SOLAW TR15

Sustainable options for addressing land and water problems - a problem tree and case studies

SOLAW Background Thematic Report - TR15

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Abbreviations and acronyms

CAADP	Comprehensive Africa Agriculture Development Programme
GIAHS	Globally important agricultural heritage systems
ICRAF	International Center for Research in Agroforestry
IFAD	International Fund for Agricultural Development
IFAS	International Fund for Saving the Aral Sea
LADA	Land degradation of drylands
LCBC	Lake Chad Basin Commission
NEPAD	New Partnership for Africa's Development
PES	Payment for environmental services
PESAL	Payments for Environmental Services from Agricultural Landscapes
RUPES	Rewarding Upland People for Environmental Services
SARD	Sustainable agriculture and rural development
TECA	Technologies and good practices for small producers
UNRCCA	UN Regional Centre for Preventive Diplomacy in Central Asia
USSR	Union of Soviet Socialist Republics
WOCAT	World Overview of Conservation Approaches and Technologies

1. Introduction

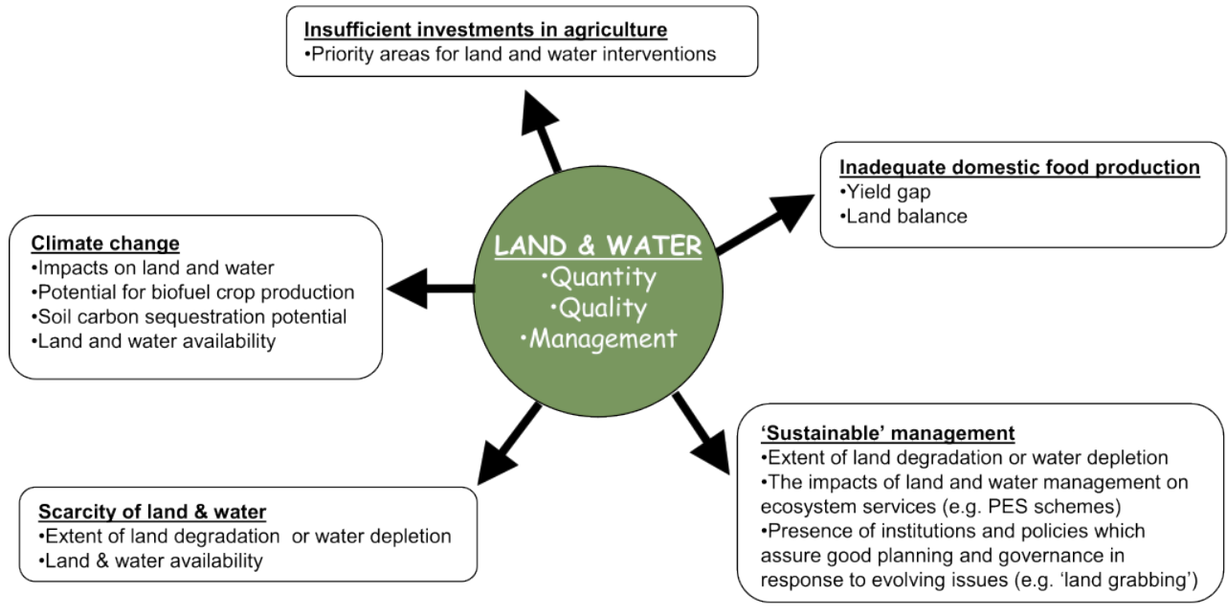
Sustainable Land and Water Management, SLWM, is defined as "the use of land and water resources, including soils, water, plants and animals, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions" (CDE, 2010).

SLWM is seen as the key to overcoming many land and water constraints, and for ultimately addressing globally important issues such as inadequate domestic food production, climate change adaptation and mitigation, scarcity of land and water, sustainable management and insufficient investments in agriculture (Figure 1). These issues are often key drivers in many national development programmes and related international cooperation activities.

Depending on the context, decision-makers may choose from among a wide range of possible options – technological, policy as well as institutional – to promote SLWM. To better convey this fact, this report presents a simplified graphic overview, in the form of a decision tree, of selected SLWM options for enhancing food security. In addition, selected case studies are presented that illustrate specific issues noted on the problem tree.

Figure 1 Data on the quantity, quality and management of land and water resources are useful for deriving a range of indicators for guiding decision-making on globally important issues. Selected indicators are listed in the box assigned to each issue. A single indicator may be useful for multiple issues.

FIGURE 1: KEY ASPECTS OF LAND AND WATER RESOURCES



Note: PES – payment for environmental services

2. Sustainable management of land and water resources for enhanced food security: Key considerations

Globally, considerable geographic variation exists in the natural endowment of suitable land and water resources for agriculture under current and future conditions affected by climate change. Locally, problems of scarcity and access – with negative implications for potential conflicts and sustainability – may be made more acute by a variety of local factors, including land-use competition, population pressure, large-scale land acquisitions and demands for liquid biofuel crop production.

Multiple stakeholders having differing and at times conflicting interests influence the local management of land and water resources. Appropriate institutions and policies are therefore pre-requisites for facilitating negotiations, assuring equitable land tenure and water rights for the promotion of sustainable management.

A wide variety of land and water technologies and implementation approaches could contribute to sustainability. However, spreading these to other parts of the world will require adaptation to local ecological and socio-economic conditions as well as appropriate cooperation at regional to international levels.

Enhancing 'food security' is a concept that encompasses not only greater food production but also access to food and adequate nutrition. Enhancement could thus be achieved through a wide variety of pathways each of which contributes to attainment of this goal.

Current projections indicate that the increased food production expected by 2050 (+70 per cent globally) will be met mostly through intensification, as opposed to expansion of cropland area (Bruinsma, 2009), thus signalling the need to promote sustainable forms of intensification.

3. A problem tree and caveats of interpretation

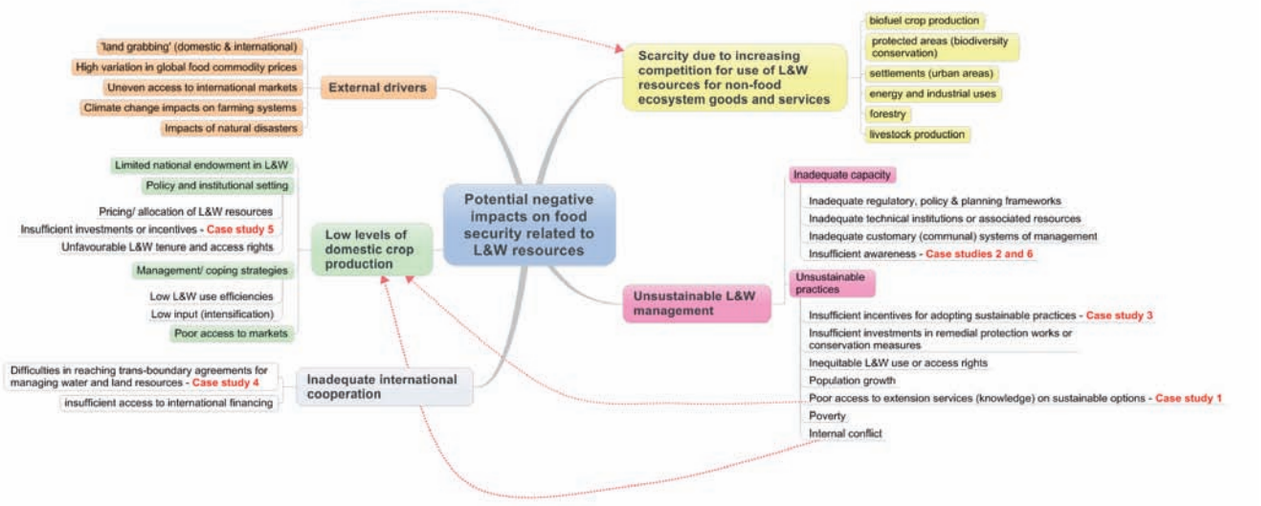
Scope of problems

The problem tree shown in Figure 2 highlights a variety of land and water problems that could hinder sustainable intensification and ultimately trigger negative impacts on food security. At the highest hierarchical level, attention has been focussed on the following five main contributory issues.

