Photos: FAO Mediabase, J. Morgan

Chapter 2

SOCIO-ECONOMIC PRESSURES AND INSTITUTIONAL SET-UP

Population increase and changed consumption patterns are the major drivers of the pressures on land and water systems that have been described in Chapter 1. Social and cultural dependency on land and water has changed as agricultural transitions and urbanization have accelerated in a more interconnected world. Many inter-related policies (including trade, rural subsidy regimes and production incentives) have promoted land and water use. But land and water management tends to lag behind macro-economic policy and sector development plans. In many cases active management has occurred only after environmental degradation has occurred.

This lack of natural resource perspective continues even where a limited natural resource base and high population growth rates are placing extreme pressure on resources. In short, macro-economic planners tend to be more concerned with supply and demand for agricultural products than with the supply of natural resource inputs and whether these are constrained or are reaching limits.

The large-scale spatial management of land and water systems started with the rise of river valley civilizations and associated agrarian development. More recently, land and water institutions have evolved to facilitate the success of intensive crop production associated with the breakthrough in genetic research – the so-called 'green revolution'. But in practice, few successful institutions have been developed specifically for integrated land and water management. Recent research has found that land and water institutions have not kept pace with patterns of use and competition, and have rarely succeeded in regulating environmental and economic impacts. In this respect, policy alignment and institutional integration have remained an aspiration rather than an operational reality. Land-use and agriculture planning, for example, is often decoupled from river basin planning and operational management for hydropower or navigation purposes. As a result, it can be argued that economic opportunities have been forgone and that a return to a much better-informed, more knowledge-rich integration of land and water is warranted.

This chapter examines the current state of institutions for land and water, and how they have both driven ever higher levels of output, as well as providing too little for social, economic and environmental sustainability. This has been to the detriment of the land and water resource base and related ecosystems, and has had severe implications for poverty and food insecurity.

Socio-economic dependency on land and water

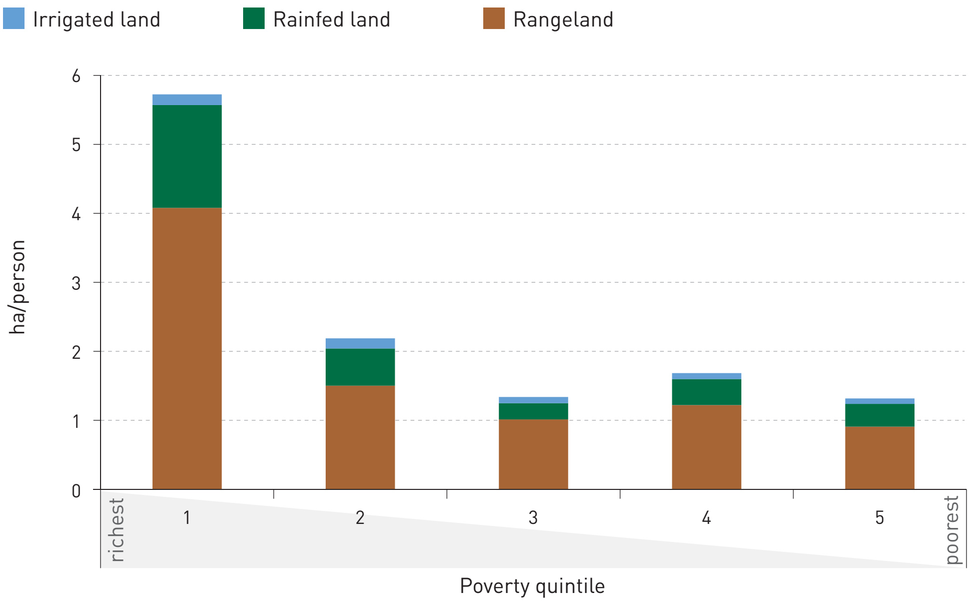
As agriculture becomes more productive, output per unit of land and per capita grows, incomes can be expected to rise, poverty reduces and food security improves, leading to reinvestment in the rural economy. In general, more intensive agriculture through irrigation has often arisen where the variability of rainfed production has proved intolerable. However, intensive agriculture has not always resulted in more rural employment and in many cases public agencies with limited budgets have had to make choices about the most desirable styles of agriculture. For instance, public investment in promoting rainfed agriculture may generate high distributional impacts but lower total growth when compared with investment in irrigated agriculture, where growth can be high but beneficiaries fewer. These considerations notwithstanding, the worldwide distribution of undernourished and food-insecure people, including those in countries in protracted crises, remains varied (FAO and WFP, 2010) and cannot always be linked to levels of agricultural productivity. Population pressure in resource-poor countries remains a key driver (Alexandratos, 2005, 2009).

The links between poverty, access to land and water, and land degradation

Worldwide, the poorest either have no land or have the lowest access to land and water (Figure 2.1), and low access to land is a predictor of poverty. In addition, poor resource management and type of farming system are also linked to poverty. The poorest often have the least-diversified farming systems. However, not all the poor live in lands considered degraded (Figure 2.2). Worldwide, only 16 percent of the poor live in degraded areas. Small changes in ecosystem health, in poor and populous areas have a significant effect, irrespective of the current ecosystem status, as the poor are heavily dependent on ecosystem health and the small surpluses they obtain can be wiped out by small negative changes in system health.

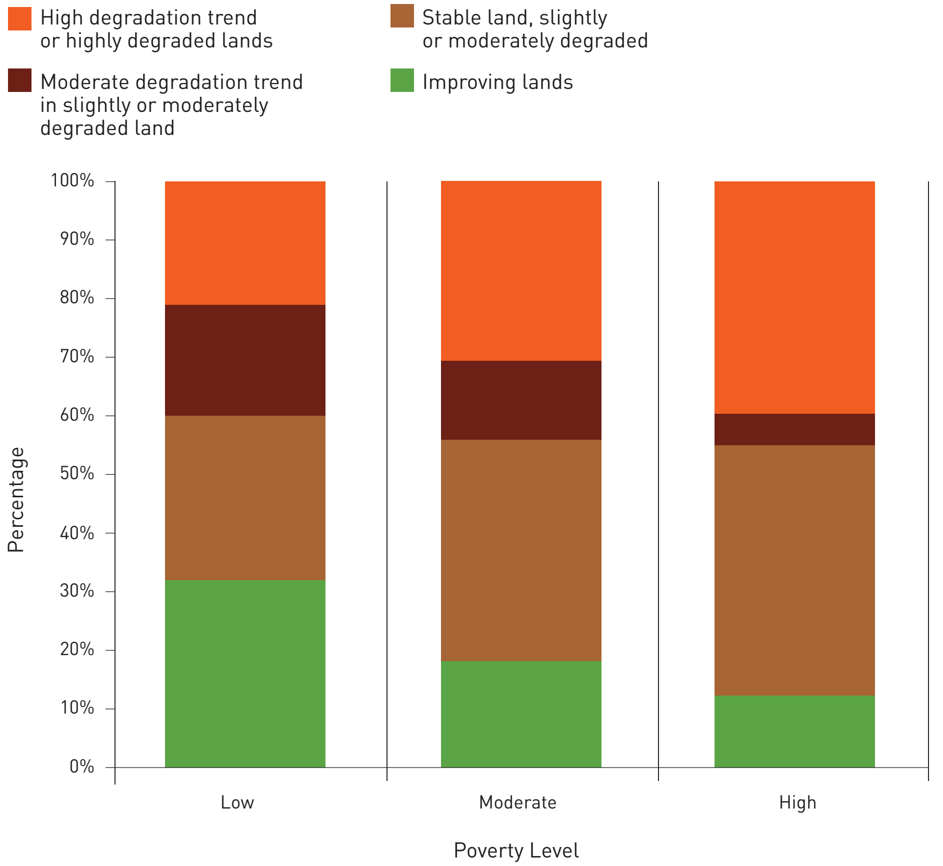
A wide variety of monetary and non-monetary indicators have been used to assess poverty levels (Coudouel *et al.*, 2002). FAO uses stunting among young children as a poverty-related chronic undernourishment measure (Gross *et al.*, 1996; FAO and FIVIMS, 2003). Indeed, where a single indicator of poverty is sought, 'stunting prevalence is one of the most reliable and most suitable indicators for monitoring and assessing poverty' (Simondon, 2010). Map 2.1 shows the prevalence of stunting among children under five years of age. It shows that high concentrations of poverty are found in Africa and Asia, particularly in sub-Saharan Africa and India. In sub-Saharan Africa as a whole, nearly half (45 percent) of the rural population are classified as poor. Map 2.2 shows the distribution of the number of poor people (based on density distribution of stunted children): in absolute terms, most of the world's poor people live in Asia.

FIGURE 2.1: PER CAPITA SHARE OF RANGELAND, RAINFED AND IRRIGATED LAND BY POVERTY QUINTILES IN RURAL AREAS IN DEVELOPING COUNTRIES



