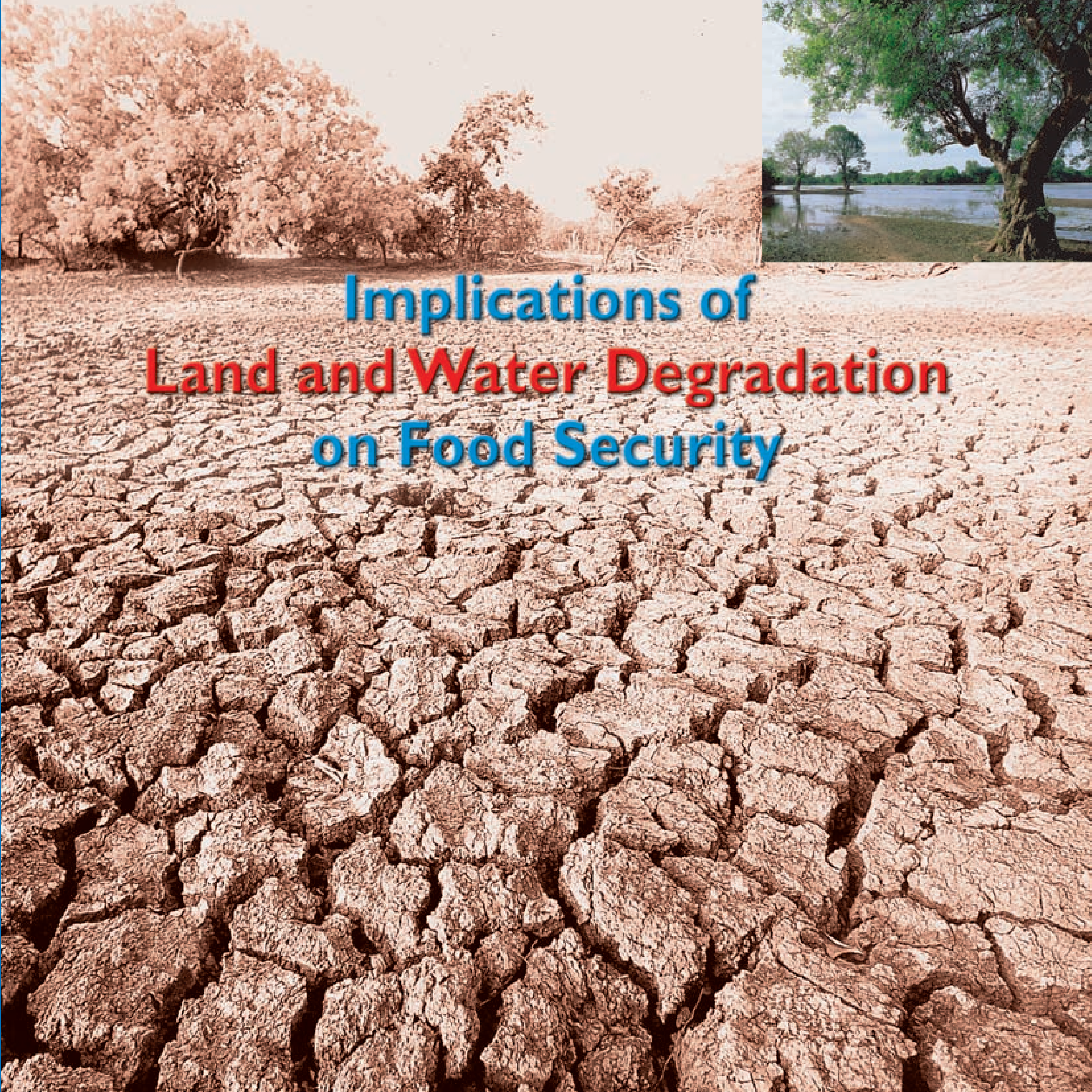
Implications of Land and Water Degradation on Food Security



Comprehensive Assessment of Water Management in Agriculture

The Comprehensive Assessment of Water Management in Agriculture (CA) is an international research, capacity-building and knowledge-sharing program focused on providing water-agriculture solutions that will reduce poverty, increase food security and protect natural ecosystems in developing countries.

The CA evaluates the costs and benefits of the past 50 years of water development for agriculture and the water management challenges people are facing today. The goal is to help governments and farming communities craft better water futures. To accomplish this work, the CA mobilizes the expertise of the Future Harvest Centers of the Consultative Group on International Agricultural Research, the United Nations Food and Agriculture Organization and numerous international and national agricultural research centers worldwide.