- Scarcity resulting from increasing competition
- Unsustainable land and water management
- Low levels of domestic crop production
- Inadequate international cooperation
- External drivers

Other secondary and tertiary contributing issues are presented in Figure 2. Issues are presented hierarchically. In practice, however, for any given location, multiple issues are often closely inter-linked and thus difficult to present graphically. As an example of such inter-linkage, 'internal conflict' contributes both to a higher incidence of unsustainable land and water management practices as well as to low levels of domestic crop production (Figure 2).

FIGURE 2: **PROBLEM TREE – OVERVIEW OF MAJOR LAND AND WATER ISSUES AFFECTING FOOD SECURITY.**



Local conditions dictate appropriate responses

The problem tree in Figure 2 is based on a global overview of the status and trends of land and water. It cannot be used as a support tool for decision-making, which would lead to optimal responses in all cases. This reflects the reality that actions or measures to promote sustainability must respond to the specific set of problems in the local environmental, economic and social setting (Figure 3). Often, a problem such as erosion or declining crop yields is recognized and addressed in isolation.

However, an optimal response might need to address an underlying or related problem, for example poor market access for produce or inputs, or additional contributory issues identified in Figure 2. Despite these limitations, a generalized problem tree could help identify a full set of conditions or issues relevant to a problem, as well as alternate options that could be considered in planning an effective response. Figure 3a presents a summary of technological options, while Figure 3b focuses on the required enabling conditions which, depending on the local context, could contribute toward sustainable intensification.

Where and what priorities for sustainable-management response options?

Geographic targeting of areas for priority attention must take into account a wide range of considerations, such as those indicated in Figure 2. Priorities for various options may be based on locally relevant socio-economic considerations: How many poor or food insecure would benefit from interventions promoting sustainable management of land and water resources? What land and water-use practices have social, economic and environmental impacts that are considered unacceptable to stakeholders? Which livelihoods are the most threatened by unsustainable management?

Agricultural land use systems

In many rural settings, livelihoods are largely determined by the local endowment of land and water resources suitable for agriculture – a characteristic that generally varies slowly, as well as by more rapidly changing socio-economic factors at national to local level such as policy shifts that often trigger changes in the choice of land-use and management options. This spatial 'livelihood' context is evident on maps of agricultural land-use systems, which integrates both biophysical and socio-economic conditions and, as such, provides useful guidance for the geographic targeting of remedial response options (Figure 4, Table 1).

Figure 4 presents a global overview, thus only major land-use systems are shown. The main characteristics of each land-use system, including crop types and the level of crop-livestock integration are shown in Table 1. Maps to support decision-making at local levels will require greater spatial detail than shown in Figure 4, which is based on generalized global data sets, while taking into account locally important factors.

FIGURE 3A: SELECTED TECHNOLOGICAL OPTIONS THAT FOSTER IMPROVEMENTS IN THE USE OF LAND AND WATER RESOURCES AND COULD CONTRIBUTE TO SUSTAINABLE INTENSIFICATION

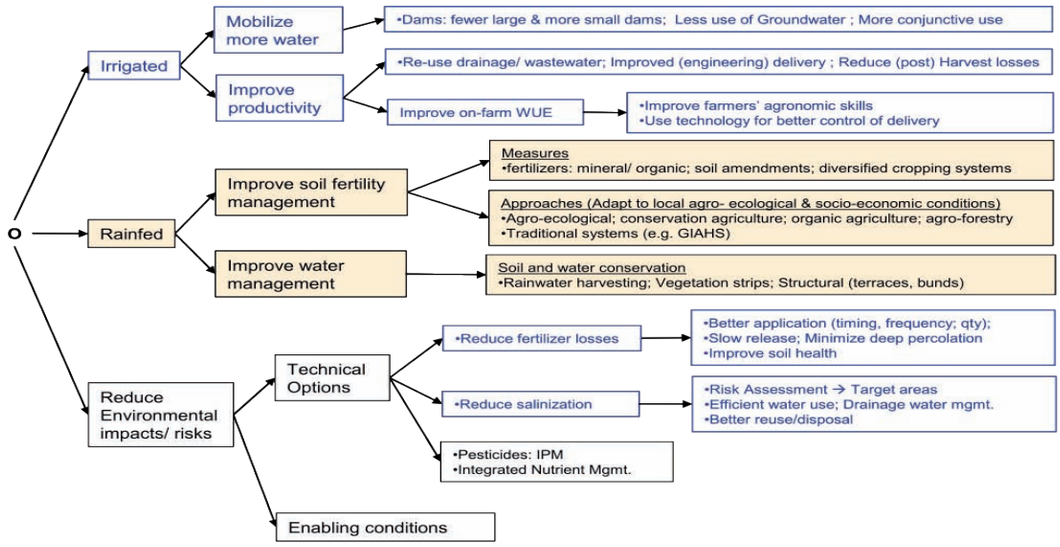
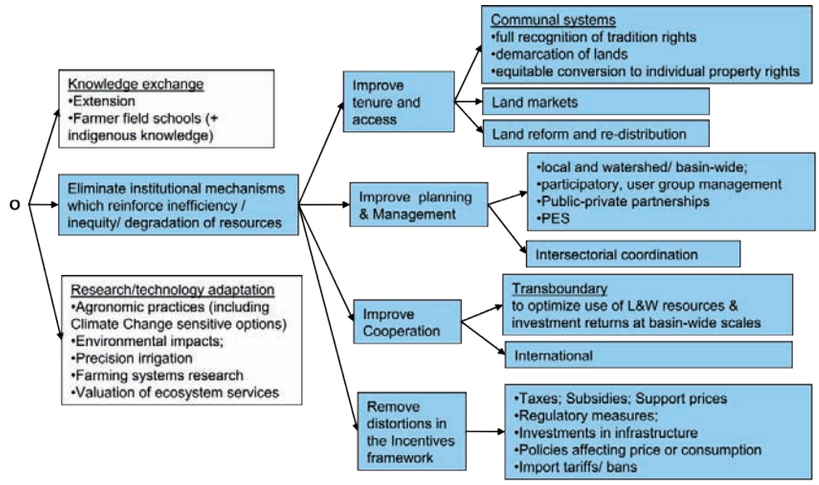


FIGURE 3B: SELECTED ENABLING CONDITIONS THAT FOSTER IMPROVEMENTS IN THE USE OF LAND AND WATER RESOURCES AND COULD CONTRIBUTE TO SUSTAINABLE INTENSIFICATION



The map in Figure 4 provides useful guidance for geographic targeting of remedial response options that support the implementation of sustainable land and water management at regional to global scales. Expert knowledge of major land uses in various geographic locations as well as selected ancillary data, namely the extent of irrigated areas, paddy zones, altitude, climate and aridity index, were used to guide each step of the stratification of land-cover data into major land-use systems. Key characteristics of each system are indicated in Table 1.