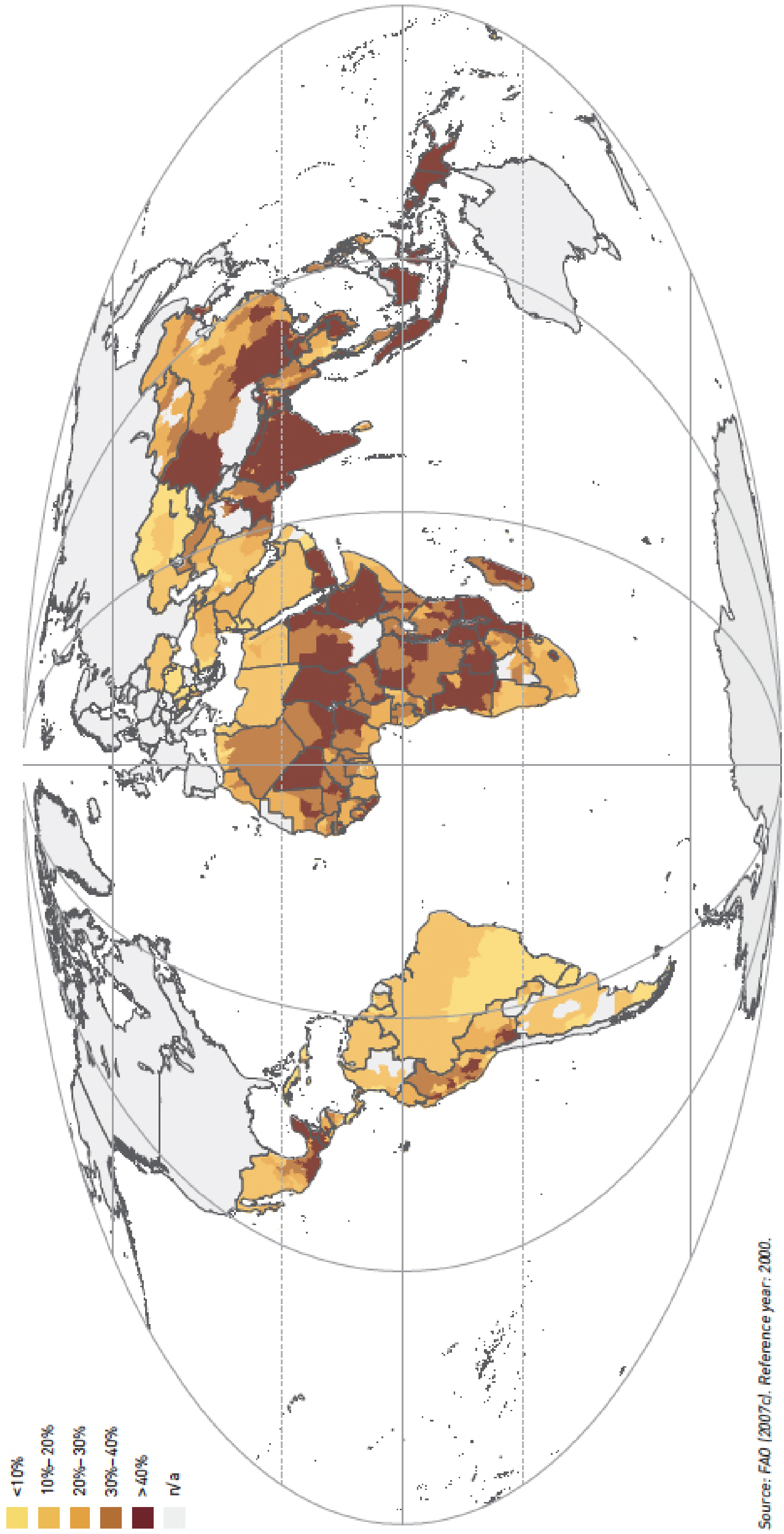
Source: Geodata Institute (2010)

FIGURE 2.2: RELATION BETWEEN LAND DEGRADATION AND POVERTY



Data sources: FAO (2007a); LADA (2010a)

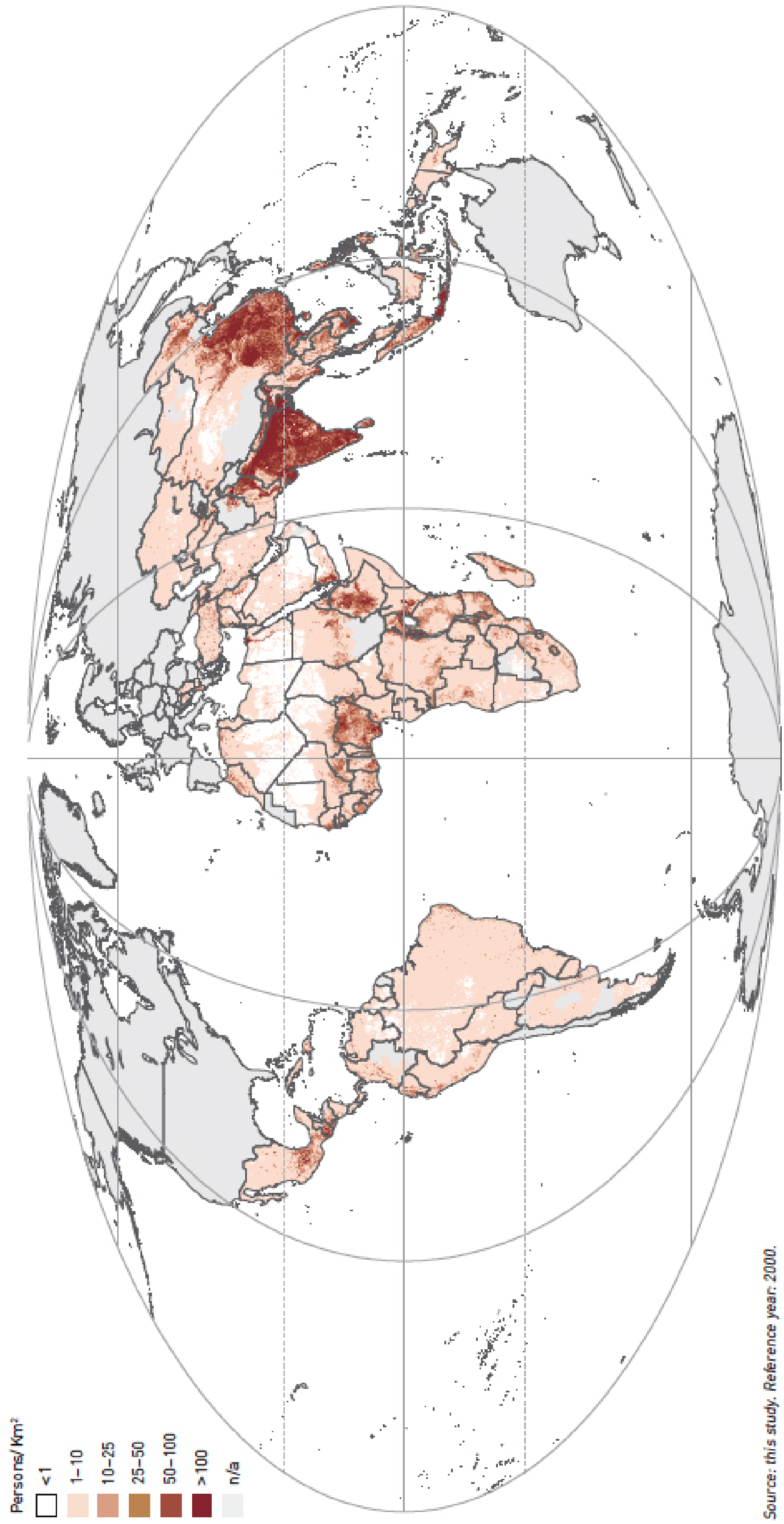
MAP 2.1: PREVALENCE OF STUNTING AMONG CHILDREN



Source: *FAO (2007c)*. Reference year: 2000.

CHAPTER 2

MAP 2.2: DENSITY DISTRIBUTION OF POOR PEOPLE, BASED ON STUNTING AMONG CHILDREN



Source: this study. Reference year: 2000.

The concentrations of rural poverty can be linked to marginal lands where access to land and water is uncertain. Commonly, poor farmers are locked in a poverty trap of small, remote plots with no secure tenure, poor-quality soils and high vulnerability to land degradation and climatic uncertainty. At the same time, technologies and farming systems within their reach are typically low-management, low-input systems that often contribute to resource degradation. However, improved farming systems can modify the relationship between land and water resources and poverty: the likelihood of being poor is much lower (less than half) when improved farming systems are employed (Hussain and Hanjra, 2004). Thus, improving land and water tenure arrangements and management practices in these areas is likely to have a direct positive impact on food insecurity and poverty (Lipton, 2007).

Intensification and poverty reduction

The rapid productivity gains of the green revolution in Asia during the second half of the 20th century was achieved through technologies of nitrogen-responsive, short season cultivars and application of irrigation. It helped create a 'springboard' out of poverty in Asia, and provided the foundation for the broader economic and industrial development that has occurred in the last 20 years (World Bank, 2005; Huang *et al.*, 2006). Empirical evidence for a sample of 40 countries shows that for each 1 percent improvement in crop productivity, poverty fell by 1 percent and the human development index rose by 0.1 percent (Irz *et al.*, 2001). However, it is important to emphasize that distribution of the benefits derived from increased production are not always equitable. In many cases it is the poorest losing both land and employment as a result of production intensification strategies, which could lower commodity prices locally and reduce incomes for poorer producers not engaged with farm intensification.

Irrigation and poverty reduction

A recent study of 26 irrigation schemes across six countries in Asia (Hussain, 2007) has furnished evidence that development of large-scale irrigated agriculture reduces poverty. The proportion of poor in such irrigated areas is much lower than in rainfed ones, especially in Southeast Asia and parts of India. Access to agricultural water reduces the incidence and severity of poverty. Agricultural water enables households to improve and stabilize crop productivity, grow high-value crops, generate high incomes and employment, and earn a higher implicit wage rate. Income inequality and poverty rates are consistently lower for irrigated areas, and households with access to agricultural water and other inputs are less likely to be poor.

A key criticism of irrigation development is that it provides benefits to a relatively small proportion of the population, giving them considerable value in terms of infrastructure and share of water resources (Smith, 2004). This inequity is partially offset by the multiplier effect of irrigation in generating additional welfare through market activity (inputs, labour, contracting, transport, processing and packaging).

Multiplier effects of greater than three have been found by various authors in Asia (Bhattarai and Narayanamoorthy, 2003; Hussain and Hanjra, 2004), although Smith (2004) assessed the range of multipliers to be from 1.3 to 2. The broader benefits of private and communal groundwater development in India have been demonstrated to be 'pro-poor' (Shah and Singh, 2004).

Irrigation reduces poverty in three ways: increased food output, greater demand for employment and higher real incomes. Irrigation also has longer-run effects on the poor through the multiplier effect that drives an increase in non-farm rural output and employment as the level of rural spending rises. Risk reduction is also an important impact of irrigation: reduced variability of output, employment and income reduces the vulnerability to risk of the poor. Improved opportunities for crop diversification also reduce risk. In turn, reduction in risk allows more productive investments to be made, and lessens the need for periodic liquidation of capital (e.g. livestock) in times of crisis. Other benefits may also accrue, such as reduced seasonal rural out-migration and improved girls' attendance at school.

However, despite these poverty-reducing benefits, many irrigated systems are still home to large numbers of poor. Irrigation can also have direct negative impacts on the poor in situations where adverse social, health and environmental costs of irrigation are so high that they outweigh the benefits received by the poor. Poverty incidence is also generally correlated with position within a scheme (tail-enders are typically poor) and with inequitable land distribution: irrigation's impact on poverty is highest where landholdings (and thus water) are equitably distributed (World Bank, 2008). It is also the case that the introduction of irrigated production in food staples can undermine the seasonal progression of producer prices enjoyed by rainfed producers who compete in the same local markets (FAO, 2006c).