The result will be a unique foundation of knowledge and information that will allow better quality decisions on water investments and management, and better targeting of development funding to meet food and environmental security targets over the next 25 years.

Compiled by Sithara S. Jinendradasa

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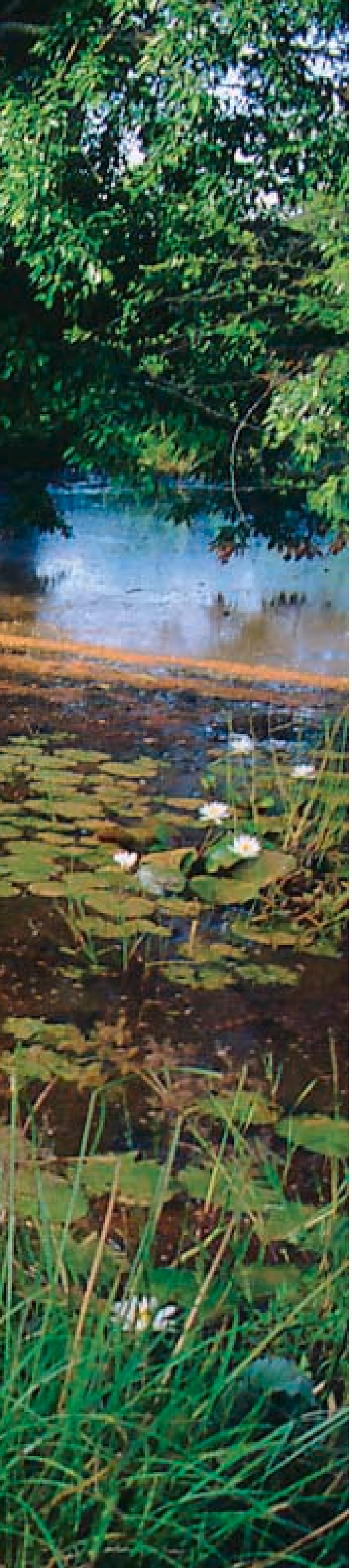


Introduction

Degradation and loss of land and water for agricultural use are widespread and accelerating concerns that pose an increasing threat to national and individual food security in many parts of the developing world. Land and water degradation may negatively impact food security in a region by reducing one or more of the following: household consumption, national food supplies, economic growth and natural capital. Agro-ecological systems and societies are resilient up to a point, but subject to collapse when degraded beyond that threshold. While the current research picture is not entirely clear, it suggests a close correspondence between areas experiencing significant land and water degradation, and areas troubled by high levels of rural poverty and malnutrition.

With few exceptions, people do not intend to degrade the natural resources they use. Their decisions to do so are guided by economic realities and lack of understanding. Policy interventions that seek to overcome environmental problems in agriculture need to be based on a proper understanding of *why* farmers degrade their environment. Farmers are not irrational. On the contrary, they maximize income and minimize risk in a dynamic context and often under harsh conditions and serious constraints. They degrade resources when there are good economic and social reasons for doing so, when the benefits they obtain exceed the perceived costs that they, as individuals, must bear.

This booklet discusses eight different aspects of land and water degradation:

- Soil Erosion and Nutrient Depletion
- Water Pollution and Sedimentation
- Groundwater Depletion
- Salt Water Intrusion
- Salinization
- River Desiccation
- Urbanization and Encroachment
- Coastal Areas and Wetland Degradation

Each section includes a discussion of the issue, accompanied by a personal story that provides insight into an individual farmer's first-hand experience of, and an approach, to the problem.

The farmers' personal stories illustrate the fact that there are many parallels between degradation and livelihood security. Land and water resource loss and degradation result from inappropriate resource management that decreases ecosystem health and capacity for food production. The stories illustrate that livelihood and degradadtion occur hand in hand, they should be approached as a single, integrated problem.

Due to rapidly changing interactions between land, water, population, community, government, wealth and health, the relationship between degradation and food security is enormously complex. Any well-founded attempt to address food and security in the context of degradation must take all of these factors into consideration. The strategy presented here incorporates a basin-wide, people-centered approach that considers the broader social and political contexts in which development programs operate.

Addressing the impact of land and water degradation to support a more food- secure future requires integrated basin-wide assessment and action. Understanding of land and water degradation processes must begin with evaluation at the basin scale. Meaningful analysis on this scale follows the flow of water through four broad interconnected geographical zones that compose the basin: headwaters (upper watersheds), plains, cities, and coastal areas, including wetlands.

A holistic and people-centered approach that treats land, water and food as components of the same system is an essential element of any attempt to ensure food security. The strength of this approach lies in its ability to identify more realistic targets for action by focusing on and incorporating the experiences of the people who manage land and water resources and who struggle with food insecurity.