FIGURE 4: GLOBAL MAP OF MAJOR AGRICULTURAL LAND USE SYSTEMS.

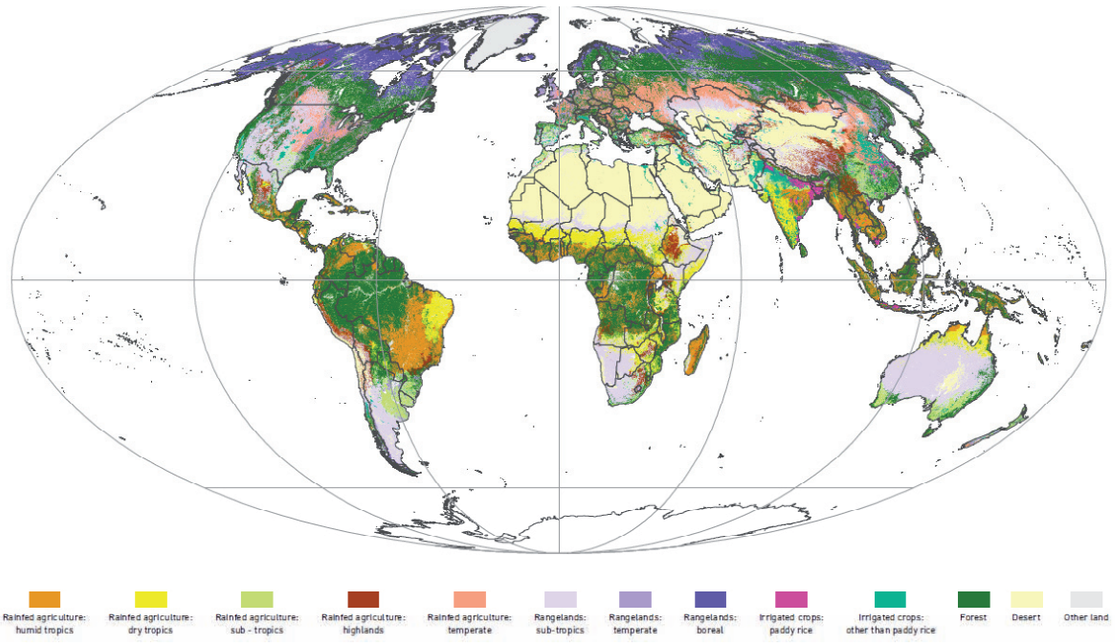


TABLE 1: STRATIFICATION SCHEME USED TO PREPARE THE GLOBAL MAP OF MAJOR AGRICULTURAL LAND-USE SYSTEMS SHOWN IN FIGURE 3, AS WELL AS KEY CROP-LIVESTOCK CHARACTERISTICS OF EACH SYSTEM

Land use objectives & management			Selected biophysical factors influencing crop production			Name of agricultural system	Additional characteristics (crops-livestock integration) and selected examples
Main land use/cover class	Management	Crop type	Altitude	Climate	Aridity Index		
Cropland	Rainfed	Other crops	Highlands			Rainfed agriculture: highlands	Low productivity, small-scale subsistence (low-input) agriculture; a variety of crops on small plots plus few animals.
			Intermediate to Lowlands	Tropics	*Dry*	Rainfed agriculture: dry tropics	Drought-resistant cereals such as maize, sorghum and millet. Livestock consists often of goats and sheep, especially in the Sudano-sahelian zone of Africa, and in India. Cattle is more widespread in southern Africa and in Latin America
					Humid	Rainfed agriculture: humid tropics	Mainly root crops, bananas, sugar cane and notably soybean in Latin America and Asia. Maize is the most important cereal. Sheep and goats are often raised by poorer farmers while cattle are held by wealthier ones.
				Sub-tropics		Rainfed agriculture: sub-tropics	Wheat (is the most important cereal), fruits (e.g. grapes and citrus), and oil crops (e.g. olives). Cattle are the most dominant livestock. Goats are also important in the southern Mediterranean, while pigs are dominant in China and sheep in Australia.
				Temperate		Rainfed agriculture: temperate	Main crops include wheat, maize, barley, rapeseed, sugarbeet, and potatoes. In the industrialised countries of Western Europe, the United States and Canada, this agricultural system is highly productive and often combined with intensive, penned livestock (mainly pigs, chickens and cattle).
	Irrigated	Paddy rice				Irrigated crops: paddy rice	Mainly found in South and Southeast Asia, often combined with livestock. In China pigs are the dominant livestock, while in Muslim and Hindu countries such as Indonesia, Bangladesh and India, sheep and goats are much more common
		Other crops				Irrigated crops: other than paddy rice	Other irrigated crops; medium to high inputs. The most important crops are cereals (mainly wheat and maize), vegetables, cotton and, fodder crops (especially in North Africa and the Near East). Livestock consists of all types of animals. Both crop and livestock productivities are relatively high.
Rangeland				(sub) Tropics		Rangelands: (sub) tropics	Mainly goats and sheep for meat production. Cattle also raised in Eastern and Southern Africa, and in North and South America
				Temperate		Rangelands: temperate	Mainly found in the Northern hemisphere and includes mainly cattle for meat as well as for diary production; high inputs and high productvity.
				Boreal		Rangelands: boreal	Found in the northern part of Canada, the Scandinavian countries, Russia and Alaska; extensive system of very low productivity
Forest						Forest	Includes extensive forest based subsistence agriculture and commercial tree crops
Desert						Desert	Very scattered extensive and low productive livestock grazing.
Other land						Other land	Includes built up areas, snow and ice, and wetlands. no agriculture present
Water						Water	

4. Case studies

Numerous case studies on sustainable management of land and water resources can be found on a variety of easily accessible websites (Box 1). This report therefore focuses only on selected studies that illustrate approaches for coping with one or more of the following three key groups of land and water constraints, labelled A to C below. These groups reflect the main issues that contribute to negative impacts on food security at the highest hierarchical level of the problem tree shown in Figure 2.

- Unsustainable land and water management
- inadequate capacity (insufficient awareness);
- unsustainable practices (insufficient incentives);
- unsustainable practices (Poor access to extension services/ knowledge of sustainable options).
- Low levels of domestic crop production
- Policy and institutional setting (insufficient investments or incentives).
- Inadequate international cooperation.