Multiple uses of water

Beyond agricultural production, irrigation systems and infrastructure can provide further services, such as provision of potable water supply (formal and informal), stock watering, washing and laundry facilities, fishing (in ponds, rice paddies, irrigation and drainage channels), and fluvial transport. In some cases, well-designed systems provide electricity supply and bulk water (e.g. for cities and towns of the Fergana Valley in Central Asia). Despite these many potential uses of irrigation water and infrastructure, it is only recently that development projects have systematically incorporated these multiple functions and taken their benefits into account in the economic evaluation of irrigation development (Smits *et al.*, 2008; FAO, 2011e).

Fish capture and production is also an important source of livelihood in rural areas. While most rural people, particularly in Africa and Asia, identify themselves as 'farmers', their households are usually engaged in a range of activities. People move and alter their activities in response to seasonal and annual variations, in particular the flood cycle. Each piece of land may seasonally serve as farmed field, grazing area and fishing ground. The importance of each activity depends on the socio-economic status of the people involved and the cultural settings, and is highly dynamic, changing as a response to environmental conditions. Such a strategy therefore not only ensures a diversified food base, but equally reduces the dependency on any single resource, and thus adds resilience to their livelihoods. Access rights change during the hydrologic cycle as ownership usually only applies to the land during the dry phase; when fields are flooded, everybody, including landless people, have rights to use the resources.

A sectoral approach to improve food security would therefore be counterproductive, as many rural people are involved in a variety of livelihood activities, inland fisheries often being one activity much overlooked.

Finding the balance between distribution and growth

As agriculture becomes more productive, output increases and food security improves. As agricultural productivity has doubled over the last 40 years, global levels of poverty and food insecurity have declined, even though malnourishment has persisted. Intensification of rainfed and irrigated production, combined with reduction of post-harvest losses and more reliable storage and transport, have been instrumental. However, these gains have not come without exerting pressure on natural capital to the extent that some land and water systems are exploited to their limits or degraded beyond economic remediation. The process of agricultural intensification has typically also been accompanied by a demographic transition out of agriculture as land consolidation, intensification and mechanization of agriculture proceed, even though labour intensity per hectare is higher in irrigated production.

By contrast, investment in rainfed agriculture generally results in higher distributional impacts but lower income growth outcomes for farmers. A policy choice between investing in rainfed agriculture as an instrument of poverty reduction with well-distributed impacts and in intensive, irrigated agriculture as an engine of growth (World Bank, 2007a) may become apparent when public budgets are limited. But generally, where rainfed agriculture is possible, a well-structured agriculture sector will have elements of both, with policies ensuring that investments in rainfed agriculture optimize growth as well as distribution, and that investments in irrigation maximize distributional impacts through a pro-poor strategy. The minimization of negative environmental impacts is critical for both.

Basic systems of allocation

Land and water management is underpinned by systems of allocation and tenure that provide access, security and incentives for profitable and sustainable use. Traditional land tenure systems may include protected rights, but often they are communally held. However, the pace of demographic and economic growth has created stresses over allocation and security of tenure, resulting in disputes over land and water, sometimes spilling over into conflict. In many cases this has led to widespread appropriation of communal rights by the powerful. At the same time, a variety of modern land tenure institutions have emerged. Formal and informal land tenure systems now overlap, although incorporating traditional institutions into modern ones remains a challenge. Such institutional adaptation has tended to lag behind the economic and social changes it was intended to accommodate. Arguably, the lack of secure tenure combined with rigid land markets has resulted in under-investment and inefficiency in the use of resources.

Irrigation water use rights have always been protected, but rapid economic and technological change has overwhelmed many traditional rights systems. Attempts are being made to recreate local communal institutions through water user associations (WUAs). At the basin level, competition between irrigation, municipal and industrial use, and increasingly hydropower is being addressed, but often there is a mosaic of tenure and use rules, so that there are few examples of well-ordered and regulated rights in use. At transboundary level, principles of equitable benefit-sharing and no uncompensated harm are accepted by many countries in regional and basin level protocols, but, again, are only applied sporadically.

Land tenure

Formal and informal land tenure systems now overlap. Through historic processes of competition and dispute resolution, land tenure institutions have been adapted to local socio-economic conditions (FAO, 2002a). The predominant form of traditional tenure was communal, with well-negotiated rules and norms for individual access. The resulting tenure usually provided security and incentives for farmers to invest in land and water development. Modern systems of legislation have then tended to overlay individual property rights systems on these traditional institutions. As a result, modern laws have rarely defined or protected communal rights. In some situations, this has led to progressive dispossession and inequity in land distribution.

Institutional adaptation has been slow. When population densities were low and farming systems at subsistence level, the tensions implicit in this legal asymmetry were largely latent. However, demographic pressures on resources have put stress on both resources and traditional institutions. At the same time, rapid technological and economic changes have taken place but have not been accompanied by adaptation of institutions.

Competition and disputes over land and water in rainfed cultivation areas have intensified. As competition has increased, institutions have not adapted to address emergent conflict over land and water. Such conflict has arisen from inequitable distribution, with concentration of resources in the hands of a few, and from the appropriation of traditional rights, often by former traditional leaders who converted communal tenure into private property. Clashes between traditional and modern systems have also resulted from changes in land and water use, for example between forest dwellers and agriculturalists, or when settlement agriculture has interrupted traditional pastoral practices. Conflicts have also arisen when land-use changes have caused separation of land and water rights previously managed jointly, for example when local watersheds that used to provide runoff to fields below have been converted to cultivation.

Conflict has also arisen between cultural groups within the production system. For example, conflict between landowners and landless labourers has long existed in Latin America, and has emerged in Africa between pastoralists and cultivators as population pressures on limited land and water resources have increased. In some countries, such as Brazil, landlessness has become a major political issue. Tensions between large landlords and tenants or share-croppers are also widespread in the Indian subcontinent and the Philippines.

Communal rights are often poorly defined and protected by law and regulations, resulting in widespread appropriation by the powerful in many places. Systems of communal tenure coexist in many countries with individual tenure. Communal systems are found in Africa, India, Brazil and Mexico. Historically, the introduction of modern individual tenure into predominantly communal tenure systems resulted in tensions, for example between indigenous populations and colonial settlers. More recently, similar tensions have arisen between farmers settling in new irrigation schemes and pastoralists (Hardin, 1968; McCay and Acheson, 1987). These kinds of conflicts tend to diminish incentives to adopt or maintain sustainable land and water management.

Communal systems are, nonetheless, capable of adapting. They give tenure security by providing individual and inheritable use rights, and have often adapted to rising scarcity by allowing for the emergence of rental markets for land and for sales within the community. Communal systems can thus provide some of the security of tenure that underpins sustainable land and water management. However, there are drawbacks: investment in land is often constrained because communal rights cannot be used as collateral for loans. The lack of secure status for traditional land tenure has resulted in underinvestment and inefficiency in the use of resources. Rainfed farmers with insecure tenure will either not invest or will opt for technologies with short-term returns, preferring, for example, vegetative contour strips rather than stone bunds to slow runoff and erosion, because the contour strips have a shorter pay-off period and therefore offer a quicker return with lower risk.

There has been no easily identifiable trend in land tenure reform. Land tenure reforms have been initiated on a periodic basis in response to population pressures and associated impacts on land quality, but such national initiatives as the enclosure or sale of public land are typically sporadic. However, these pressures are promoting more progressive examination of regional approaches and generic problems in land tenure (FAO, 2011b), and links between reliable land tenure systems and poverty reduction have been recognized.

Two broad lessons of experience have emerged. First, the nature of land tenure arrangements determines scope and quality of land management, and without stable and transparent arrangements, underinvestment and less sustainable farming practices result. Second, the incorporation of traditional or customary institutions into modern legal regimes remains a challenge.

Water-use rights

Water rights traditionally evolved to share irrigation water, but these have been overtaken by economic and technological change. Historically, the evolution of water-use rights systems has been driven more by irrigation development agendas than any other sectoral interest (Caponera, 1992; FAO, 2006e). For irrigation systems, land and water are inseparable components of the production system, and management institutions have dealt with them jointly in the form of irrigation districts, command area authorities and WUAs.

The development of water control technologies and energized pumping has enabled the expansion and intensification of irrigated areas. These have, however, been largely outside of communal institutions and regulation, and have altered previous patterns of use within irrigation schemes and across river basins. Traditional institutions have proved unable to cope with many of these alterations, and disputes over entitlements to water are now common (Box 2.1).

There has been a marked expansion of groundwater use in irrigated agriculture. Aquifer depletion and the accompanying deterioration of groundwater quality have been driven by demand for precision irrigation and economic incentives, such as rural energy tariffs that encourage a 'race to the pumphouse'. As shown by Shah (2009) in the case of India, formal attempts by states to regulate groundwater rights and extraction have had little or no impact. The challenge of intervening at the local

BOX 2.1: CONFLICT, ADAPTIVE CAPACITY AND A SHIFTING EQUILIBRIUM IN YEMEN'S WADI DAHR

Yemen has a long history of water conflict and of subsequent accommodation of change. Yet Wadi Dahr (close to Sana'a) had a long, well-documented history of managing its water resources well. Rules had been agreed over centuries through an evolving process of conflict, contentious judgements, and ultimate development and acceptance of new rules that progressively crystallized into an 'established tradition'.

In 1970, tubewell technology burst into the finely balanced water economy. A downstream community in the wadi complained to the court of the sheikh that upstream motor pumps had reduced the stream flow and disturbed 'laws and customs … by which we have been guided for thousands of years'. This new conflict was resolved, but not by the courts. The rich and influential downstream farmers simply invested in the new pump technology themselves. 'The stream dwindled and died, but no one with influence any longer cared.' A new equilibrium emerged: assets were rebalanced and concentrated more in the hands of the richer. The conflict was resolved, and a new 'established tradition' had emerged.

Sources: Mundy (1995); World Bank (2010b)

level in the regulation of hundreds of thousands of groundwater users can exceed the capacity of many water pressure administrations, but this is not to say that local autonomous solutions are impossible (Blomquist, 1992).

If the institutional and incentives framework remains unchanged, the current patterns of agricultural groundwater use (Siebert *et al.*, 2010) will continue to result in permanent damage to both the quantity and quality of strategic groundwater reserves. Important sources of freshwater for growing rural, municipal and industrial demands are also affected. For groundwater, local 'point of abstraction' regulation is required, and better-informed management by water user groups may offer a way to moderate the demand for groundwater, or at least bring local agreement on the maximum admissible drawdown in shared aquifers (World Bank, 2010a).

