Annex: Gender issues addressed in the Comprehensive assessment on water management in agriculture –based on 17 Chapters.

The comprehensive assessment on water management in agriculture is a collective effort and a book "water for food, water for life: a comprehensive assessment of water management in agriculture". Gender issues were profiled in most of the chapters thanks to the review and advice of a "gender review team" (stimulated by this joint project). Thereafter are quoted the major elements profiled in the book (in brackets are indicated the chapters were these information are presented).

1- Concepts in the Chap 2 conceptual framework

Agriculture, water management and human culture are inextricably linked. The sustainability of agriculture and pathways of rural development are highly dependant upon religious and ethical values and convictions, and cultural background. Land inheritance, ownership, and access and even agricultural and water management practices are inherently linked with social and cultural settings. Indeed, cultural systems can be conceptualized as the means by which human populations adapt to and make use of natural resources.

The social, cultural, economic and political patterns and institutions that underlie both traditional rural societies and modern nation-states are in many ways the product of humans' evolving ability to manage plants and animals for the production of food and other services. The way people develop and interact and learn and respond to age- and gender-related cultural norms and practices strongly influences their social values and both offers and limits choices which cumulatively lead to patterns of behavior in a social and institutional context.

Roles, rights and responsibilities of women and men are socially defined and culturally based (Box 6). They are reflected in the formal and informal power structures in place. These structures influence how management decisions are taken and may favor or deprive certain groups. Local examples around the world show that increased equity boosts efficiency and sustainability of management systems in the water sector. (Intizar, 2005, Zwarteveen's case from Burkina in IWMI RR & PhD Thesis)

Agriculture as well as water management are embedded in social interactions and structures. Therefore, any change in water management and or in a production system may also affect the relations that exist between men and women of different age groups and classes. Understanding the social dynamics in agricultural water management requires looking at the diverse forms of social differentiation such as gender, poverty, class, caste, religion, and ethnicity. Practitioners in water and agriculture sectors, extension workers, scientists and policy makers will always directly or indirectly affect the social relations among such groups when trying to direct or change certain management and/or production dynamics; but these social relationships are also likely to affect the outcome of change programs. By being aware of this, actions and interventions can be better designed to try to strengthen, break, change or adapt existing gender

patterns and dynamics; but such interventions are also fraught with uncertainty about the likely outcomes.

Box 6: Women, poverty and water

Rural women are responsible for half of the world's food production and produce between 60 and 80 percent of the food in most developing countries. It is likely that their contribution to food security is growing due to a process known as 'feminization of agriculture' where men go to the city in search of paid jobs leaving the women to do the farming and provide food for the family.

But, overlooked and undervalued, women's contribution to food security is not reflected in ownership and access to services. Fewer than 10 percent of women farmers in India, Nepal and Thailand own land; women farmers in five African countries received less than 10 percent of credit provided to their male counterparts; and only 15 percent of the world's agricultural extension agents are women. Traditionally, irrigation agencies have tended to exclude women from access to water—often implicitly, for example, by requiring land titles to obtain access to irrigation water. Explicitly targeting women farmers in agricultural and water development schemes and giving them a voice in water management is an essential ingredient for the success of poverty alleviation programs. Interventions that are designed to be gender-equitable are not simply a matter of social justice; they are also necessary to improve productivity and food security.

Women also use irrigation water for domestic purposes, home gardens and cottage industries. Recognizing and supporting these multiple uses in water development and management programs could greatly benefit women.