While literature on land and water degradation tends to emphasize biophysical processes and impacts rather than socio-economic considerations, in practice, policymakers must make difficult decisions about dividing limited resources between competing priorities. Recognizing these constraints, intervention strategies should be built around concerns that carry the greatest policy relevance—those problems that affect national, local and farm-level food security and agricultural development. Accordingly, the development community should assign top priority to the following actions:

- Apply lessons from places where people have retarded or reversed degradation.
- Set well-informed priorities through integrated analysis of problems and solutions.
- Target appropriate technology development and dissemination for the food insecure.
- Develop a policy and institutional environment that enables appropriate use of land and water, including:
  - development of institutions that enable local people to participate in landscape- and water shed-scale planning processes;
  - provision of strong and equitable public governance that secures the resource rights of food-insecure people; and
  - creation of incentives for investment in land and water resources.

A strategy that incorporates all of these actions serves as a solid foundation on which to build toward the resolution of local land and water degradation problems, as it considers and addresses the perspectives and needs of farmers, policy makers and development organizations within the local agro-ecological context. This booklet was prepared as part of the Comprehensive Assessment of Water Management of Agriculture. It is meant to accompany Research Paper 01 on Integrated Land and Water Management for Food and Environmental Security which gives a more detailed discussion on land and water degradation and the links to food and livelihood security.

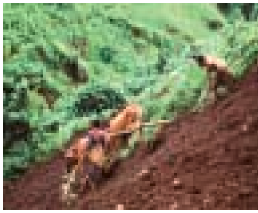
Soil Erosion and Nutrient Depletion

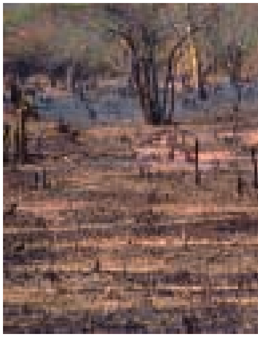
Agricultural practices can lead to displacement of soils and depletion of the plant nutrients they contain. Erosion reduces the depth, nutrient content and water-retaining capacity of soils. Over time, unchecked erosion can reduce previously productive agricultural areas to bare rock and wasteland. Erosion also results in serious downstream impacts including polluted drinking water supplies, silt filled rivers and irrigation canals, degraded coastal ecosystems, and landslides. While erosion is a natural process, human activities—particularly farming and road building—accelerate it 10 to 100 fold. These human impacts can be greatly reduced through appropriate land and water conservation and management practices, including the careful selection of sites for roads and bridges.

Crops draw plant nutrients from the soil. In sustainable agriculture, nutrients are replaced (in the form of chemical or organic fertilizer) at the rate at which they are removed. Unsustainable agricultural practices that fail to replace soil nutrients, lead to nutrient depletion and a reduction in soil organic matter. This results in lower yields, decreased yield stability and a decline in the effectiveness of inputs such as fertilizer and high-yielding varieties. These processes slowly render soils infertile and reduce the agricultural value of the land.

A lack of suitable technologies and markets contributes to nutrient depletion as well. Nutrient depletion is often associated with shifting ("slash and burn") cultivation. In the last 50 years, the number of people practicing this type of agriculture has increased due to population growth, migration and relocation and the absence of effective laws and/or control measures. Specific recommendations for addressing soil erosion and nutrient depletion:

- Promote a balanced nutrient supply to crops and soils in intensive farming systems.
- Develop improved fallow systems for crop production on problem soils.
- Support the identification of plant nutrient cycles.
- Encourage small-scale recycling of nutrients in crop residues and manure.
- Implement the large-scale recycling of nutrients in food and in waste, as continued transport from sources (rural areas) to sinks (cities, rivers) is unsustainable.
- Create opportunities and incentives for farmers to invest resources in the land they tend.





B.B. Yirenkyi is a farmer in Nkawie-Toase, a small community about Water Pollution and Sedimentation 15 km from Kumasi, Ghana. BB has a farm of 2 acres with ginger and some maize . He also has shares in two citrus farms. "The soil is good here, or was good," he says. "Since the fields are in hilly terrain, degradation problems such as soil erosion, nutrient deficiency and water stress are obvious wherever you look. Due to the sloping landscape, seedlings and topsoil wash into the valley during the rains and small gullies start to form. The land is becoming dry—resulting in delayed fruiting and low yield of citrus plants. Also the water stress condition encourages diseases."