The key constraints addressed in each case study are indicated below:

Case study 1: Promotion of sustainable traditional rice-fish culture in China (A3)

Case study 2: Capacity building for land degradation assessment in multiple countries, the Land Degradation of Drylands (LADA) project (A1)

Case study 3: Payment for environmental services – coffee agroforestry, Indonesia (A2)

Case study 4: Capacity building for trans-boundary management of land and water resources within the Aral Sea basin (C)

Case study 5: Boosting investment in water for agriculture and energy in Africa – The SIRTE approach (B1)

Case study 6: Sustainable management - Lake Chad Basin (A1)

Each case study describes the specific land and water issues faced by stakeholders, the local context, remedial actions undertaken and resulting benefits. Case studies necessarily reflect local conditions. However, the case studies presented highlight the importance of some key common success factors, such as the benefits of necessary enabling conditions, participatory approaches, capacity building of stakeholders, good governance, as well as incentives and investments.

BOX 1: WEB RESOURCES FOR CASE STUDIES

- Sustainable land and water management
- Various projects on water management: http://www.fao.org/nr/water/projects.html
- Globally Important Agricultural Heritage Systems (GIAHS): http://www.fao.org/nr/giahs/en/
- Kagera river basin: http://www.fao.org/ag/agl/fieldpro/kagera/index.htm
- TerrAfrica: http://knowledgebase.terrafrica.org/
- World Overview of Conservation Approaches and Technologies (WOCAT): http://www.wocat.net/en/knowledge-base/technologiesapproaches.html
- Technologies and good practices for small producers (TECA): http://www.fao.org/teca/content/home-page
- Sustainable agriculture and rural development (SARD): http://www.fao.org/sard/en/init/1574/2225/1846/index.html
- Somalia water and land information management: http://www.faoswalim.org/
- Investments in land and water
- SIRTE www.sirtewaterandenergy.org

4.1 Promotion of sustainable traditional rice-fish culture in China

Case Study 1

Issue

The declining practice of traditional agricultural systems such as rice-fish farming in China affects local food production and other benefits derived from it.

Major considerations:

- Rice production is very important locally and rice has strongly influenced social, economic, political and ideological developments in China.

- Current agricultural development policies emphasize modern technologies to increase production and shorten the production period.

- Modern technologies have advantages of higher production and lower labour requirement. However, disadvantages include excessive application of chemicals (particularly pesticides); intensification of rice monoculture and separate intensive monospecies fish culture; land and habitat conversion with biodiversity loss.

- Rice-fish culture, or raising fish in rice fields using traditional means (captured fish and with wild fish seed/species) promotes symbiosis between fish and rice in the paddies and reduced or no use of pesti cides. Yields are lower than with intensive monocultures; however, multiple advantages include:

- access to quality nutrition – production of both rice and fish with higher nutritional content than that produced using modern technologies, and without the use of potentially unsafe pesticides;

- higher market prices for traditional rice varieties, and additional income from sales of fish;
- malaria reduced – fish reduce mosquito larvae;
- pest regulation – fish feed on insects and clears pathogens in water;
- conservation of biodiversity – traditional rice varieties, domesticated and aquatic biodiversity;
- pollination – fish enhance rice self-pollination by their constant movement within the rice paddies;
- more efficient carbon and nutrient cycles reduce pollution;
- cultural preservation – social and culture attributes: fish festivals, traditional cuisine or ethnic food, knowledge systems, farmers' preference to keep traditional varieties for eating and conduct of cultural festivities.

Local institutions have low capacities to promote traditional rice-fish culture.

Interventions

Awareness-raising activities by the Globally Important Agricultural Heritage Systems (GIAHS) project on the benefits of rice-fish culture, commenced in 2004. These activities included training workshops to which radio and TV journalists were invited, field visits, construction of a rice-fish monument and an agricultural museum, and published studies on agricultural heritage systems.

Outcomes and benefits to stakeholders

- Increased awareness of farmers, academics and government officials at local to national levels; tourists as a result of the broadcasts by local and international television on Qingtian's rice-fish culture.
- Over the last 50 years, cultivation of traditional rice varieties has declined steadily from 100 million ha in 1949 to 7.4 million ha in 2003. After the introduction of GIAHS in 2004, the area under traditional rice varieties increased to 15.8 million ha by 2009.
- A policy shift in government support in 2009, when the local government issued temporary legislation to promote and encourage rice-fish conservation and development and provision of technical and infra structure support to the local communities.

Lessons learned/Key success factors

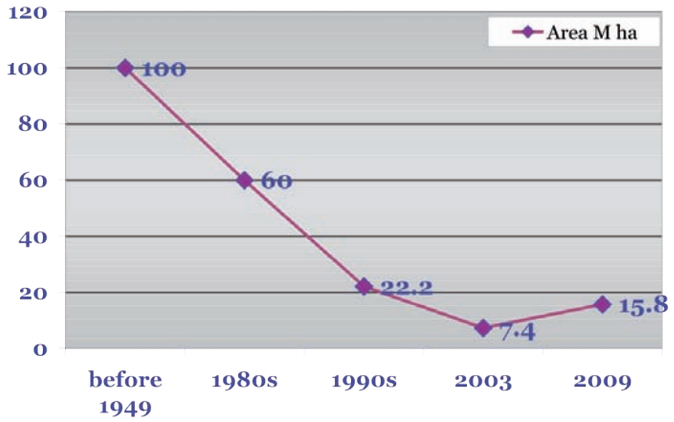
- Preservation (protection), and transmission of valued traditions and rice-fish related cultural activities to new generations, plays an essential role in the long-term conservation of traditional farming system.
- Scientific research and studies showing ecological advantages, resiliency, socio-cultural factors, etc. and technical extension can reinvigorate and infuse new vitality into traditional agricultural practices by influencing local and national governments.

- Informal certification and labelling provides higher market values, which motivates local farmers, local governments and other stakeholders to conserve GIAHS.

- Inclusion and involvement of communities, and all relevant stakeholders (community-based interactive participation), emphasizing sharing of responsibility between and among them to support conservation of GIAHS goods and services.

- Awareness building on the importance of rice-fish culture is a necessary step in obtaining remedial action.

FIGURE 5: CULTIVATION OF TRADITIONAL RICE VARIETIES IN WANNIAN COUNTY, CHINA



4.2 Capacity building for land degradation assessment in multiple countries – the LADA project

Case study 2

Issue

Insufficient knowledge of the status of land degradation (i.e. nature, extent, driving forces) required to formulate and prioritize remedial policies and other interventions at the global level (e.g. Parties to the UNCCD) as well as at national level, within the context of rural development programmes.

Major considerations

Addressing land degradation requires an evaluation and public discussion of long-term impacts on ecosystem services resulting from methods of how land management. Stakeholder perception of such impacts (social, economic and environmental) is a key factor in selecting which land management response options are likely to be sustainable.

Interventions

- Capacity building in six pilot countries: Argentina, China, Cuba, Senegal, South Africa and Tunisia. National teams were created in training workshops on methodologies for land degradation assessment at national and local level; undertaking of assessments at national and local levels; and awareness building at high-level meetings and conferences.

- Improving access to information on land degradation through creation of knowledge bases and websites providing information on land degradation.

Lessons learned and key success factors

- Combating land degradation requires a clear understanding of the main problem, its location and its extent in the country. The population affected and its socio-economic conditions play a key role that will determine the impact of the problem and the potential of remedial actions.

- Land degradation has different aspects (vegetation and soil health, water availability and quality, biodi versity, economic value and socio-cultural considerations all provided by a given ecosystem). Its very existence in one or other aspect can be questioned by groups of stakeholders. Therefore LADA proposes a comprehensive approach and framework that minimizes the likelihood of rejection of the results.