(CA-Blue paper,2004)

2-Facts

Women key players in agriculture

Today rainfed agriculture is practiced on 80 % of the agricultural land area worldwide with large regional differences. More importantly, the importance of rainfed sources of food weighs disproportionately on women, given that approximately 70 % of the worlds poor are women. Smallholder farmers are usually aware of the effects of shortage and/or variability of soil-moisture on the variety, quantity and quality on produce, leading to a very narrow range of options for commercialization. This together with the fluctuations in yields, make it hard for resource-poor men and women in semi-arid areas to respond effectively to opportunities made possible by emerging markets, trade and globalization. (in Chapter 9/Rainfed agriculture)

Better targeting of women farmers is likely to result in increased agricultural productivity and growth [see Institutions and Policies Chapter]. There has also been a progressive feminization of agriculture due to urban and seasonal migration (Buechler, 2004): women represent 54% of the agriculture and related labor force in Sub Saharan Africa and 65% in Southern Asia, and their role in agriculture is likely to grow further. However, the design, operation and management of the systems has rarely accommodated such changes (Vera, 2005). Box 3 presents some simple gender-related questions (Van Koppen et al, 2002) for irrigation management and offers some implications for where practical efforts can be directed towards better service for women farmers (Bruins and Heijmans (1993); Meinzen-Dick and Zwarteveen (1998)).

There is ample evidence to support the logical conclusion that women are as efficient producers as men, provided that they have similar access to inputs and markets, and that they themselves control the fruits of their labor, instead of having their male kin appropriating this (van Koppen, 2000). If the different concerns of women and men are addressed, it should be possible to reap more productivity gains. Clearly this is the case in female farming systems where attention has been given to men, and more subtly the case in mixed and male dominant systems where a focus on women could raise the value per unit of water. (Chap 8/water productivity)

By 2050 two thirds of the world's people will live in cities. This implies that "*on average each rural person will have to shift from feeding herself (most of the world's agricultural workers are women) and one city dweller today to feeding herself (Cohen in science-am*-Sep 2005).

Gendered roles in the different farming systems

In many countries, women may be responsible for domestic and livestock water use, and **irrigation** of garden/backyard plots that make a vital contribution to the variety and nutritional quality of diet (FAO/IPTRID, 1999). If they are not explicitly understood, there may be too much bias to field crop irrigation at the expense of household needs, especially when the volumes required are small but have relatively high value (Meinzen Dick and van der Hoek, 2001) (*Chapter 10/irrigation*).

As in agriculture in general, gender issues in **rice production** are complex and site specific. Women participate in various degrees in the cultivation of rice and often have specific tasks such as transplanting, weeding, or harvesting. In Central and West Africa women constitute the majority of upland rice farmers. Increasing water scarcity and technological response options affect women in different ways, depending on whether they are paid or unpaid laborers. For example, a shift from transplanting to direct seeding may specifically affect the livelihoods of women since transplanting is their traditional task in most Asian and African societies. If they are unpaid laborers, the shift will remove the drudgery and back-breaking burden of transplanting. But if they are paid laborers, it will deprive them of a source of income. The same reasoning holds for weeding. Water scarcity and response options such as alternate wetting and drying and aerobic rice may promote weed growth and increase the need for manual weeding. In Africa women's preference for using water to control weeds arises from their being unpaid laborers.
Thus it is important to include a gender perspective in the development of alternative response options or technologies of rice production. The same holds true for the development and deployment of new rice varieties. Women should be specifically included in activities such as participatory varietal selection, as they often have different perceptions of relevant crop traits, for example, grain quality and feed quality of the straw (in many cases, it is women who tend the livestock). (Chap 15/Rice)

The water sector is often presented as a key entry point for poverty alleviation and gender empowerment (see Poverty Chapter). **Fisheries,** and in particular fish-related activities such as fish processing and trading, are no exception to this rule. In contrast with professional fish capture (harvesting), which is in most cases a male-activity, the post-harvest sector (fish processing, fish retailing and trading) is very often done by women, in particular in Africa but also in many other parts of the world. Because it does not require large capital investment or high technical skills, post-harvest activities are very often those in which uneducated and poor women get