BB felt that extension officers were not doing enough to reach farmers with soil management technologies, as compared with the introduction of new crop varieties, and so decided to take the initiative himself. When the local university was looking for volunteers for on-farm trials to test fertilizers and poultry manure, he was the first to join them. BB found that even with the lowest rate of manure application, his maize plants were the only green ones in the whole vicinity.

"My heart leapt with joy," he said. "The manure helped my maize to grow fast in the first months and to benefit from the early rain. When the rains stopped unexpectedly, my neighbour's maize crop was still small and did not make it, but my one succeeded!"

No other farmer had tried poultry manure on staple crops in his area and BB became an informal "extension officer" promoting nutrient replenishment and soil conservation. Together with his university partners, he introduced soil fertility management practices to 52 other farmers, and over the course of two years, convinced around 215 fellow farmers to adopt soil fertility management.

Water Pollution and Sedimentation

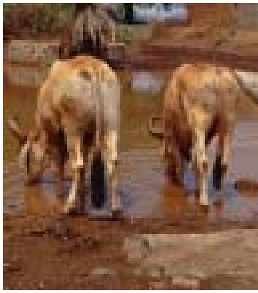
Pollution alters the natural processes of many important ecosystems. Water pollution reduces food security by limiting the amount of water that can be used by crops and brings about a reduction in fisheries through contamination of aquatic food sources. Toxins emitted from pesticide use, waterborne diseases associated with watering cattle at streams, and heavy metals released through mining activities are major sources of water pollution.

Sedimentation is most often the result of soil erosion. Water pollution and sedimentation are both predominant in areas of intensive farming. While most pollution from non-specific agricultural sources results from the leaching of agricultural chemicals or naturally occurring but harmful constituents from the soil, pesticides in surface water generally pose a more urgent problem. Where polluted water is used for domestic uses, particularly as a drinking water source, human health is at risk.

Urban agriculture is an additional source of water pollution. Downstream sections of many rivers near rapidly developing mega cities are heavily polluted. Overuse of nutrients for high value crops is associated with peri-urban agriculture. Excess nutrients, often mixed with pesticides, enter waterways and pollute both water and soil. Intensive poultry, pig and seafood production near mega-cities, causes a large nutrient efflux (mainly organic waste) that is then carried to downstream cities and coastal areas. In peri-urban areas, concentrated livestock production poses particular problems of waste disposal, and water and land degradation. These conditions can bring about negative impacts on health, environment and food security. Specific recommendations for addressing water pollution and sedimentation:

- Provide education, incentives and technologies to encourage the appropriate application of water, fertilizers and pesticides in places where intensification is a concern.
- Ensure sufficient investment in land modifications necessary to support intensification in a sound manner (irrigation, water harvesting, supplementary irrigation, drainage, nutrient enrichment).
- Correct price distortions that encourage excessive use of modern inputs by removing subsidies on fertilizers and pesticides.
- Encourage and support farming systems that are based on ecological principles.
- Ensure that new sources of water for agriculture do not introduce waterborne diseases.

Anand Reddy lives with his wife and three children in a small village in Uttar Pradesh, India, downstream of the city of Hyderabad, which has a population of four million. He irrigates his 2½ acres of land with water pumped from the Musi river that flows year-round with urban domestic wastewater and industrial effluent—mainly from the city. He says, regarding the quality of the water he uses:



"When we switch on the pump, we can see foam on the water, rising as high as the house. We can see colored effluents in this water. The rice paddy is affected; the leaves of the rice plant turn red at the edges. The leaves grow very tall but the inflorescence (panicle) of the rice that grows is weak. Only about half of the grains become fully formed. Attacks by stem borers on the rice seem to have increased. This started happening four or five years ago. The use of pesticides over the years has increased but our yields have continued to decrease."

"When we were kids we used to play in this water. Now we are afraid even to wash our feet with it. If this water falls on our skin we get all sorts of allergies and we have to take injections. If the cattle drink this water, the milk also smells different. If one eats the fish grown in this water, we get allergies. The rice cooked in this water has no flavour. It gets spoiled in an hour and the prices that the rice mill people give us are low as this paddy is grown from Musi water and therefore considered to be of low quality."

"We have told the officers in the Janmabhoomi program and they said that we will get this water filtered with machines but nothing has been done. We are not able to do much about the quality of water and our lands are degrading by the day."