- LADA considers a balanced approach of all aspects and in particular promotes trade-offs between the biophysical and the socio-economic aspects of land degradation. These need to be given due attention in the process of assessing the status of the land and proposing interventions.

- Stakeholder involvement is essential for achieving a robust assessment and laying the foundations for effective implementation of prevention and remedial measures.

- One lesson learned during the LADA activity highlighted the need for data and knowledge sharing in a given country. Often environmental and socio-economic information is held by different stakeholders and institutions. The level of openness among such institutions is not always ideal, which creates obstacles to informed decision-making. Sharing the existing information is essential is a country is to reach the maximum result from its analytical and planning efforts.

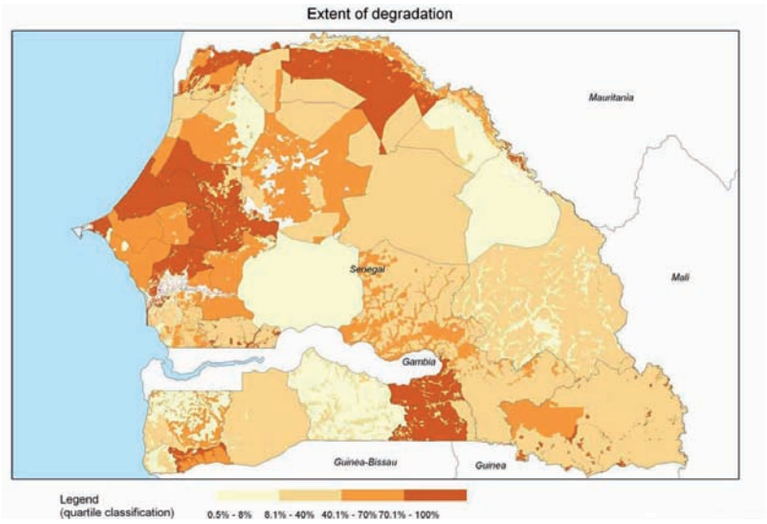
- The findings of the land degradation assessments need to be widely publicized and shared within countries, in order for their suggestions and findings to be widely known and to allow potential users to improve the goods and services of the land for the benefit of all.

- The study on “best practices in sustainable land management” at country level, realized under the LADA project, is a good example of this positive interaction among different institutions. The knowledge organized and generated by the study forms the basis for the remedial interventions in areas affected by land degradation.

- The participatory assessment of land degradation at subnational level carried out in each LADA country has helped start a virtuous circle of collaboration among national institutions and stakeholders that will help to monitor and combat future degradation.

- The difficulty of communicating in different languages in the LADA project – where participants spoke five different mother tongues – brought an extra benefit: adequately covering different technical terms and cultural approaches under a harmonized umbrella.

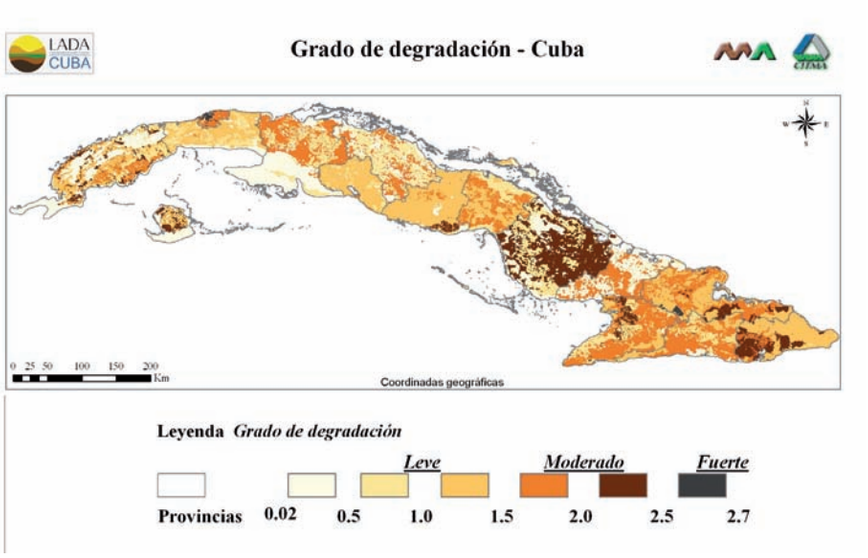
FIGURE 6: THE EXTENT OF ALL TYPES OF LAND DEGRADATION WITHIN DIFFERENT LAND-USE SYSTEMS FOR EACH ADMINISTRATIVE UNIT IN SENEGAL



Source: FAO-LADA, CSE (2009)

Results are based on expert-opinion surveys involving teams of land users and multidisciplinary specialists. Values are expressed as a percentage of the area of each land use system.

FIGURE 7: MAP SHOWING DEGREES OF LAND DEGRADATION IN CUBA



For more information
LADA website: http://www.fao.org/nr/lada/

4.3 Payment for environmental services – coffee agroforestry, Indonesia

Case study 3

Issues

- assuring the protection of forests (forest land stewardship);
- reducing runoff and water erosion of soils; and
- reducing high siltation rates in a hydropower reservoir resulting from farming practices in surrounding watersheds.

Major considerations

The complex agroforestry canopy of coffee gardens protects the soil from erosion caused by rain and provides water conservation benefits.

Interventions

- Introduction of good agroforestry practices for coffee production in 70 percent of Sumberjaya state-owned protected forest (13 000 ha coffee gardens; 6 400 farmers) in West Lampur, Indonesia.
- The farmers of the subcatchment Way Besai (400 ha, 1 percent of the entire catchment) organized themselves into a group RiverCare. The farmers have learned the principles related to water conserva tion, including reducing sediment and monitoring of water quality, and have built and maintained dams, drains and terraces.
- To enhance the sustainability of the programme, RUPES[1] is facilitating farmer groups to deal directly with the hydropower company by strengthening their organizational and managerial skills, and is currently approaching the Watershed Management Body of the Ministry of Forestry about monitoring.

Benefits to stakeholders

- Farmers belonging to the Wana Makmur (RiverCare) farmers' association are rewarded by the Indonesian Government with conditional land tenure rights (5 years, with possible extension to 25 years) for the water conservation benefits associated with coffee gardens, with the help of the RUPES programme.
- The farmers' organization (RiverCare) receives payments from the hydropower company (through the RUPES project) according to measured sediment reduction (US$250/year for less than 10 percent, up to US$2 000/year for 30 percent or more reduction).
- A 20 percent reduced sedimentation rate was measured. Although the farmers did not fully accomplish a 30 percent sedimentation reduction, the hydropower company paid the full amount and

[1] RUPES: 'Rewarding Upland People for Environmental Services', a programme managed by ICRAF (International Center for Research in Agroforestry) with IFAD support (International Fund for Agricultural Development).

gave them a micro hydropower generator for their efforts in watershed conservation, recognizing that much erosion material came from a forest landslide upstream from the farmers' area. In a subsequent phase, the hydropower company should scale up this initiative to other villages within the watershed through direct contract with RiverCare.

