumption and sheep farming.



Location Map of the Lalsohara Biosphere and Cholistan Desert

Khanasser Valley Integrated Research Site *Syria*

Photographer: Richard Thomas

Overview

The Khanasser Valley is a typical dryland area in the transitional rain-fed agriculture - rangeland zone of Syria. The valley is located approximately 70 km southeast of the city of Aleppo. A range of options for farmers were considered, including strengthening traditional farming activities, diversification options and intensification options.

Institutional arrangements

Lead institution: International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria

Team Leader: Dr. Richard Thomas

Partner Institutions:
General Commission for Scientific Agricultural Research; Ministry of Agriculture and Agrarian Reform; University of Tishreen (Syria); Syrian Atomic Energy Commission.

Environmental conditions

The Khanasser Valley falls within the winter rainfall zone of 200 to 250 mm per year and is, therefore, marginal for cereal production. The agricultural area and the natural rangelands of the steppe meet in the valley. More than 5,000 sheep are kept on the grazing lands. Seasonal in-migration of Bedouin flocks in the summer may bring in another 25,000 animals to graze on cereal stubble and other crop residues. The relatively high densities of human and livestock populations in the valley put enormous pressure on the land resources of the area and soil degradation is severe.

Socio-economic conditions

Approximately 11,000 people live in 26 villages in the valley, another 32 villages are located in the surrounding hill ranges and rangelands. The people are poor and the majority of the population is involved in agricultural activities. Most households practice a combination of crop production and livestock rearing. Rain-fed farming, with barley as the dominant crop, occupies the major part of the arable land. Off-farm activities are very important in providing sufficient income for the families in this resource poor area.

Main challenges

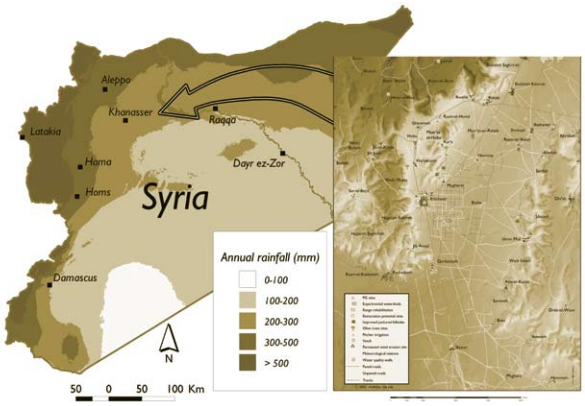
In Syria, SUMAMAD project activities were designed to address the following major challenges:

- Insufficient rainfall for rain-fed cultivation of crops;
- Unsustainable irrigation practices combined with a low natural recharge leading to degradation of groundwater resources (both quality and quantity);
- Insufficient drinking water supplies for local communities;
- Soil erosion by wind and floods.

Major achievements

The research team in Syria was able to achieve the following:

- Establishment of farmer interest groups to determine researchable issues;
- Estimations of sustainable groundwater use;
- Demonstration of the value of small, low-cost, dam structures;
- Increased community awareness of nutrient flows and inefficiencies of use at farm scale;
- Higher yielding crop rotation options;
- Increased awareness of agricultural and non-agricultural options for marginal areas at government planning level;
- Multi-stakeholder process established for the protection of a wetland area.



Zeuss-Koutine Watershed *Tunisia*

Photographer: Mohamed Ouessar

Overview

The watershed of Zeuss-Koutine is situated in south-eastern Tunisia, north of the city of Médenine. In this region, anthropogenic pressure has increased considerably since the 1960s leading to environmental degradation in terms of reduced vegetation cover, poor and eroded soils. Adaptation mechanisms of the local population to environmental change were analyzed and validations of techniques for combating land degradation were carried out.

Institutional arrangements

Lead institution: Institut des Régions Arides (IRA), Médenine, Tunisia

Team Leader: Dr. Mohamed Ouessar

Partner Institutions:
Institut d'Olivier-Zarzis; Commissariat Régional au Développement Agricole in Médenine; Association des Jeunes de Zammour in Béni Khédache; Association des Amis de la Terre in Tataouine; Association de la Protection de la Biodiversité in Béni Khédache; Association de Sauvegarde de la Nature et de la Protection de l'Environnement à Douiret in Tatouine; Union Tunisienne d'Aide aux Insuffisants Mentaux – Section de Médenine.

Environmental conditions

The Zeuss-Koutine watershed of southeastern Tunisia is characterized by steppe vegetation in an arid climate. There are also some Wadi beds and watercourses with a distinct species composition. Total rainfall is low (150 to 240 mm) and highly irregular. Temperature differences are extreme between the seasons ranging from -3 °C up to +48 °C (in the shade).

Socio-economic conditions

Approximately 1.4 million people live in the Jaffra (figures from 1994). Despite problems of desertification and water scarcity, the agricultural sector remains the major source of income in the area. Olive production represents the main agricultural activity, but also the cultivation of cereals and traditional breeding of camels and small-stock contribute to the livelihoods of people.