Groundwater Depletion

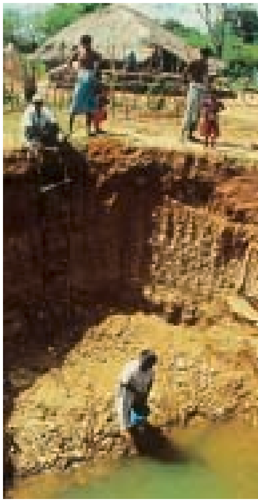
Groundwater is heavily exploited for agriculture for several reasons. It is accessible to many, provides cheap and convenient individual supplies, generally does not require a large capital investment and does not depend upon mega-water projects (Shah et al. 2000). While groundwater development is often more amenable to poverty-targeting than large surface systems whose design is driven by topography and hydraulics; when groundwater levels drop to uneconomical levels as a result of overuse, the poor suffer the greatest impact.

Tube wells are often considered the most significant innovation in irrigation in the last 50 years. In major grain producing areas, the number of tube wells has risen dramatically allowing many farmers to intensify and stabilize agriculture on their land. While use of groundwater in addition to surface water or rain can prove effective for smallholders, replenishment of groundwater is usually a slow process. In situations where groundwater withdrawals are higher than recharge, the water table drops. The dramatic growth in the number of farmers using groundwater in the past two decades has not been accompanied by parallel increases in the regulation of pumping. As a result, groundwater supplies often become degraded and exhausted through over-pumping.

Estimates of the contribution of groundwater irrigation to agriculture, and of the extent of unsustainable groundwater use, highlight the gravity of the problem. In many of the most pump-intensive areas of India and China, water tables are falling at rates of 1-3 m per year. This trend poses significant threats to the national food security of these and other countries. Specific recommendations for addressing groundwater depletion:

- Effectively manage groundwater use to allow for adequate replenishment.
- Increase agricultural efficiency to achieve the same level of production with less water.
- Create institutional and technological innovations to put groundwater irrigation at the service of the poor in a sustainable manner.
- Through appropriate legislation and information, encourage improvement of aquatic resources management in and around farmlands in a sustainable manner.

Zhonghua Song, is a farmer living in the Beiliubo Village of Xian County , located downstream of the Fuyang river basin—one of the regions on the North China Plain suffering from severe water shortage. Since 1978, due to declining surface water supplies resulting from upstream development and increasing water demand, the villagers began to dig tubewells and thereafter, groundwater became the major water source for irrigation. From 1990 to 2001, groundwater was the sole source for irrigation in this region—irrigating an area of 113 hectares with 20 deep tubewells and 6 shallow tubewells. But with the increasing exploitation of groundwater, the water table has declined, especially since 1990—from 25 m below the surface in 1992 to 50 m in 2001.



Says Zhonghua, "In the 1970s, the water table was 3-4 m below the surface and the tubewell depth was about 4 m. Today, the water table has dropped as low as around 50 m. We have had to invest more and more money to dig deeper and deeper tubewells."

Tubewell depths have increased from 25 m in the 1980s to 200 or even 300 m in the 1990s. The total cost for one 200 m tubewell is about US$3,900, nearly 4 times the cost of a 25 m tubewell.

Zhonghua says, "before 1995, we did not consider water shortage as a serious problem; however, after 1995, myself and the other farmers in the village have begun to worry about increasing water shortage issues and resulting negative impacts on our production and livelihood."

Between 1996 to 2001, 20 percent of the tubewells in the village ran dry and there had been a drop in grain yields by 25 percent. Zhonghua knows about water saving technologies such as pipeline and sprinkler irrigation. However, he cannot adopt these technologies in the short term, considering the huge investment and the low agricultural production return rate. He also said that they cannot resolve the groundwater depletion problems adequately, except for deepening tubewells and improving management. He hopes that the government can give them some good solutions and advice them on resolving water shortage issues in the long term.

Salt Water Intrusion

Salt water intrusion occurs when saline seawater moves inland into river or aquifer systems. Causes of salt water intrusion include lowered aquifer levels, reduced river discharge, prolonged drought, and rising sea levels. Groundwater depletion is a significant cause of salt water intrusion. The pumping of aquifers in excess of recharge causes a drop in the water table which draws seawater further inland. Since this reduction in the natural freshwater stored in groundwater aquifers is difficult to detect, well water can turn from fresh, to brackish to saline within a very short period of time, destroying freshwater sources for agriculture or cities.

Unless reversed by recharging the aquifer with additional freshwater, salt water intrusion can have far-reaching social and economic impacts. As falling yields due to a reduction in water availability undermine the economic viability of agriculture, farmers often shift to salt pans that further aggravate the problem. Resulting alterations to the shoreline can put coastal investments at risk. Reduced agricultural activities due to salt water intrusion undermine the income of farmers in coastal areas, threatening livelihoods and food security. Salt water intrusion can also bring about a drinking water crisis.