Institutions also have to arbitrate between agriculture, municipal and industrial needs (and increasingly hydropower). Governments generally give priority to abstractions for municipal and industrial supplies. Although the volumes are often relatively small in comparison with uses in agriculture or the in-stream requirements for maintaining hydropower generation, rising allocations to municipal and industrial uses are raising levels of water stress. In water-scarce regions such as the Middle East and Northern Africa, there is strong competition among sectors, and water allocations to agriculture are diminishing, such as in Jordan. The institutional rules to govern surrender of water entitlements are highly contested, and reallocation of water out of agriculture can lead to social unrest. In many developed river basins, competition for releases between irrigation and hydropower can both constrain optimal allocation between the productive sectors and compromise the reliability and quality of flows for municipal water supply.

At the transboundary level, cooperative principles rather than water rights have been adopted as the best approach. The high political and economic cost of development by individual states, and the loss of the extra value if investment were planned at the basin scale, have led to a number of cooperative agreements and the development of principles of 'equitable use' and 'no significant harm', which are codified in the (as yet unratified) Convention on the Law of Non-Navigational Uses of International Watercourses. In practice, though, nations have largely given priority to their own internal water agendas over those that require cooperation and benefit-sharing (Bingham *et al.*, 1994; Yetim, 2002).

Under conditions of intensifying competition, the need to manage land and water jointly becomes even more pressing (FAO, 2004b). However, the relationship between land tenure and water-use rights is highly variable, with a mosaic of regimes even within countries. For example, some states in the USA and in India adopt prior appropriation rules while others give precedence to upstream claims. At the same time, the use of land has major impacts on both the quality and quantity of water resources, so that decisions regarding the use and allocation of one resource impact directly or indirectly on the use and allocation of the other. There is thus strong advocacy in many countries for integrated approaches to the use and management of land, water and other natural resources. In rare cases, such as the Andhra Pradesh Water, Land and Trees Act of 2002, these approaches have been translated into law.

Policy responses to date

Policies and their incentive frameworks are the mechanisms by which governments seek to align development with societal objectives. Land and water use in agriculture is at the crossroads between several suites of policies, which can easily lack alignment or work at cross-purposes. As a result, policies and incentives have often driven unsustainable use and the proliferation of negative environmental externalities.

Agricultural policies typically aim at growth with equity, but sometimes result in damage to the environmental services on which growth depends – for example, fertilizer subsidies contribute to nutrient pollution, or energy subsidies to groundwater depletion. The typical objective of land policy is to ensure equitable, secure access. Yet institutions for defining, negotiating and managing access problems are often under-resourced. Past supply-driven water policies have created excess demand for water in many basins. In recent years, integrated water resource management policies have been adopted, applying intersectoral, often decentralized approaches. As a result, better options have emerged for efficient allocation and management of scarce water resources, but these are only slowly being applied.

By contrast, environmental policy has emerged as an active force in diagnosing problems, but it is often catching up rather than intervening with foresight, and is generally weak in regulatory capacity. Environmental policy faces particular challenges in low-income countries in influencing the development agenda, where it may be seen as anti-development, or even anti-poor. Some joint land and water management approaches have arisen, both for specific environmental problems and from introduction of basin planning, and land and water master-planning. However, these have had little impact on macro-economic planning or on development, although basin planning has improved water resource management practices and accountability.

Agriculture and related policies

The policies and institutions related to land and water management are generally designed in line with national objectives, typically principles of efficiency, equity and sustainability. But choices and decisions at lower levels (provincial, local, individual farmers) also shape policies and institutions. Policy objectives aimed at efficiency in the allocation of resources to create the highest economic value are tempered by an equity objective that may aim to alleviate poverty in rural economies. The third objective of sustainability reflects the long-run interest in protecting natural capital to maintain a flow of environmental services upon which growth and livelihoods depend.

Objectives have tended to be translated into a policy and institutional framework through a range of instruments. These include price and trade policy, fiscal policy and budget allocations, legislation and institutional set-ups for land and water administration, and agricultural services. A dominant feature of agricultural policy has been the influence of the incentive framework transmitted through the tax regime, subsidy policies and the pricing of inputs, particularly for fertilizers and energy. Policies that affect the costs of production, such as trade policy, tariff barriers and export bans, have also proved powerful incentives. Some of these policies have led to unintended negative impacts on the environment.

Land policy

The typical objective of land policy is to ensure equitable, secure access (Molden, 2007). Land policies set the framework for how land is allocated and how land use is planned. Land policies may also set rules for investment in land, including commercial and sovereign investment. Land policies also define and regulate land tenure rules, administration and dispute resolution, and manage the information base for land-based taxation (FAO, 2004a). A land policy may also provide for specific land tenure measures, such as: management, development and privatization of public lands; consolidation of fragmented land (FAO, 2003); and land reform and distribution of former collective lands (as in the former Soviet Union). Particular problems are:

- **Under-resourced institutions for defining, negotiating and managing access** – poorly functioning land registration, weak defence of rights, and poorly performing markets for both ownership and rental.

- **Common property regimes that adapt poorly to changing socio-economic conditions.** Well-functioning common property regimes are governed by agreed rules with no free riders, with low competition and high cooperation. As discussed above, where traditional institutions become weak or do not adapt, individuals may exploit common resources outside the rules, with resulting overexploitation and degradation.

- **Gender and land access.** In many societies women perform most of the agricultural work, and may be sole operators of a family farm, yet tenure rules often exclude them, so that they have no access to land title, and hence have no security of tenure or access to bank credit (FAO, 2002c; Ellis, 2000).

- **Inward commercial and sovereign investment.** Inward investment in land for production is on the rise. Lands may be allocated by governments under modern land tenure statutes when the lands are already owned and in use under traditional tenure arrangements. Unless policies and institutional mechanisms are in place to ensure the interest of local people, growth of this phenomenon could lead to impoverishment, food insecurity, and social and political tensions (Cotula *et al.*, 2009).

Water policy

Many water policies and sector strategies have been dominated by a focus on supply. The development of water resources to supply irrigation, hydropower, and municipal and industrial demands has characterized the activities of river basin agencies for most of the 20th century. Massive investments have been made in large public irrigation schemes, and during the 1960s to the 1980s more than half the public agriculture budget in many countries and more than half of World Bank agricultural lending was directed to irrigation (Rosegrant and Svendsen, 1993). Arguably, this supply-driven approach has led to excess demand in many countries. In countries where water is short, resources may have been over-allocated to one sector (typically agriculture), creating rigid entitlements. Water charging policies that have depressed the real cost of supply may have encouraged overuse (FAO, 2004c). Water entitlements locked into these uses have proved hard to negotiate downward even as farmers have increased their water productivity. However, the pressure to account for water use in agriculture in social, economic and environmental terms is building (OECD, 2010a).

As many nations came to the end of the period of 'easy' expansion of irrigation, problems of rising costs, excess demand and fiscal over-commitment have become apparent. At the same time, negative environmental and socio-economic impacts emerged. Adjusting supply and demand while also taking into account sets of environmental externalities requires institutional change. Responses typically include demand management measures, such as pricing measures, rationing and reduced allocations. However, poverty reduction and food security goals also had to be taken into account and a rationale for integrated water resource management set.

Integrating land and water into macro-economic planning processes

The need for more integrated land and water planning and management to address intensifying competition for resources has been identified, and some joint land and water approaches have emerged. What began as the aspiration of geographers to combine hydrology with earth and social sciences (Chorley, 1969) was integrated into global initiatives such as the 1992 Rio Conference on Environment and Development and the related conventions on biodiversity, desertification and climate change. To date, two types of approach have emerged: (1) as a remediation of the negative side-effects of intensive agriculture (the clean-up of the Rhine and Danube systems in Europe and the adoption of the European Union Water Framework Directive are cases in point; see Box 2.2); and (2) as a means of planning development at the basin or regional scale, which forced consideration of land management and the circulation of water through and across it.

Generally, it is in the highly developed river basins in post-industrial economies, such as the Danube and the Rhine (with correspondingly high levels of infrastructural development and intensive use), where the management of land and water have been tightly linked and regulated to protect rights in use and to reduce environmental impacts. Elsewhere, land and water management have been decoupled by default, as different institutions have responded to specific demands from their respective sectors, or by design in order to free up natural resource transfers among users and sectors. The evolution of the Murray-Darling basin, Australia is a case in point.

Despite these advances, few natural resource management criteria are used in macro-economic and sector planning. It is only where land and water constraints impact economic growth that more explicit forms of land and water planning and management appear on the political agenda, as for example with integrated landscape planning (*'gestion du terroir'*) in Burkina Faso.

BOX 2.2: EUROPEAN UNION WATER FRAMEWORK DIRECTIVE

The EU Water Framework Directive (WFD) was adopted in October 2000 in response to increasing demand by EU citizens and environmental organizations for cleaner rivers, lakes, groundwater and coastal beaches. Early European water legislation began with standards for rivers and lakes used for drinking water abstraction in 1975, followed in the 1980s by quality targets for drinking water, and legislation on fish and shellfish waters, bathing waters and groundwater. In 1991, the Urban Waste Water Directive imposed secondary wastewater treatment, and the Nitrates Directive addressed water pollution by nitrogen from agriculture. Later, the Drinking Water Directive reviewed and tightened drinking water quality standards, and in 1996 an Integrated Pollution Prevention and Control Directive (IPPC) addressed pollution from large industrial installations.

Pressure for a fundamental rethink of EU water policies came to a head in mid-1995, when the EU was requested to address in a more coherent fashion the increasing awareness of citizens and other involved parties for the quality and the management of their water resources. The main purpose of the new European Water Policy was to reduce pollution and ensure clean waters are kept clean. It had the following aims:

- expanding the scope of water protection to all waters, surface waters and groundwater;
- achieving 'good status' for all waters by a set deadline;
- water management based on river basins;
- 'combined approach' of emission limit values and quality standards;
- getting the prices right;
- getting the citizen involved more closely; and
- streamlining legislation.

Citizens were put at the centre of the reform process: the policy was thus developed through an inclusive and open consultation process involving representatives of Member States, regional and local authorities, enforcement agencies, water providers, industry, agriculture and, not least, consumers and environmentalists.

Source: European Commission (2010)

Integrated spatial 'master plans' today have little influence on development. In the 1970s and 1980s, detailed land-use planning was carried out for agricultural purposes (e.g. classification of soils and land-use suitability) and incorporated in area development 'master plans'. However, these plans were generally used as information repositories rather than as spatial planning instruments. District or county structure plans today in industrial countries give broad zoning demarcations, including 'green space' and environmental reserves, but they are not generally used for detailed agricultural planning or environmental management of land use.