Key success factors

- Capacity building of farmers in techniques of water conservation, construction and maintenance of small dams, drains and terraces.
- Organization of farmers into a group (RiverCare) to facilitate negotiations with purchasers of environtal services.
- Provision of scientific/technical inputs and seed capital. The RUPES programme, which acts as the buyer of environmental services during the experimental start-up phase will be replaced by the hydropower company in a later operational phase.

Lesson learned

Contracts for payment for environmental services can evolve beyond the contractual obligations to shared responsibility between sellers and buyers.

FIGURE 8: COMMUNITY MEASURES TAKEN TO REDUCE RUNOFF SPEED AND TRAP SEDIMENT ON PATHS AND ROADS

For more information
http://www.worldagroforestry.org/downloads/publications/PDFS/pp06375.pdf
http://www.worldagroforestrycentre.org/SEA/Publications/files/leaflet/LE0044-07.PDF

A rapid rural appraisal tool for PES is being developmed by FAO (Payments for Environmental Services from Agricultural Landscapes, PESAL), which will facilitate introduction of payment for environmental services in more environments. It focuses on four key factors: capacity building; justifying PES investments; participatory design and implementation; coordination and information management. *http://www.fao.org/es/esa/pesal/index.html*

4.4 Capacity building for transboundary management of land and water resources within the Aral Sea basin

Case study 4

Issue

Slow progress in agreeing on the shared management of water resources that have significant potential for improving environmental, economic and social conditions in participating countries.

Major considerations

- The Aral Sea Basin includes the territories of Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, Afghanistan Turkmenistan and Uzbekistan (Figure 3), but most of the waters within the basin originate in the upstream countries of Afghanistan, Tajikistan and Kyrgyzstan.

- During the era of the Soviet Union, 1960s and 1970s, many dams were built in the Aral Sea Basin and over 7 million ha were put into irrigated agricultural production, growing cotton, wheat and rice. Inadequate irrigation and drainage design and management resulted in a huge increase in water consumption, decreasing flows into the Aral Sea, which caused environmental degradation.

- The environmental consequences of this huge irrigation development have been aggravated by low irrigation efficiencies owing to poor maintenance of the irrigation systems during the last two decades and the lack of an adequate drainage network, resulting in major waterloging and salinization problems.

- Studies in the basin have shown that agricultural water productivity in the Aral Sea basin is among the lowest in the world.

- The upstream countries Tajikistan and Kyrgyzstan are the poorest of the five Former Soviet Republics and have no significant gas or oil reserves. At the time of Union of Soviet Socialist Republics (USSR) they used to receive oil and natural gas from their neighbours downstream, Kazakhstan, Turkmenistan and to some extent Uzbekistan.

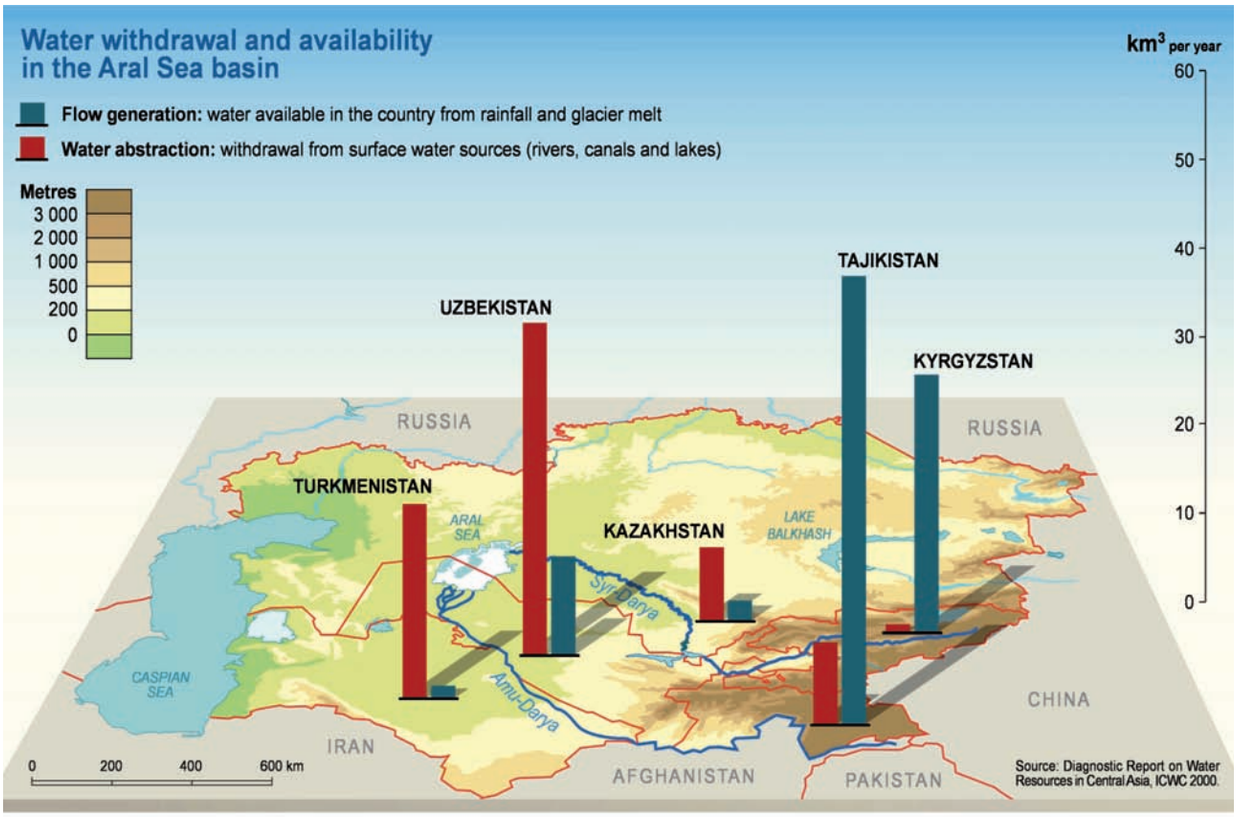
- These gas and oil providers increasingly expect Tajikistan and Kyrgyzstan to pay international market prices for these energy resources. Lacking the foreign exchange, these two upstream water-rich countries have lately reverted to producing energy with their hydropower stations during the peak of their energy need in winter. As a result, there have been floods in the downstream countries because of the unexpected release of water from the dams in winter and, on some occasions, the reser voirs have depleted if there has been insufficient water for the following irrigation season, which has largely affected the downstream countries.

- Tajikistan and Kyrgyzstan have announced the construction of new dams to produce the additional energy they need. This has sparked long and heated discussions initially with the downstream countries, which seem to have formed a united front against the construction of these new dams. In 2010 Tajikistan began to prepare environmental studies for a new large dam at Rogun. This is contested

by Uzbekistan that claims this would substantially reduce the amount of water running into the territory during the growing period.

- Tajikistan and Kyrgyzstan argue that just as their downstream neighbours expect monetary compensation to provide the natural resources of oil and gas, in turn they should be economically compensated for the water they provide to their downstream neighbours.