The problem of salt water intrusion is widespread and is likely to increase given rising water needs, mounting dependence on groundwater and possible adverse impacts of climate change. Specific recommendations for addressing salt water intrusion:

- Develop effective sustainable institutional solutions to stop seawater intrusion in coastal areas.
- Reverse seawater intrusion into freshwater sources by recharging aquifers with additional freshwater when appropriate.

Arunbhai Patel is a farmer from the coastal region of Saurashtra in the Indian state of Gujarat. The people of this region were once farmers, growing mainly cotton, groundnut and onions. They relied on rainfall and shallow open wells for drinking water and irrigation. Urbanization and rapid industrial development in the region increased water demands and accelerated groundwater extraction—without adequate recharge. As the aquifers have been emptied, sea water has moved in to take the place of the fresh water.

Says Arunbhai "About 30 years ago, the sea began moving inwards and the water level in the wells began dropping from 20-25 feet to more than 150 feet at present, with no guarantee of striking water. Even if water is found, it is saline and unfit for agriculture. Before very long, we farmers were faced with falling yields and improper growth of crops, especially with the increase in salinity of the water."

By the early 80s many farmers were forced to find alternative survival strategies. They either moved into horticulture, coconut cultivation, transport and other trades like diamond cutting and polishing Those very near to the coast, like Arunbhai, converted their agricultural fields into salt pans.

"When salinity increased to unsustainable levels, we converted our fields into salt pans and started using wells (often by deepening them) and pumps to accumulate water into these pans," says Arunbhai. However, this practice has exacerbated the saltwater intrusion. In Arunbhai's village, salt pans are fed by a 1.5 km long channel during low tides and sea water is stored in deep pits, almost similar to dug wells. The result has been the salinzation of inland residential and agricultural areas as well.

NGO's and other organizations seeking a solution to this problem now face four major setbacks: irregularity and scarcity of monsoon rainfall, the large time span required to fight salt water intrusion, the increasing demand for water for various uses and the continuing use of saline water (due to scarcity).

Salinization

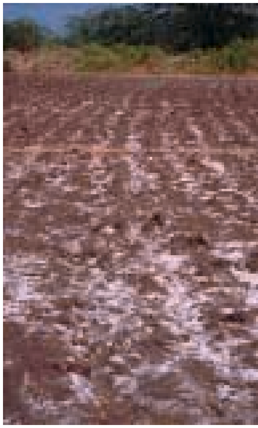
Salinization is the accumulation of salt in the upper soil in quantities significant enough to inhibit crop yields. Salinization of land is particularly prevalent in areas with high water tables and poor lateral drainage that experience high evaporation rates and lack opportunities for leaching excess salts. Increased withdrawals for irrigation combined with limited drainage lead to salt build-up in river basins. The most famous case of salinization occurred in ancient Mesopotamia where soil salinity due to irrigation led to the fall of ancient civilizations (Postel 1999).

The impacts of salinization extend beyond agriculture to effect society and communities as a whole. Salinization brings about adverse social and economic effects in farming communities by lowering living standards and introducing health problems (including stomach diseases, breathing difficulties and skin conditions). These circumstances induce local populations of young people to migrate to other areas, leaving the local land unattended and making life very difficult for the women and children of these communities.

Poorly sited or mismanaged irrigation has led to the salinization of close to 20 percent of irrigated land. Each year, approximately 1.5 million hectares are lost to salinization, resulting in approximately $11 billion in reduced productivity. These figures represent annual losses of nearly 1 percent of the global values for both irrigated areas and annual production levels. Specific recommendations for addressing salinization:

- Expand the application of successful models for preventing salinization including modern irrigation technology in Jordan, effective irrigation systems in Mexico, and the expanding small-scale irrigation in semi-arid areas of Africa and the Andes (Scherr and Yadav 1996).

Islam Tulepbergenov is a farmer in Jambul, Kazakastan within the Aral Sea area. He has l36.3 hectares of irrigated land, of which 18 hectares is planted in cotton, 17.5 in wheat and the rest in vegetables.



"I have been involved in agriculture for 20 years. Here in Jambul I've been working for 7 years as a brigadier of the collective farm, and I have now been a private farmer for about a year. For the last 7 years I observed an increase in the salinity of the irrigated land in our area. The crop density in the saline affected land is very low. You can see white spots in the fields without crops. In the saline affected land I have to spare double the quantity of seed, fertilizer and labor," said Islam.

Salinization in this area was first noticed in the mid-1950s when new irrigation projects were initiated. And not only farm land is affected. After the salt is leached out of the soil, large amounts of saline drainage water form and partially infiltrate the groundwater, which is often the main source of drinking water.