Main challenges

In Tunisia, SUMAMAD project activities were designed to address the following major challenges:

- Frequent periods of serious droughts;
- Floods causing soil erosion;
- Overgrazing in rangelands;
- Land uses competing for limited water resources.

Major achievements

The research team in Tunisia was able to achieve the following:

- Optimized use of the olive waste water '*margines*' for soil stabilization and fertility improvement;
- Alternative groundwater recharge structures (recharge wells) tested;
- Better understanding of the role of water harvesting in flood prevention;
- Most appropriate rangeland rehabilitation practices were identified;
- Local action plans for combating desertification in place for Béni Khédache (Médenine) and Chareb-Ségui (Kébili);
- Economic diversification in participating communities through establishing ecotourism facilities linked with marketing of erg sand-based handicraft;
- Enhanced capacity of SUMAMAD team through post-graduate education and skills training.

Karnab Chul *Uzbekistan*

Photographer: Muhtor Nasyrov

Overview

The Karnab Chul is a steppe region located in the southern part of Uzbekistan south of the Kyzylkum desert. About half of the land area is rangeland and overgrazing has destroyed many plant communities, especially those close to watering points. Research focused on adequate pastoral management schemes and the development of ecotourism and handicraft production to diversify dryland economy.

Institutional arrangements

Lead institution: Samarkand Division of the Academy of Sciences of the Republic of Uzbekistan

Team Leader: Dr. Muhtor Nasyrov

Partner Institutions:
Samarkand State University; Uzbek Research Institute of Karakul Sheep Breeding and Ecology of Deserts; Universtiy of Saskatchewan (Canada); Utah State University (USA); Colorado State University (USA); Technical University of Munich (Germany).

Environmental conditions

The Karnab Chul is located in a steppe region and consists of rolling lowlands with elevations between 100 and 500 m. The Uzbek climate is predominantly continental resulting in wet and cold winters, while summers are mostly dry and hot. The annual precipitation ranges from 100 to 200 mm for the most part of the Karnab Chul region. Desert soils of Uzbekistan are characterized by low organic matter, a high level of calcium and a generally low agricultural potential. Frequently, the soils are saline and alkaline and have a high level of compaction. The flora in Uzbekistan is extremely rich, and comprises more than 3,100 species of vascular plants, of which 366 are endemic.

Socio-economic conditions

Agriculture is practiced on 62% of the land, with irrigated land occupying only 15%. Raising small ruminant animals has become increasingly important in recent years. However, the main source of income for adults is employment in nearby towns and cities and out-migration to work as seasonal labourers is common.

Main challenges

In Uzbekistan, SUMAMAD project activities were designed to address the following major challenges:

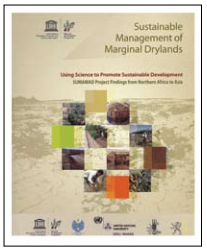
- Widespread degradation of natural resources, with accompanying losses in organic matter and soil fertility and increased salinity;
- Overgrazing with sheep and uprooting of shrubs threatening the high plant biodiversity;
- Population growth and associated expansion of agricultural activities causing land degradation;
- Water scarcity and misuse compounding the threat to food security, human health and ecosystems.

Major achievements

The research team in Uzbekistan was able to achieve the following:

- An improved herd management system has alleviated the grazing pressure on rangelands;
- Local farmers trained in simple monitoring techniques to keep track of land degradation trends;
- Native fodder plants were successfully tested for rehabilitation of degraded rangelands;
- Various income-generating activities were promoted, including production of wool carpets, marketing of traditionally produced soaps based on native medicinal plants, marketing of ecotourism sites in the region, processing of sheep products (meat, wool, milk and karakul pelts) as well as ostrich farming.

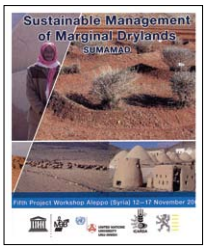
SUMAMAD Publications



Sustainable Management of Marginal Drylands. *Using Science to Promote Sustainable Development – SUMAMAD Project Findings from Northern Africa to Asia.*

Published by UNESCO, 2008.

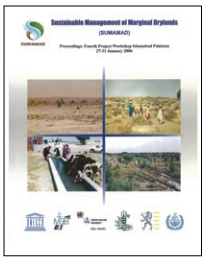
This publication synthesizes the results of the SUMAMAD project. The objective of the project was to elaborate wise dryland management practices by involving local communities while satisfying their needs for sustainable livelihoods. Study sites included field research stations and biosphere reserves, which also served as testing grounds for alternative income opportunities among dryland communities based on their perceived needs and priorities. It is hoped that the knowledge gleaned from the individual project sites will also benefit dryland regions in other parts of the world.



Proceedings of the 5th Project Workshop: Sustainable Management of Marginal Drylands, in Syria.

Published by UNESCO, 2007.