FIGURE 9: MAP OF THE ARAL SEA BASIN AND SURROUNDING COUNTRIES WHICH COULD BENEFIT FROM SHARED MANAGEMENT OF WATER RESOURCES



Source: http://maps.grida.no/go/graphic/water-withdrawal-and-availability-in-aral-sea-basin

Interventions

- In 1993, following the break up of the Soviet Union, the presidents of the five Central Asian Republics created the International Fund for Saving the Aral Sea (IFAS). The main objective was to develop and implement long-term actions to mitigate the environmental degradation of the Aral Sea and improve the socio-economic conditions within the basin.

- Aware of the potential conflict in the region, the United Nations General Assembly created the UN Regional Centre for Preventive Diplomacy in Central Asia (UNRCCA). IFAS has requested UNRCCA to help coordinate United Nations support in the process of building consensus for water manage ment coordination issues. FAO is working with UNRCCA to promote the concept of mutually benefi cial agreements.

Potential benefits to stakeholders

- Rational use of available water resources would be to the mutual benefit of all countries in the region. The World Bank estimates that Uzbekistan would gain US$36 million per year and Kazakhstan US$31 million from operating the Toktogul Reservoir in Kyrgyzstan for irrigation instead of power. The incremental costs borne by Kyrgyzstan would amount to US$35 million. The cost–benefit analysis shows that the basin as a whole would gain US$32 million per year from cooperation, with all countries gaining if the downstream states compensate Kyrgyzstan.

- Tajikistan could become the world's third largest producer of hydropower. However, it is held back because the lack of cooperation between countries makes international financial institutions reluctant to lend for hydropower projects. The costs of noncooperation will be very high to the downstream countries: financing water self-reliance through new dams in Kazakhstan and Uzbekistan is a high-cost option.

- Improved water management at the irrigation scheme level, would not only increase the economic viability of irrigated agriculture and improve livelihoods but will reduce the associated environmental degradation including waterlogging and salinization.

Lessons learned

- Focusing regional discussions on water allocation and on maintaining the status quo for the last two decades, has led to stagnation of discussions and deterioration of relations.

- Coordination and agreement over water resource use and development can simultaneously take several different forms including bilateral and multilateral agreements, without necessarily resulting in a single comprehensive regional agreement.

- International organizations could demonstrate the mutual economic benefits to be derived from a multi-sectoral approach water resources management through their regional development and technical assistance.

- There is a need to devise mechanisms at the national level to deal with the conflicting interests of energy production and provision of irrigation services. This will be a first step to use these mechanisms at the regional level where they are badly needed.

4.5 Boosting investment in water for agriculture and energy in Africa – The SIRTE approach

Case Study 5

Issue

Simultaneous consideration of water and energy use at the policy level can enable significant increases in productivity of resources and food production. Yet, in most African countries, integrated management of land

and water are not fully explored nor taken into account in policy-making. To address this problem, countries need assistance to undertake assessments on:

- the status and conditions of water and energy resources at national and regional levels;
- identifying successful 'best' practices of integrated management; and
- estimating and prioritizing related investment needs.

Major considerations

- Africa, with its uneven distribution of water resources by countries/regions, faces escalating water scarcity in the agricultural sector, which is exacerbated by climate change, and is threatening African food security.
- The high and growing demographic pressure on water, energy, and food resources and dramatically soaring prices need to be analysed within the context of climate change.
- Three-quarters of African countries are in arid and semi-arid zones: even small reductions in rainfall could cause large declines in river water and it is estimated that in the next 10 years, between 75 and 250 million people could be exposed to significant water shortage resulting from climate change.
- Increased climate variability affects agriculture performance and food production by altering the availability of water and land, and heightens uncertainties throughout the food chain, from yields to trade dynamics among countries and ultimately the global economy.
- With a cultivated area of 211 million ha, representing 27 percent of its potential and with only 7 percent under irrigation (3 percent in sub-Saharan Africa), the continent offers a clearly significant potential for agricultural expansion.
- On the positive side, Africa has a vast, largely untapped, potential of both renewable and nonrenewable energy sources. In particular, Africa's large hydropower potential appears an attractive option for meeting energy needs.
- There is improved national and international awareness and commitments to increase investments in agriculture and in agriculture's share of development aid. (For example, the commitments of Monterrey, theWorld Food Summit of 1996 and the second Summit of 2002; Maputo budget target).

Interventions

- FAO provided technical assistance to countries to:

(1) conduct a comprehensive assessment of the situation of water and energy resources;
(2) analyse investment needs for water in the agriculture and energy sectors at national and regional levels. A comprehensive portfolio of about 1 000 projects and programmes for a cumulative investment over the next 20 years of about US$64.6 billion (see Table 2);
(3) build regional capacity – through the organization of subregional workshops for identifying regional

trends in water use in the agricultural and energy sectors as well as for knowledge and information exchange on a regional scale.

- Ministerial Conference on Water for Agriculture and Energy in Africa: the Challenges of Climate Change (Sirte, Libyan Arab Jamahiriya, 15-17 December 2008) organized by FAO together with the Libyan Govern ment and other development partners. This Conference served as the main venue to ensure a strengthened dialogue between all stakeholders and to formulate recommendations and concrete actions to tackle the challenges related to the agricultural and energy sectors.

- Country-based actions in a number of African countries enhanced capacity to conduct a comprehensive review of the national investment profiles. In particular, project portfolios, to prioritize and prede sign investment programmes in line with the agenda of the Comprehensive Africa Agriculture Develop - ment Programme (CAADP), particularly related to the process of the National Compacts. (Note: short term < 4 years; medium term 4 – 8 years; long term > 8 years).

TABLE 2: **INVESTMENT ENVELOPE**

Size of Project Time Frame	Small scale water control	Rehabilitation of irrigation	Large scale	Total
Short-term	2,385	778	7,818	**10,981**
Medium-term	7,041	3,509	28,207	**38,758**
Long-term	1,491	1,329	12,042	**14,862**
Total	**10,917**	**5,616**	**48,067**	**64,600**

Outcomes and benefits to stakeholders

- A stocktaking of the major issues of water for agriculture and energy as well as the impacts of climate change.

- A declaration by the Governments of Africa and development partners to put together an Action Plan and engage in investment programmes for water development in support of agriculture and energy in the short medium and long term.

- Increased capacity of national institutions and stakeholders to assess the investment needs and to priori tize investment programmes through the application of relevant financial and institutional diagnostic tools.

- Enhanced involvement of multi- and bilateral donors in water-for-agriculture related projects thus enhanc ing resource mobilization.

Key factors contributing to success and lessons learned

- The demand-driven approach for estimating investment needs allowed greater involvement of stakeholders and an accurate identification of investment projects based on effective policies and country needs.

- The financial analysis of investments should be linked with accurate institutional and policy analysis of water resources management.

- The provision of an advanced financial diagnostic tool is a key element of the increased capacity for assess ing, estimating and phasing investment needs.

- The success of the approach, and its application, is ensured by a continuous and tight involvement of the National Government as well as of all stakeholders, the private sector and the donor community.

- The strongly consultative process allowed for awareness-raising and for stakeholders to fundamentally contribute to the shaping of the investment portfolio.

- It is imperative that New Partnership for Africa's Development (NEPAD)/CAADP National Compacts are aligned for detailing programmes and projects that could be supported by the various partners and that address national priorities.