Basin planning has, however, improved water resource management and accountability. The emphasis on district or river basin water master plans in the 1970s and 1980s has not continued, although their legacy has formed a variety of river basin-based water allocation and management institutions (e.g. River Basin Offices in Tanzania), and continues to provide a strong information baseline for national inventories of water use. These master plans also helped in the first compilation of FAO AQUASTAT data in the late 1980s. Overall, although land policy and management may not have always been coupled with basin planning, the 'sentiment' of integrated water resource management has prompted adoption of more progressive water accounting and environmental regulation. The degree to which these basin planning approaches have succeded in mitigating negative socio-economic and environmental impacts remains open to question (Molle and Wester, 2009).

Institutional approaches and performance

The institutional responses to rising demands on land and water include the policies, incentives, norms laws and rules that allocate resources and regulate their use. These land and water institutions are taken to include:

- land and water development policies, plans and organizations, and systems of allocation and protection of land and water rights;
- related agricultural policies, plans and organizations, together with broader policies affecting incentives such as fiscal policy and trade policy; and
- environmental policy and organizations dealing with regulations and incentives for natural resource protection, and the consequences of the 'externalities' of land and water use.

For land and water, the challenge is that, while governments may make policies, management is largely the responsibility of farmers. Ministries of agriculture or rural development usually have primary responsibility for guiding land and water management, but it has become increasingly common for services such as extension to decline precisely where they are most needed. Some attempts at joint approaches to land and water have been effective at the watershed level, but much more attention is needed to integrate approaches for land and water. Few programmes are yet to persist long enough to achieve significant results.

Nonetheless, land-use planning has improved, with more accessible tools, and it has been effective in land resource allocation in some developed countries. But such land-use planning has had little impact on development programmes in developing countries, and there has been limited compliance with plans in countries with little or no institutional capacity. Some decentralized and participatory land-use planning has been successful, but generally only at local levels.

Agriculture agencies

The primary institutional responsibility for land and water management has rested with ministries of agriculture or rural development. The role of these agencies in delivering technical and support services to rural communities or to individual farmers has been to encourage the uptake of inputs and the adoption of improved agronomic practice. In some cases, the role of the private sector and equipment suppliers has been important, particularly in the application of precision irrigation. It has been rare for traditional extension services deploying under-resourced government officers in the field to have more than limited impact on improving productivity in land and water management. In a recent global review of extension practice (FAO, 2008b) the case has been made for transforming national advisory services into decentralized, farmer-led, market-driven extension systems.

Watershed management approaches

An example of an institutional approach is the watershed management approach, which seeks to manage both land and water and the wider ecosystem of the watershed in an integrated way. Successes have been limited so far, partly because of the asymmetry of interests between upstream and downstream stakeholders, and partly because of the sheer complexity of the perceptions of natural and anthropogenic functions at the scale of a watershed (see Box 2.3).

The first generation of watershed management projects in developing countries in the 1970s and 1980s applied a soil and water planning approach that emphasized engineering works for specific on-site and downstream physical outcomes. In general, too little attention was paid to the needs of upstream populations or to their ownership of programme actions. As a result, investments were high-cost and not always well justified, and the assets created often had a limited life. By the end of the 1980s, the comparative failure of this 'engineering-led' approach was clear, and a major rethinking of watershed management approaches was undertaken by national and international agencies.

The 1990s represented a departure for watershed management programmes supported by the international community in developing countries. While engineering solutions were not excluded, the emphasis was placed more on farming systems and on participatory approaches implemented in a decentralized fashion. Support was given by the renewed emphasis on rural poverty reduction in development programmes. The move away from planned investments towards participatory approaches was designed to seek synergies between both local land and water

BOX 2.3: WATERSHED MANAGEMENT EFFECTS ON THE WATER CYCLE

Experience from SE Zimbabwe exposes the myth that 'poor agricultural practices in the headwaters lead to increased siltation in reservoirs'. The large sugar estates of the lowlands are major agribusiness users of water, and rely on an extensive series of mid-catchment storage dams that now face problems of sedimentation. This increased sediment is blamed on poor farming practices, including deforestation and overgrazing by the 'indigenous', 'subsistence' farmers of the headwaters.

Following the devastating drought of the early 1990s, some of the sugar estates started outreach programmes to work with farmers in the headwaters to 'improve' their land management. By the late 1990s, those involved in the outreach programme were reporting positive results: the suspended solids entering their dams were decreasing dramatically. Yet, there appeared a contradiction: the outreach programme was tiny, and the catchment area large. Research also revealed a ten-year cyclical pattern of above and below 'average' rainfall, possibly related to the El Niño southern oscillation (ENSO). The 1980s had been the driest on record.

The combination of research and local farmers' perspectives resulted in an alternative narrative to that of the sugar cane farmers. During the long dry years, water levels drop, shrubs and grass die, and livestock (before dying) exacerbate the situation by eating everything available. During this period, sediment levels generally increase, as erosion occurs when rain does come. In particular, large storm events at the end of the dry period move huge quantities of 'stored' soil. However, once a wetter period is entered, browse and crop cover quickly returns, aided by low livestock numbers, and erosion more or less ceases. Photographs of the study site in the 1990s show bare red earth; yet since then, vegetation has been lush. Sediment measured leaving a small headwater catchment where there had been no outreach programme and where subsistence agriculture was being practised never exceeded 5 t/ha – far below the 70-100 t/ha reported from many plot-based experiments.

Source: FAO (2002b)

management benefits and downstream impacts. However, the timeframe for implementation is generally long, and few programmes have persisted for long enough to achieve significant results, and even then the long-term impacts on the water resource base can be questionable (Batchelor *et al.*, 2003).

Land-use planning

Land-use planning has formed a part of area development planning since the 1970s, such as through soil surveys and land capability or evaluation mapping exercises (FAO, 1976, 2007b). With the advent of cheaper computing systems, more sophisticated geographical information system (GIS) approaches have been deployed, for example in Kenya, Swaziland and Bangladesh (all supported by FAO). However, while national capacities in land-use decision-making have been strengthened, these have not translated into agricultural plans or investment strategies, mainly because they were attempting to be too deterministic (deciding which crops should be grown based on soil and terrain conditions) at a time when economic liberalization and market penetration was advancing. Where plans have been developed, compliance has been limited as there is little or no institutional capacity to regulate land-use. By contrast, land use planning in Europe has tended to play a more structural role in allocating land to different uses: urban, forests, farming or protected areas.

In general, land-use planning has been more successful at the local scale and generally has had only weak links to the larger scale. When tied to decentralization and agriculture sector support programmes, there is more evidence of localized investment and support for land-use planning. The adoption of participatory rural appraisals (PRAs) as a primary planning tool in the 1990s has improved local-level ownership. However, the decentralized and demand-driven focus has contributed to fragmentation. This remains one of the main issues in watershed management, for example, where participatory and demand-driven planning at local level is not matched with the needs of those downstream or with integrated plans for basin-wide land and water management.

Irrigation management agencies

Given the scale of public funding to medium- and large-scale irrigation, the role of government agencies in developing, operating and maintaining irrigation systems has been dominant. But few publicly managed large irrigation schemes have achieved fiscal efficiency or demand-responsive water service (Molden, 2007). The major causes of poor service delivery are bureaucratic institutions and rigid technical design, both of which generally originate in a top-down, planning-led approach to irrigation. There has been a vicious circle of insufficient funding, inadequate operation, and maintenance and system deterioration, often leading to the need for successive rehabilitations.

Nonetheless, governments have been transferring some responsibility for large-scale irrigation management to user groups. But the experience with participatory irrigation management (PIM) and irrigation management transfer (IMT) has been mixed (FAO, 2007a; Molden, 2007, Ch. 5). In the evolution from public to collective and market-oriented institutions, irrigation management is going to have to be more contextualized and pluralistic (Meinzen-Dick, 2007). However, the issue of covering operation and maintenance costs and turning transferred assets into profitable, viable operations remains considerable (Box 2.4).

BOX 2.4: IRRIGATION MANAGEMENT TRANSFER EXPERIENCE: OPERATION AND MAINTENANCE IN ROMANIA

In Romania, irrigation systems depend heavily on pumping. Out of a total of 3.1 Mha of developed land in the late 1980s, about 2.85 Mha were under sprinkler irrigation, with heavy energy costs: in some places, the static lift of irrigation systems exceeds 270 m. After the dissolution of state and collective farms in 1990, there was no clearly designated authority for the operation and maintenance of irrigation infrastructure, and national organizations had neither the staff nor the budgetary resources to take such responsibility. As a result of ageing of the irrigation infrastructure, complicated by an inability of both the government and farmers to pay for energy costs, the earlier annual irrigation use of 2 500–3 000 m^3/ha dropped to about 1 000 m^3/ha, and the revenues from fee collection became insufficient to cover the cost of maintenance of the infrastructure. In addition, on-farm equipment and pumps had been destroyed or stolen, or were too old to operate properly.

The Land Reclamation Law of 1999 formalized the creation of WUAs and completely restructured the National Land Reclamation Society (SNIF) into a land reclamation agency, which included significant staff reduction, transfer of authority to regional offices, as well as a stronger WUA role in systems management. Now canals and secondary pressure pump stations are operated by WUA staff who are also responsible for fee collection. The law was further modified in 2004 and 2005 to allow WUAs to control management from the primary pumps to the river. At present only about 700 000 ha are being irrigated, owing to lack of maintenance of the irrigation systems and the age of the large pumping units, as well as the costs of energy. The Land Reclamation Law established that an irrigation system can only be operated if there is a demand for water of at least 20 percent of its command area, both at the distributary canal and overall system levels. The challenge for the WUAs remains that of being able to maintain enough area under irrigation to be able to properly maintain the existing infrastructure.

Source: FAO (2007a)

In some cases, the private sector has been effective in introducing modern irrigation by helping to introduce more advanced farming practices, such as downstream control, surge irrigation, subsoil drip and fertigation. These have been led by privately financed initiatives where market conditions have exerted a strong pull for precision irrigation. The efficiency of some private initiatives sometimes stands in stark contrast to publicly run schemes: for example, the productivity of the privately run Kenana sugar estate in central Sudan compared with the vast public Gezira scheme only 100 km to the north, where the full operation of the sugar estate compares with only partial cropping within the Gezira. Another example is the advent of shallow groundwater access in many gravity irrigation commands across India, which has triggered what Shah (2009) terms ‘atomistic irrigation’ – a private response to the institutional and hydraulic failure of the command area authorities.

Overall, there is a need for more flexibility and responsiveness in irrigation management, which requires well-thought-out capacity-building programmes as much as modernized infrastructure (FAO, 2007e).