"I have 5 children working with me in the field and agriculture is the only way of income generation for us. Last year we planted winter wheat, and we were expecting at least a 4 ton per hectare yield. Unfortunately, we got only half of it. Now I have to pay for seed, tractors and taxes and will end up in debt" says Islam.

Islam estimates that 50-60 percent of the total irrigated area of Jambul is saline and all his farming neighbours are also searching for solutions. Farmers are trying to control the leaching of salts and the groundwater levels. However, water is not always available to carry out these activities, thereby making the situation worse.

River Desiccation

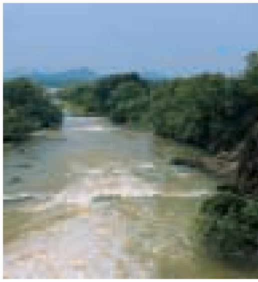
Intensive land and water use often results in river desiccation. River desiccation occurs when growth in consumption of water, in particular by the agricultural sector, leads to drastically reduced or dried up rivers in coastal areas. Reduced flows result in higher concentrations of pollution, impacting both human and ecosystem health.

Desiccation poses the greatest risk to coastal estuaries and lagoon systems. In dry regions, the irrigation process increases evapotranspiration from land surfaces in order to produce crops. As a result, river discharges decrease. When agricultural areas in coastal regions suffer a lack of water, they are vulnerable to a chain reaction as farmers once reliant on surface water turn to pumping groundwater, inducing seawater intrusion in turn. Livelihoods dependent on crop agriculture or fisheries are particularly at risk if yields are reduced or agricultural areas have to be retired.

River desiccation is the result of upstream activities that are often based on decisions made without considering downstream effects. River desiccation brings about increased competition, salinization and pollution that threaten the food security of both upstream and downstream communities. Downstream communities are unable to meet their water needs as a direct result of reduced river flow, while upstream communities cannot develop more water for agriculture because of river depletion. Specific recommendations for addressing river desiccation:

- Develop water allocation procedures within river basins and within irrigation systems that encourage sustainable land and water conservation practices, whether market or ration based.

Benson Mwangi, a Kenyan farmer, depends on the Ewaso Ngiro river to irrigate his crops. But now, during the dry season, the river is reduced to a thin trickle—mainly due to the increase in water use upstream. The problems started in the 1940s when commercial farming began in the area. The dry season volume of the river has decreased from the 1960s to the 1990s.



Benson explains, "In the 1960s just a few people were working here as farm laborers from neighboring districts. With the growth of their families, the demand for water increased. This area is too dry for rainfed agriculture, so irrigation is a necessity. Numerous domestic water supply projects constructed every year require more water from the river."

"I am using tied-ridges and mulching to reduce the runoff from my fields. I plan to construct a farm pond and start supplemental irrigation sometime," says Benson. He added that farming along the river banks and wetlands is affecting the quality of the water.

During the drought years , farmers are totally dependent on food aid. Up to three consecutive harvests can be lost during a drought. Regarding the problems of the river drying out, he said that most farmers are only concerned about their survival and continue to extract more water, aggravating the situation when drought hits.

He also remarked that uncoordinated initiatives were being carried out. Researchers are promoting efficient irrigation methods and NGOs are providing financial support to convert the gravity furrow water supply systems with high seepage losses to piped systems.

Urbanization and Encroachment

Urbanization and the accompanying resource and infrastructure needs of growing urban populations have far reaching impacts with regard to land and water use. Land and water degradation in urban and peri-urban areas takes many forms: changes in hydrology, subsidence, water and soil pollution, and non-agricultural use of land and water.

As cities grow, the intensity of food and water consumption increases along with the need for infrastructure to accommodate the housing, transportation, recreation and industrial needs of urban populations. Encroachment, or loss of land through conversion to non-agricultural purposes, plays a role in land degradation. Generally, land and water used for economic enterprises other than agriculture provide greater financial returns. Each year, the expansion of urban infrastructure (houses, roads, industrial areas and golf courses) consumes approximately 0.5 percent of prime land globally. Locally, higher rates are often observed.

Urbanization results in increased levels of pollution. The import of huge quantities of food and feed into urban and peri-urban areas results in soil and water pollution, as well as transportation related air pollution. Downstream sections of rivers near rapidly developing mega cities are often heavily polluted. Food production for urban populations extracts a significant environmental toll in peri-urban areas through the over-use of nutrients that contribute to water pollution, and through concentrated livestock production that poses particular problems of waste disposal.