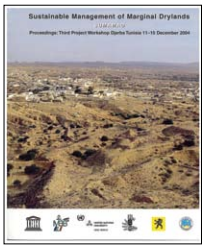
This workshop was organized from 12 - 17 November 2006 by UNESCO, the United Nations University, and the International Centre for Agricultural Research in the Dry Areas. The event was hosted at ICARDA's Headquarters in Aleppo (Syria) and included a field trip to Khanasser Valley.



Proceedings of the 4th Project Workshop: Sustainable Managament of Marginal Drylands, in Pakistan.

Published by the UNESCO, 2006.

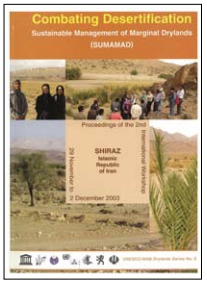
During 2005, the SUMAMAD project made considerable achievements, as demonstrated by the country reports. This workshop was organised by the Pakistan Council for Research in Water Resources.



Proceedings of the 3rd Project Workshop: Sustainable Management of Marginal Drylands, in Tunisia.

Published by UNESCO-MAB, 2005. MAB Drylands Series No 4.

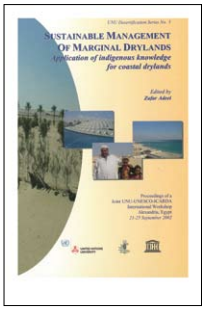
Desertification processes in drylands cause adverse impacts on non-dryland areas; these impacts are physical, societal and economic. The affected areas are often located thousands of kilometres away from the desertified areas. The physical impacts include dust storms, downstream flooding, impairment of global carbon sequestration capacity, and regional and global climate change.



Proceedings of the 2nd International Workshop on Sustainable Management of Marginal Drylands, in Iran.

Published by UNESCO-MAB, 2005. MAB Drylands Series No 3.

This workshop was organized 29 November - 2 December 2003 by UNESCO, the United Nations University, and the International Centre for Agricultural Research in the Dry Areas. The event was hosted in Shiraz, Islamic Republic of Iran, by the Fars Research Centre for Agriculture and Natural Resources and included a field trip to the Gareh Bygone Plain.



Proceedings of the 1st International Workshop on Sustainable Management of Marginal Drylands, in Egypt.

Published by UNU, 2003. Desertification Series No 5.

This workshop was organized 21 - 22 September 2002 by the United Nations University, UNESCO, and the International Centre for Agricultural Research in the Dry Areas. The event was hosted in Cairo, Egypt, with a field visit to the Omayed Biosphere Reserve and the Marsah Matrouh Project.

Copies of the above publications can be obtained through the respective organization. Please contact t.schaaf@unesco.org or contact@inweh.unu.edu to receive a copy or for more information.

Annex 3

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Acknowledgments

This policy brief synthesizes the key messages of the multi-country initiative “Sustainable Management of Marginal Drylands” (SUMAMAD) that was implemented from 2003-2007. The project investigated community-based strategies to combat desertification and to improve livelihood conditions of dryland dwellers in nine study sites spanning from North Africa to East Asia. This report complements the SUMAMAD synthesis publication (available from UNESCO).

The SUMAMAD project would not have been possible without the collaboration and support of multiple partners, including: UNU-INWEH, the Man and the Biosphere Programme of UNESCO and ICARDA, who formed the core inter-agency management team; the Flemish Government of Belgium, who provided substantial financial support; the country partners comprising the Chinese Academy of Science (China), the University of Alexandria (Egypt), the Fars Research Centre for Agriculture and Natural Resources (Iran), the Royal Society for the Conservation of Nature (Jordan), the Pakistan Council of Research in Water Resources (Pakistan), ICARDA (Syria), the Institut des Régions Arides (Tunisia) and the Academy of Sciences of Uzbekistan (Uzbekistan) that coordinated national research activities and supported complementary work on study sites; as well as Ghent University (Belgium) and K.U. Leuven University (Belgium) for contributing their expertise to the success of the project.

A number of individuals played a key role in ensuring the success of the project, in particular the leaders of the study teams in the project countries, including (in alphabetical order): Mr. Mohammed Al-Qawabah (Jordan), Prof. Jiang Gaoming (China), Dr. Muhammed Akram Kahlown (Pakistan), Prof. Sayyed Ahang Kowsar (Iran), Dr. Muhtor Nasyrov (Uzbekistan), Dr. Mohamed Ouessar (Tunisia), Prof. Boshra Salem (Egypt), Dr. Wang Tao (China), and Dr. Richard Thomas (Syria). Dr. Rudy Herman, representative of the Flemish Government, has been a valuable source for technical backstopping and made expertise available through a network of experts; two experts, Prof. Donald Gabriels and Prof. Dirk Raes, have accompanied the SUMAMAD project since its inception.

This policy brief was developed through joint efforts of the writing team and was enriched by on-the-ground examples and experiences contributed by the case study coordinators. Dr. Juliet Wallace (post-doctoral researcher at McMaster University, Canada) gratefully helped by proof-reading the report. Ms. Harriet Bigas (UNU-INWEH) contributed valuable ideas to the design and layout of the policy brief.


SUMAMAD


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