As these private operators have demonstrated they can manage commercial schemes, so public–private partnership (PPP) models might be adaptable to private management of smallholder schemes. Large-scale commercial operators in premium crops such as sugar, tea and citrus fruits have been efficient irrigation managers, even under difficult circumstances. It is possible that private operators could run public schemes; however, experience is limited to date. A review of emerging PPPs in irrigation (World Bank, 2007b) recommends that bringing in a third-party service provider to improve service efficiency makes sense, but that in doing so careful attention has to be paid to mitigating risks for third-party service providers.

The emergence of flexibility outside the public sector

Overall, the liberalization of irrigated agriculture, away from centralized planning and production quotas or the dominance of price support schemes, has seen irrigated production respond to changing market demands with a more diverse set of crops. Traditional surface irrigation schemes have not been able to match the on-demand, just-in-time requirements for irrigation, but flexibility has been provided by a deepening reliance on groundwater (Shah, 2009), with all the consequent externalities generated by more intensive aquifer use (Llamas and Custodio, 2003).

As a result of growing water scarcity, both informal and formal water markets have developed for surface water and groundwater. Water markets have strong theoretical advantages and can be efficient, particularly local markets which can increase water-use efficiency with little infrastructure and minimal governance structures. Informal water markets have proven effective in distributing benefits derived from groundwater (Shah, 1993). Yet such formal markets exist only in Chile, Australia and the western USA. They have demanding requirements: clear, defensible water rights, an institutional and legal framework for trade, and infrastructure to transfer water between users.

Environmental consequences of past policy choices

Past policy and institutional approaches have raised land and water productivity and output, but have also led to environmental externalities in some regions. Agricultural policy has promoted mechanization, fertilization and pesticide use, all of which have created environmental risks and costs. In some cases, land policy has promoted expansion into marginal lands, along with forest and wetland clearance, while tenure insecurity has led to underinvestment and short-horizon production strategies. Water policy has promoted large-scale irrigation schemes, groundwater development and wholesale water abstractions. While most of these policies contributed to the rapid rise of productivity, they also contributed to widespread degradation of land and water resources. In recent years, environmental policy and organizations have been active in diagnosing these problems, but have been reactive rather than predictive, and have often been weak in regulatory capacity.

Environmental institutions have emerged in response to these environmental impacts of intensified farming, but face challenges in developing countries in influencing the development agenda. Following the 1992 Rio Conference, awareness of environmental problems rose, and most nations established an institutional framework of laws, policies and organizations to influence growth and natural resource management towards paths of environmental sustainability, and to limit and mitigate environmental degradation. These institutions have been effective in 'greening' the agenda, particularly in developed countries. For example, the US Environmental Protection Agency has established major programmes to reduce non-point sources of fertilizers and pesticides from agricultural land. However, environmental institutions have to cope with weak compliance, and tend to be reactive rather than proactive. A further problem is the ownership of the environmental agenda: although the environment has a voice in developed countries, in developing countries concern for the environment can be seen as anti-development, or even anti-poor, and environmental policy faces challenges in influencing the development agenda.

Unintended perverse incentives have also been a powerful driver of negative externalities. The incentives with which countries have promoted agricultural growth have frequently produced negative externalities, for example macro-economic and trade policies favouring food production and natural resource extraction in areas without comparative advantage. In some countries, distorted incentives have contributed to degradation of land and water (Box 2.5). Subsidized energy prices, for example, have driven the depletion of groundwater reserves in many countries.

The problem is not just the application of poorly adapted policies, but also the absence of good ones. Examples from Kenya and Ethiopia (Box 2.6) show the powerful effect on land and water of getting policies right, and the negative impacts of getting them wrong or leaving a policy vacuum.

A central problem is that costs and benefits of externalities are asymmetrical. On-site intensification may produce both on-site and downstream risks to land and water. For example, higher stocking rates for animals can exacerbate soil loss on-site, causing loss of fertility as well as downstream siltation. Intensified use of fertilizers may contaminate on-site groundwater and also cause downstream water pollution. On-site costs can be internalized; that is, if the incentive and enabling

BOX 2.5: THE IMPACT OF DISTORTED INCENTIVES ON LAND AND WATER MANAGEMENT

In some countries, a distorting incentive framework encourages degradation of land and water resources. Where fertilizer is heavily subsidized (e.g. Bangladesh, China), application rates tend to be beyond recommended levels, resulting in overuse. In 2008, Chinese farmers received US$84 per ha in fertilizer subsidy. In 2008–9, Bangladesh spent US$758 million on urea support. In both countries, large adverse impacts on groundwater quality resulted.

In Brazil, until the economic crisis of the early 1990s, credit subsidies and tax exemptions favoured the clearing of land in the Amazon region for often unsustainable production. The distorted incentive framework contributed to the permanent loss of forest ecosystems, but failed to encourage an efficient, equitable or sustainable agriculture.

Sources: Huang et al. (2011); Binswanger (1991)

BOX 2.6: HOW OVERALL POLICIES CAN INFLUENCE SUSTAINABLE LAND MANAGEMENT

In the former Machakos district of Kenya, population increased sixfold from the 1930s to 1990s, while agricultural output increased tenfold. Recent years have witnessed widespread adoption of erosion control measures and a significant increase in tree coverage. The conditions that favoured these developments were relatively favourable price policies, access to international markets for export crops, the development of infrastructure, the proximity to the market in Nairobi, the remittances sent by temporary migrants, secure individual rights to land, and local extension services helping with soil conservation practices.

In Ethiopia during the time of Haile Selassie and the Derg, farmers were heavily taxed through a variety of methods. Infrastructure and market development was minimal, and agricultural services largely absent. Access to domestic and international markets was often disrupted. Employment opportunities in the rural non-farm sector and the urban economy were limited. Land rights were highly insecure. Widespread deterioration of land resources resulted from the insecure rights, combined with poor infrastructure, market access and incentives, and from the policy distortions.

Sources: Tiffen et al. (1994); Grepperud (1994); Heath and Binswanger (1996)

framework encourages natural resource conservation, the farmer will correct practices that impair the productive capacity of his farm. But farmers rarely have incentives to correct externalities. Usually some adjustment to the incentive framework is needed. There is thus now a challenge of how to adjust the actual incentive structure so that upstream farmers (who bear most of the costs of acting on externalities but receive a smaller part of the benefits) are motivated to practise land and water conservation in their part of the watershed. There are some good examples of reconciliation of such conservation and intensification objectives (Box 2.7), but other programmes have had difficulty in establishing incentive structures that work.

As competition for land and water has increased, the lack of clear and stable use rights has reduced private incentives to invest and manage, and policies have too often driven unsustainable use and the proliferation of negative externalities. Despite the functional systemic integration of land and water, modern law and institutions now tend to deal with land and water separately. Even institutions dedicated to integrated resource management (such as basin agencies) deal primarily with a single resource in multiple uses, rather than with land and water jointly. This institutional gap has widened as natural resource planning has become increasing micro-focused, with decentralization and demand-driven approaches.

In addition to impacts on natural resources, there have been socio-economic costs such as competition and conflict where land and water resources have become scarcer and competition from other sectors has grown. Poverty and food insecurity have resulted from changes in the allocation of land and water resources, insecurity of tenure, or deterioration of land and water assets. In most basins and countries, the rate of socio-economic change and the accumulation of environmental impacts has outpaced institutional responses. The growing intensity of river basin development

BOX 2.7: WATERSHED REHABILITATION IN THE LOESS PLATEAU OF CHINA'S YELLOW RIVER BASIN

Unsustainable farming practices on the Loess Plateau of China's Yellow River Basin, including deforestation, overgrazing and poor land reclamation practices, together with growing population pressure over the last hundred years, has resulted in the reduction of protective vegetative cover to only 20 percent of the total area (Brismar, 1999). A successful watershed rehabilitation programme was implemented, including terracing, strip farming, sediment retention dams, and the large-scale planting of trees and grasses. About 2 100 small sediment control structures were built, capturing an estimated 25 million tonnes of sediment per year.

These measures improved both land and water quality through reduction of soil erosion and river sedimentation. Grazing bans, particularly on sloping lands, generated dense natural vegetation cover at low cost. Artificial grasses and herbs (mainly astragalus and alfalfa) were planted on flat or gently sloping wasteland as fodder for pen-fed animals and to reduce unsustainable grazing on slopes. The sustainable production systems established are now profitable for farmers. They now have the incentive to maintain these investments. This outcome has been obtained after high initial levels of public investment.

Sources: World Bank (2003, 2007d)

and the degree of interdependence and competition over land and water resources require more adaptable and authoritative institutions (Molle and Berkoff, 2006).

Investments in land and water

Investment in land and water management is essential for attaining sustainable increases in agricultural productivity. Overall investment in land and water has increased slightly in the last five years, but levels remain below those necessary to intensify production while minimizing negative impacts on the ecosystem. A particular concern is the low level of investment in the more vulnerable rainfed systems where poverty and food insecurity are prevalent and risks of land and water resource degradation are high.

Public investment in agriculture

Global public expenditure in agriculture doubled in real terms between 1980 and 2002, although declining from 11 percent to 7 percent of total public expenditures (Table 2.1). The increase in real expenditure is particularly evident in Asia, where it almost tripled to US$192 billion in 2002. Levels of public investment in agriculture across sub-Saharan Africa have remained low.

Private capital and foreign direct investments

In recent years, private capital and trade flows have concentrated more on the industrial nations which account for much of the surge in global foreign direct investment (FDI) flows, which reached US$1.1 trillion in 2000. Within developing countries, the overall flow of FDI has been heavily concentrated in East Asia and the Pacific, and in Latin America and the Caribbean, with scant investment in sub-Saharan Africa. The long-term trend, however, suggests a larger share for sub-Saharan Africa (Winpenny, 2010).

TABLE 2.1: PUBLIC EXPENDITURE IN AGRICULTURE IN SELECTED DEVELOPING COUNTRIES 1980–2002

	Constant 2000 US$ (billion)				Percentage of agricultural GDP				Agricultural share of total government expenditure (%)		
Regions*	1980	1990	2000	2002	1980	1990	2000	2002	1980	1990	2002
Africa (17)	7.3	7.9	9.9	12.6	7.4	5.4	5.7	6.7	6.4	5.2	4.5
Asia (11)	74	106.5	162.8	191.8	9.4	8.5	9.5	10.6	14.8	12.2	8.6
Latin America and Caribbean (16)	30.5	11.5	18.2	21.2	19.5	6.8	11.1	11.6	8.0	2.0	2.5
Total	**111.8**	**125.9**	**190.9**	**225.6**	**10.8**	**8**	**9.3**	**10.3**	**11.3**	**7.9**	**6.7**

* Number of developing countries examined in each region.