For more information
http://www.sirtewaterandenergy.org/

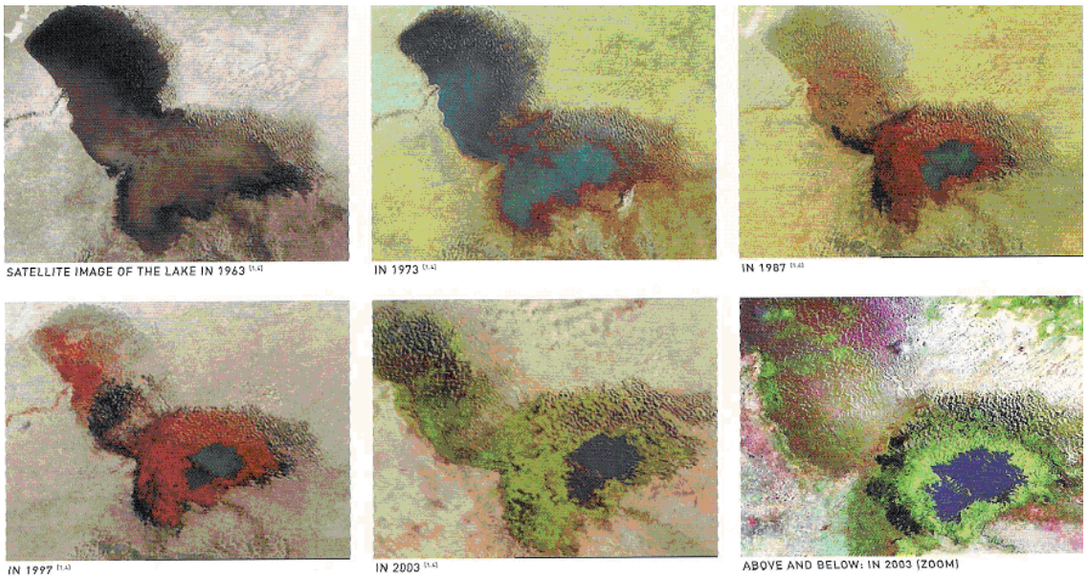
4.6 Building awareness and mobilizing funds for adaptive and sustainable management in the Lake Chad Basin to safeguard livelihoods and enhance food security

Case study 6

Issues

- In recent decades, the open water surface of Lake Chad has reduced from approximately 25 000 km2 to less than 2 500 km2, heavily impacting the Basin's economic activities and food security.

- The shrinking of the lake has been driven by climate change and vastly increased competing demands on the lake and the surrounding land.



SATELLITE IMAGE OF THE LAKE IN 1963 [1,4]
IN 1973 [1,4]
IN 1987 [1,4]
IN 1997 [1,4]
IN 2003 [1,4]
ABOVE AND BELOW: IN 2003 (ZOOM)

Major considerations

- The entire geographical basin of Lake Chad covers 8 percent of the surface area of the African continent, shared between the countries of Algeria, Cameroon, Central African Republic, Chad, Libya, Niger, Nigeria and Sudan.

- The Lake Chad Basin serves as a source of freshwater for 30 million people who depend on it for their liveli hoods. The lake's rich biodiversity is the source of fishery, pastoral and agricultural activities for the inhabitants in the Basin.

- Climate change is expected to further compound these problems in the region through changing rainfall patterns with resulting impact on hydrological regimes, agriculture, food production and nutrition security. It is expected to cause increased temperatures, increase in the prevalence of vector-borne diseases, decreased water security, sea-level rise and increased variability of floods and droughts.

- To be effective, remedial action needs to confront a number of key challenges. These include the conserva tion of available limited water resources, restoration of the lake level and its ecosystem, tackling the problem of drought and desertification arising from rainfall deficits, inefficient system of data collection and regional cooperation and networking. Also, while much attention has been placed on respon sive measures that focus on supply management, less attention has been given to demand management. The combination of both, as well as the introduction of emergent measures that respond to the global cause of the problem, is needed within an adaptive framework to remedy the situation.

Interventions

During the FAO Ministerial Conference on Water for agriculture and energy in Africa, held in December 2008 in Sirte (Libyan Arab Jamahiriya), a round table was organized on Lake Chad in support of the international campaign to save the Lake approved by the Eighth Summit of Heads of Government of Lake Chad Basin held in Abuja (Nigeria). The round table called for the need to:

(1) take into account several scenarios for the transfer of water in the region and to examine possible alternatives with socio-economic and environmental feasibility studies;

(2) involve the Basin donor and recipient stakeholders in all the phases of the preparation of studies and implementation of projects;

(3) establish an international committee to support the work of the Lake Chad Basin Commission and follow the technical aspects of the project of transfer of transboundary water; and

(4) establish an observatory for the Lake Chad Basin.

A seminar was organized by FAO and the Lake Chad Basin Commission (LCBC) on the occasion of World Water Week 2009 in Stockholm to address the current challenges in the Lake Chad Basin and explore opportunities for Adaptive Water Management. The seminar, which was attended by more than 50 participants representing Lake Chad Basin countries, donors and other institutes, addressed the:

- aquifer recharge and storage systems to halt the high level of evapotranspiration;
- Chari-Longone water transfer project'
- application of climate adaptation systems and the improvement of predictability systems; and
- appraisal and the upscaling of water conservation and small-scale agriculture technologies.

In October 2009 and at the World Food Day, FAO together with LCBC organized a special event on Saving Lake Chad: A System under Threat. The event increased awareness and knowledge of Lake Chad as well as mobilized funds to save the Lake. The seminar concluded that:

- new ecosystem management strategies need to be found urgently;
- water, land and living resources should be managed in an integrated manner; and
- this should be secured through the setup of local, national, regional and continental networking field activi ties, taking into account the concerned people, their needs and practices.

Outcomes and benefits to stakeholders

- The supporting programme favoured a debate amongst all stakeholders on the cause of the shrinkage of Lake Chad, supported the identification of the priorities for the management of the lake, and suggested a set of management practices that could be adopted.
- The programme contributed to awareness-raising in the context of several international fora. Relevant publications and promotional materials have been prepared to sensitize a wide public view to the shrink age of Lake Chad.
- The programme will continue to support awareness-raising, partnership building and information sharing, while assisting the LCBC and the Basin countries to prepare an emergency plan to safeguard the Lake and the formulation of innovative ecosystem management strategies, and to foster the creation of an interna tional committee under the umbrella of LCBC to ensure coordinated international support.

Key factors contributing to success and lessons learned

- Support and assistance from all development partners and indeed the international community is required to save Lake Chad: the conservation of the global value of the largest freshwater reservoir and the survival of the inhabitants living in the Lake Chad Conventional Basin is a mission which is the role and responsibility of all.
- The African leaders are strongly committed to saving Lake Chad and to enhance the adaptive and sustainable management of the natural resources and biodiversity of the Lake Chad Basin for the benefit of present and future generations. This political commitment has to be sustained and an agenda set to ensure good governance and sustained, focused intervention.

- Political commitment should be accompanied by strong participation of all stakeholders in decision-making. The interests of all stakeholders should be considered in a wide participatory process and grass- root mobilization pursued.

- Drafting of an emergency plan should focus on safeguarding the already scarce resources of the lake and longer-term innovative ecosystem management strategies planned. These should involve gaining greater knowledge of local techniques that have been developed through experience and building on them.

5. References

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