The hydrological characteristics of urban areas are unique. Runoff from rain is more rapid in cities and can lead to temporary flooding of infrastructure and buildings, and mass movement of soil from steep slopes. Characteristics of the urban environment result in reduced recharging of groundwater. As groundwater under cities is depleted by withdrawal for industrial and domestic use, subsidence may occur, causing extensive damage to roads and buildings and sewers, with cracked sewers adding to urban health problems.

Madam Akua from Medoma in Ghana is a 70 year old widow with a household of 15 heads. She is a farmer who has suffered from the consequences of urbanization.

"My problem is not peculiar to my household, she says, but the same as in all other 150-200 households in this community. All our farmland has been sold for residential purposes, by our village chiefs. Farmers were not compensated for their losses." The problem began about 7 years ago with the rapid increase in population and proximity of the community to Kumasi. Today, she says they have virtually nothing to farm on.

"As in many areas in Ghana, our land is family land but at the end of the day we have only user rights and it can be sold at any time by the chief who is the "owner" of all lands in the village."

While formerly, the household had about 20 acres, Madam Akua is today farming on about one third of an acre, cultivating some plantain, cassava and cocoyam which is just enough for home consumption. Her son Kofi who is 32 years old is without a job, as no land means no work.

"Young men and women of this household who were once farmers now occasionally get minor jobs (for about US$1-2 a day) at new building construction sites . This income augments the little we obtain from the farm. Sometimes two of my children who work in the city remit money to me. This does help, but it is not regular and therefore not reliable."

In other communities family clans struggle for the land. Land near to the cities is worth a lot, but it is not so for the farming community. The few plots which remain are wetlands where nobody wants to build a house. Some of them start irrigated vegetable production in these lands. This can be very profitable, but requires hard work. Besides, who knows if the plot will still be there tomorrow?

Coastal Areas and Wetlands

Approximately 39 percent of the world's population lives within 100 km of a coast. High population density puts pressure on coastal and marine environments, leading to encroachment into fragile wetlands and coastal areas. The increasing impact of tourism also contributes to degradation.

Coastal areas are strongly impacted by upstream land and water degradation processes as these zones receive sediment loads and pollution transported by waterways from upstream agriculture and cities. These areas are also vulnerable to reduced and modified river discharge brought about by upstream development activities such as diversion of water for irrigation schemes and damming of rivers.

Pollution and sedimentation from upstream areas are significant sources of coastal degradation. Inputs of excessive amounts of nutrients and organic matter cause deterioration of water quality and can bring about eutrophication and sedimentation. Sedimentation can also arise from soil erosion. Sedimentation is detrimental to coral reef ecosystems and can bring about high levels of coral mortality. The death of corals has implications for food security as reduced habitat correlates with a decrease in fisheries.

Coastal wetlands are among the most species-rich natural habitats and are important in coastal ecosystem functions. Wetlands include swamps, marshes, lakes, rivers, estuaries and peatlands. Half of the world's wetlands are estimated to have been lost in the twentieth century, primarily to aquaculture. In most instances the results of conversion of coastal wetlands, such as mangroves, to aquaculture has been unsuccessful due to severe acidification problems that render farms sterile and non-functional after a period of 5 to 10 years. Even when operational, these farms do not contribute to national food security, as they produce for export.

R. P. Gunatilake has been a fisherman in the Kalametiya Kalapuwa (lagoon), on the south coast of Sri Lanka, since he was a young man. However, over a period of time he has watched the natural resources that he relied on for his livelihood gradually degrade. He recalls that as a child, the lagoon was so extensive and rich that it supported 200 fishing families. His wife remembers her father going to catch something for lunch and returning half an hour later with crabs caught in the lagoon.

"Things began to change in 1967 when the canal was built," Gunatilake says, referring to the Uda Walawe Irrigation Scheme, designed to irrigate 600 hectares of paddy land. "It wasn't designed properly and too much water drained into the lagoon. It changed the salinity and the fish and prawn catches dropped. One year the paddy lands flooded, so the farmers complained and a drainage channel was cut to the sea. This helped, but it meant the sand barrier was no longer naturally breached, so seawater couldn't enter the lagoon and the prawns disappeared altogether.

"We started to face other problems too because of the sediment entering the lagoon along with the irrigation water. More invasive plants like water hyacinth began to grow, which increased sedimentation, and fertilizers and pesticides were washed into the water. The lagoon started to give an offensive odor and became covered with a green film.

"Things have worsened in the last few years. Another canal was built to divert water to the sea outlet so that paddy lands could be restored. Now the lagoon has hardly any water flowing through it. It's turning saline, and dying. Only 25 families can manage to fish in the lagoon now and catches are very low."

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Comprehensive Assessment of Water Management in Agriculture

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