Source: Akroyd and Smith (2007)

Although agriculture attracts less than 1 percent of overall FDI in developing economies (US$14.3 billion from a total US$2 trillion stock in 2004), investment in the sector has been growing, tripling between 1990 and 2004 (Table 2.2). Part of these capital inflows have been commercial and sovereign investment in land and water under deals to produce food and biofuel feedstock. Concerns have been raised about the possible impact on equity and food security in host countries from this kind of investment (Box 2.8).

Future investment needs

Based on long-term estimates for food demand, FAO projects that gross investment requirements 2007–50 for primary agriculture and its related industries in developing countries could amount to US$9.2 trillion, with 18 percent of the total (US$960 billion) allocated to water management and irrigation, and about 3 percent (US$161 million) for land development, soil conservation and flood control (Table 2.3).

The bulk of the investment (58 percent) is expected to be in Asia, reflecting the region's large agricultural base, its high overall output and its relatively capital-intensive forms of agricultural production (Table 2.4). Rates of growth in agricultural production in Asia are more modest. The opposite is true for sub-Saharan Africa, where the overall level of investment requirements is expected to be relatively low as a consequence of the region's generally labour-intensive and capital-saving forms of production (9 percent of the total). Growth rates, however, are projected to be higher, reflecting a very gradual shift to a more capital-intensive form of agriculture and moderately rising per capita production levels, driven by a doubling of its population and consumer base.

TABLE 2.2: ESTIMATED INWARD FDI STOCK, BY SECTOR AND INDUSTRY, 1990 AND 2004 (MILLION US$)

Sector	1990			2004			
	Developed countries	Developing economies	World	Developed countries	Developing economies	Southeast Europe and CIS	World
Primary	139 563	23 715	163 278	268 171	151 632	20 725	440 529
• Agriculture	3 193	4 063	7 256	7 739	14 339	483	22 561
• Mining, quarrying and petroleum	136 371	17 601	153 972	256 642	137 294	20 242	414 177
• Unspecified Primary	–	2 051	2 051	3 791	–	–	3 791
Manufacturing	586 379	144 372	730 750	2 406 127	613 559	20 448	3 040 135
Services	716 544	151 589	868 133	4 624 699	1 224 356	34 286	5 883 341

Source: UNCTAD (2006)

BOX 2.8: LAND DEALS IN DEVELOPING COUNTRIES

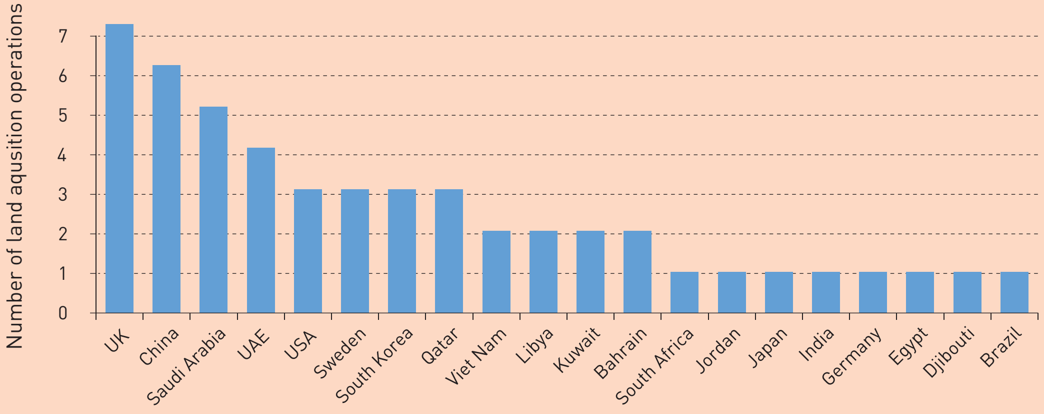
Investments in fertile land in developing countries have significantly increased. Typically, land deals are for substantial blocks of land (over 10 000 ha) and have a lease period of between 50 and 99 years. The main actors involved are national governments, agricultural investment funds and the private sector, including investment banks, agribusinesses, commodity traders and mining companies (Smaller and Mann, 2009). These land acquisitions can be categorized into four types (Bickel and Breuer, 2009):

- Countries with large populations and sustained growth (China, India, Japan, South Korea) undertake investments to satisfy the increasing internal demand for agricultural products.
- Countries with negative food balances and limited land and water resources but rich in capital (Gulf states, Libya).
- Industrialized countries target land investments for biofuel production.
- Domestic land speculation in developing countries (e.g. for touristic purposes).

Land acquisition can be seen as a win–win strategy. The investor country acquires land and guaranteed access to the food produced, while reaping high financial returns. The recipient country

Number of land acquisition operations

Investor Countries



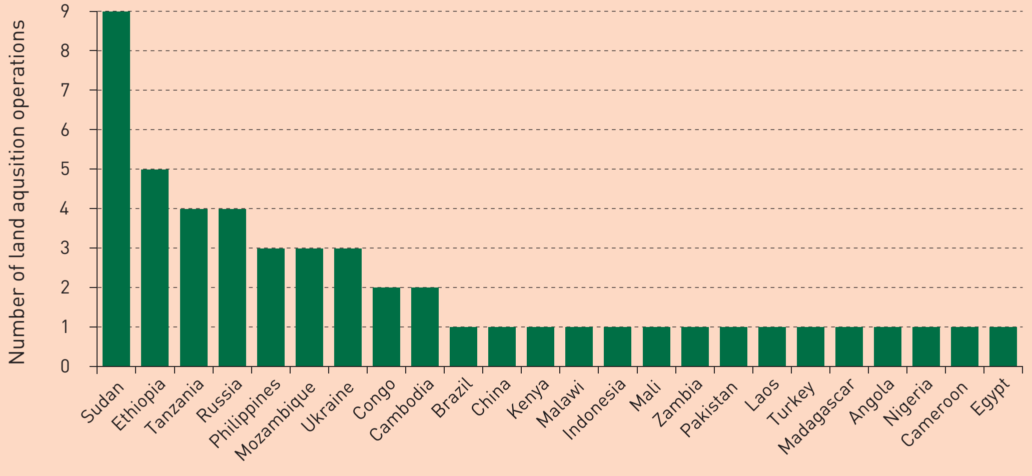
Source: IFPRI (2009)

International cooperation on land and water

International cooperation on land and water originated in the 1940s with concerns about food security, linked to the need for rural development in the newly emerging nations. From the 1980s, negative environmental impacts from unregulated use of natural resources became increasingly apparent at local, regional and global scales. The evaluation of the causes of these impacts brought land and water issues such as soil erosion, salinization of irrigated lands, spread of waterborne diseases, obtains an infusion of capital into its agricultural sector, leading to economic development. Yet these arrangements do contain risk for the investor (e.g. political risk in the host country) and for the citizens of the host country, who may face expropriation of land, labour abuses and loss of their own food security (Cotula *et al.*, 2009).

As is the case for other international trade and foreign direct investment, 'rules of engagement' are advisable to ensure that foreign investments are beneficial to both host countries and land users who lose their land permanently or temporarily. These rules could include transparency in negotiation and trade deals, protection of investors, compensation of land users, respect for existing land rights, focus on investments with benefits for local communities, and assessment of potential positive or negative environmental impacts (Von Braun and Meinzen-Dick, 2009; Cotula *et al.*, 2009). No single institutional mechanism will ensure favourable outcomes for all parties involved: rather, cooperation through international law, government policies, and the involvement of civil society, the media and local communities is needed to ensure that the land transactions follow the rules of engagement.

Target Countries



water resource depletion and pollution to international attention. Since the 1990s, further land and water issues in relation to reduction of biodiversity, climate variability and climate change have joined earlier environmental concerns. From these origins, sustainable land and water management issues have become an integral component of global focus on the food security, environment and climate change nexus of challenges.

TABLE 2.3: PROJECTED INVESTMENT NEEDS OVER THE PERIOD 2005–7 TO 2050 IN BILLION 2009 US$

	Net	Depreciation	Gross
Total for 93 developing countries	3 636	5 538	9 174
Total investment in primary production	**2 378**	**2 809**	**5 187**
of which crop production	*864*	*2 641*	*3 505*
Land development, soil conservation and flood control	139	22	161
Expansion and improvement of irrigation	158	803	960
Permanent crops establishment	84	411	495
Mechanization	356	956	1 312
Other power sources and equipment	33	449	482
Working capital	94	0	94
of which livestock production	*1 514*	*168*	*1 683*
Total investment in downstream support services	**1 257**	**2 729**	**3 986**

Source: Schmidhuber et al. (2009)

TABLE 2.4: REGIONAL DISTRIBUTION OF PROJECTED INVESTMENTS IN CROP PRODUCTION 2005–7 TO 2050

	Net	Depreciation	Gross	Share in total
	Billion 2009 US$			%
93 developing countries	3 636	5 538	3 505	100
Sub-Saharan Africa	478	462	319	9.1
Latin America and Caribbean	842	962	528	15.1
Near East and North Africa	451	742	619	17.7
South Asia	843	1 444	1 024	29.2
East Asia	1 022	1 928	1 015	29.0

Source: Schmidhuber et al. (2009)

Milestones and achievements

From the 1980s, the UN emerged as the forum where global values and principles for sustainable development were negotiated. Milestone conferences, including the Rio Summit (1992), the Millennium Summit (2000), and the Johannesburg Summit on Sustainable Development (2002), helped shape the global development agenda that was summarized in the 2002 Millennium Development Goals (MDGs). The Convention to Combat Desertification (UNCCD, Box 2.9), the Convention on Biological Diversity (CBD) and the Framework Convention on Climate Change (UNFCCC), all have important linkages to land and water management. In addition, the UN has sponsored global research and synthesis efforts like the Millennium Ecosystem Assessment (MEA), the Global Environmental Outlook, and the Intergovernmental Panel on Climate Change (IPCC).

The remarkable mobilization of the global community around sustainable development over the past 30 years has seen a consensus emerge on development pathways and benchmarks. Principles of economic, social and environmental sustainability have been adopted. From the successive conferences and resulting actions, there are clearer principles for important parts of the land and water management agenda, particularly for sustainable management of forests, for integrated water resource management and for combating desertification.

BOX 2.9: DESERTIFICATION: THE CHALLENGES OF LAND AND WATER IN DRYLANDS AND THE UNCCD RESPONSE

The world's drylands include desert, grassland, savannah and woodland, in climates ranging from the hottest deserts to the coldest arctic regions. Most of the dryland ecosystems are fragile, and suffer from water scarcity and low productivity. Dryland resources are increasingly threatened, as results of inappropriate management practices and overpopulation. The fight against desertification is also a fight against rural poverty and food insecurity, which are all strongly inter-related.

The United Nations Convention to Combat Desertification (UNCCD) is the centrepiece in the international community's efforts to combat desertification in the drylands. It was adopted in 1994, entered into force in 1996 and currently has 194 parties. The UNCCD recognizes the physical, biological and socio-economic aspects of desertification, the importance of redirecting technology transfer so that it is demand-driven, and the involvement of local communities in combating desertification and land degradation. The core of the UNCCD is the development of action programmes by national governments in cooperation with development partners. A strategic plan of action and framework was devised in 2008 to promote the mainstreaming and upscaling of sustainable land management (SLM) practices and enabling policies, in synergy with the food security, climate change and biodiversity agendas. These programmes aim to build collaboration among the concerned line agencies, and strengthen farmer and pastoralist organizations, along with decentralized capacities. They promote secured land tenure arrangements, new market opportunities (including green products), as well as participatory land use planning, research and extension programmes.

Action on the ground to combat desertification includes the upscaling of a number of practices based on sustainable intensification, such as conservation agriculture and no-tillage techniques, crop rotations and intercropping, integrated pest management, agro-forestry and reforestation schemes, and pasture improvement with planned grazing processes. Improved water management is promoted through the implementation of water harvesting and small-scale irrigation investments, at watershed and village levels.

International cooperation has also allowed countries to share knowledge and develop principles and approaches that can be applied at regional, national and local levels. The process has enabled countries to agree on actions where each nation and individual can contribute to sustainable management of ‘global commons’. International cooperation has also given countries access to financial and technical resources, and innovative financing mechanisms such as PES, the Clean Development Mechanism (CDM) and carbon trading have begun to test ways to improve incentives.

However, there have been disappointments on the sustainable development agenda both at the international level and at the national level. At the international level, progress on increasing levels of aid and improving its effectiveness has been slower than expected, and a further slowdown may be anticipated from the global economic crisis. In addition, there has been lack of unanimity on important parts of the agenda, including stalemate in the World Trade Organization (WTO) Doha round, particularly on the key issue of trade in agricultural products. Divergent donor agendas have further complicated the prioritization of key development requirements.

On land issues, countries have recently developed and implemented biofuel policies without international consultation, and international land leases and purchases have been concluded by several countries without broader consultation or consideration of the ramifications for local and global communities. On water issues, where transboundary resources are concerned, nations have not ratified the UN Convention on International Watercourses, and have often given priority to their own internal agendas over those that require cooperation and benefit-sharing. Major water impoundment and diversion investments have been made without consideration of the possibility of optimizing benefits at the basin scale, or of negative impacts of unilateral development on other riparians.

Overall, the principles and programmes agreed at the international level have made a substantial contribution to changing policies and approaches, but their impact on changing behaviour on the ground has been limited. Only in a few places has the challenge of intensifying land and water use while limiting negative impacts on the resource base and on the broader environment been successfully met. The challenges of the vulnerability of the major food-producing systems of the developing world remain outstanding, while little progress has been made with pro-poor and ecologically sustainable intensification in the rainfed systems of the tropics and mountain areas. Agreements on sustainable groundwater management have been followed by increasing levels of overdraft. The elaborate and well-thought-out integrated water resource management framework agreed at the Dublin International Conference on Water and the Environment in 1992 has been widely incorporated into policy and institutions, but results on the ground have been limited.

Is there an agreed framework for sustainable land and water management?

Despite agreement on important component principles, there is no consolidated and agreed set of principles for the joint management of land and water within a sustainable ecosystems context, joining up the principles and practices that have been discussed throughout this report. There is thus no agreed international integrated framework around which major initiatives for sustainable land and water management can be formulated. Nonetheless, in response to land and water degradation and increasing levels of risk, several programmes, supported by the GEF and the UNCCD in particular, have developed visions and strategies, and recent conceptual and empirical work has defined ecosystem services, and placed agricultural production and land and water management within an ecosystems framework. Advantage should be taken of these advances to work towards an agreed set of principles for the management of land and water resources.

Trends in official development assistance

Total donor assistance to developing countries in 9 broad sectors of relevance to land and water[1] shows an upward overall trend, increasing from US$57 billion annually in 1995 to US$158 billion in 2008 (in constant 2008 US$ terms). However, overall support to specific land and water sectors in agriculture (namely, Sector 3 – Agricultural land resources, and Sector 4 – Agricultural water resources) dropped in the 1990s and stagnated until some recovery, largely attributed to commitments to environmental policy and research (Sector 8), was apparent starting in 2005. The share of land and water in overall official development assistance (ODA) for rural, water and environmental investment has also been declining (Figure 2.3). In recent years, most of the ODA for land and water (54 percent) went to Asia, and almost a quarter (21 percent) was invested in sub-Saharan Africa (Figure 2.4) (OECD, 2010b).

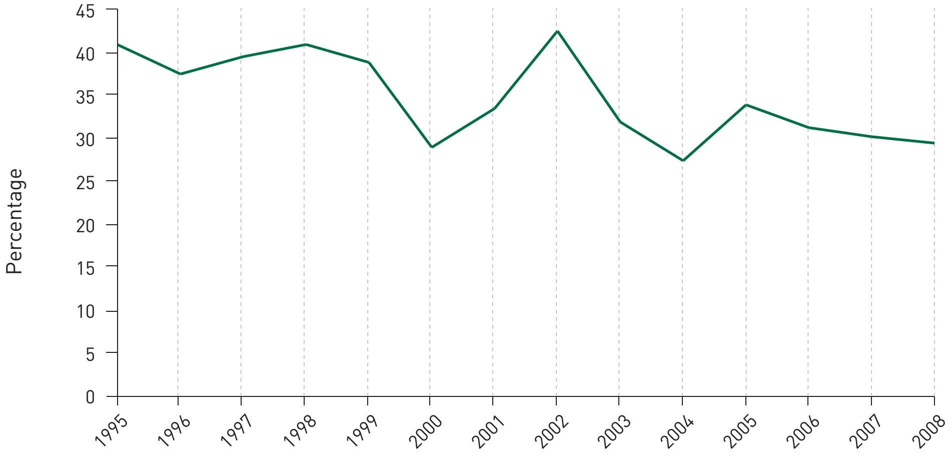
The gap between commitments and actual investments

In the framework of commitments made at the FAO High-Level Conference on World Food Security (Rome, 2008), the G8 summits in Japan (2008) and in Italy (2009) agreed that US$30 billion should be invested each year in agriculture in developing countries (equivalent to just 8 percent of the subsidies paid by OECD countries to their farmers). The G8 L'Aquila summit pledged US$20 billion to be mobilized over three years specifically for investment in food production in order to move from emergency food relief to reliable and sustainable domestic production.

These commitments were paralleled on a regional scale by the governments of sub-Saharan Africa. In Maputo in 2003, African Union governments committed

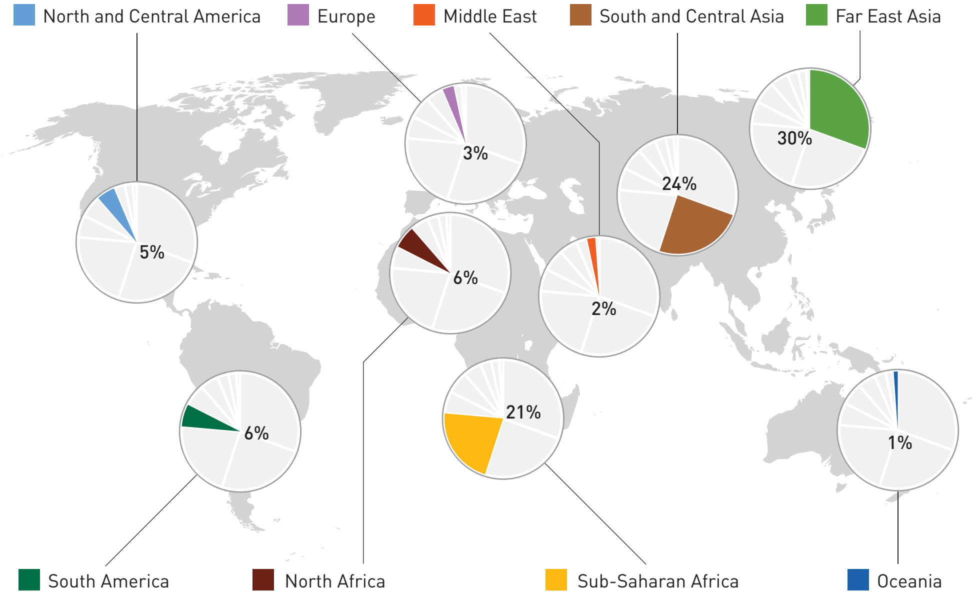
[1] Major 'land and water' sectors defined by OECD: (1) Water resources protection, (2) River development, (3) Agricultural land resources, (4) Agricultural water resources, (5) Forestry development, (6) Environmental policy and administrative management, (7) Flood prevention/control, (8) Environmental research and (9) Rural development.

FIGURE 2.3: LAND AND WATER ODA AS A SHARE OF OVERALL ODA FOR RURAL, WATER AND ENVIRONMENTAL INVESTMENT



Sources: CRS Database of OECD (accessed June 2010); OECD (2010b)

FIGURE 2.4: DISTRIBUTION OF AID FOR LAND AND WATER BY REGION (MEAN 1995–2008)



Sources: ODA data; CRS Database of OECD (accessed June 2010); OECD (2010b) to allocating at least 10 percent of their national budgets to agriculture and rural development. However, actual transfers and investments have fallen short of these targets. Governments, authorities and development practitioners are thus facing the paradox of having agreed to development goals requiring increased production with diminishing per capita natural resources, but without the accompanying investment to do this.

Conclusions

Maintaining the integrity of linked land and water systems to meet an increasingly sophisticated set of competing demands has become a well-accepted global priority. Integrated river basin development has been embraced as an ideal tool for reconciling these demands since the mid-20th century. But the practice has been overrun by the sheer pace of economic development, and the subsequent expansion of urban, industrial and agricultural land use in river basins. A decade into the 21st century, a return to integration should be much better informed. Advanced knowledge on the hydrological cycle, improved agricultural practices and new tools for mitigating the impacts of chemical pollutants and managing wastewater now offer a set of knowledge-rich solutions to reduce environmental impact. When combined with stakeholder-centred institutional approaches to resource management, the scope for effecting positive change across the key land and water systems that furnish the global food supply is expanded. Conservation of forests and wetlands will be particularly important in this context, as they play a crucial role as natural regulators of the hydrological cycle. Addressing systems at risk will require land and water management institutions to become much more resourceful in the way they engage with stakeholders and deploy solutions.