involved. These can be fishers' relatives (wives, daughters), or even independent self-employed women. Small-scale (household) fishers, however, tend to include a large proportion, often a majority, of women and children. Some of them may be so successful in running their fish-trade businesses that they soon become owners of out-board engines or boats, or able to provide loans and credits to fishers to purchase fishing equipment. The success-story of those few entrepreneur-women should however not mask the reality of hundreds of thousands of others for whom fish processing and trade is more about economic survival, often operated in an informal environment, making the contribution of those women less visible than the rest of the sector (men-led capture). For them, the income generated by post-harvest activities is often the only source of cash income, in particular in societies where men control a large part of the household's main cash-generating activities. Studies have shown that a disproportionately high number of vulnerable women (e.g, woman-headed households) get involved in those post-harvest activities which then play a crucial safety-net function. (Chap 13/fisheries)

Indian women and children dominate many areas of **animal production**. Women contribute 71% of labour in the livestock sector (Anthra 1999; Chawla et al., 2004; Devendra et al., 2000; Ragnekar, 1998; Upadhyay, 2004) and spend 20 to 25% of their time attending to animal keeping. At home, women influence household decision making but follow-up on decision made is left to men. Key tasks shouldered by women include feeding and watering of animals kept at home, managing domestic water for all uses including animals, care of sick animals, cleaning sheds and pens, collecting manure and eggs, and selling produce locally. One reason women dominate is that animal keeping is a labour intensive task and relatively uneducated people are assigned to these low paying activities. Men tend to handle grazing, watering of grazed animals, taking sick animals to veterinary clinics, and selling animal products to agents and larger more distant markets. Men also have easier access to critical inputs such as extension, veterinary care, credit and training. Variation is gender roles can be found with in India and beyond. Chap 14/livestock)

Beyond grain-fed meat production and consumption, water used to support animals and their **multiple gendered role**s in peoples' livelihoods in developing countries, provides great value. Livestock contribute to the livelihoods of at least 70% of the world's rural poor and their livelihoods are enhanced by strengthening their capacity to cope with income shocks (Ashley et al., 1999). They provide milk, blood, manure, hides, and farm power essential to cultivation and marketing of crops. Wealth security often resides in peoples' ability to maintain their assets in the form of livestock. Sale of livestock and livestock products is a vital strategy to enhance income and cope with unexpected or major family expenses. Production of all of these vital goods and services depend on water. Climate change confounded with demographic changes may affect water available for livestock production and impose changes on poor herders' and livestock keepers' livelihoods in coming years (Thornton et al., 2002). (Chap 14/Livestock)

Ecosystems, a source of income in rural area and often most important for women

There is increasing evidence that **ecosystems** play an important, but not necessarily widely recognized role in poverty reduction and hunger eradication (Silvius et al. 2000, World Resources Institute 2005). It has been argued that rural poor people who make direct use of a variety of sources of income and subsistence activities that

are based on ecosystems are most directly vulnerable to the loss of ecosystem services. In many instances these sources of income are supported predominantly by women and/or children whether through the consequences of social custom, education or health/disease. This includes undertaking small-scale farming and livestock rearing, fishing, hunting, and collecting of firewood, or other ecosystem products that may be sold for cash or used directly for innumerable household needs. (Chap 7/ecosystems)

The dilemma with many f**isheries** is that they are a livelihood of last resort for many of the poorest and most vulnerable groups, including women, children, the disabled and ethnic or religious minorities. The downward spiral of poverty, over-exploitation and subsequent resource degradation leads to the conclusion that sustaining many, but not all, fisheries requires both improved environmental management and reducing livelihoods dependency upon them. Alternative livelihood options centre largely on alternate uses of water. But those options must ensure net poverty reduction gains and avoid undermining existing livelihoods, many of which are already marginal. All too often, policies, instead of being poverty-centred, have focused on the different outcome of generating inequitably distributed economic wealth, and fisheries dependent communities have been a significant casualty in the process. (Chap 13/fisheries)

Gender in decision making, voicelessness of women

Water sector reform strategies are increasingly expected to address concerns beyond water management issues, including reducing poverty and gender inequity, reversing environmental degradation, and giving voice to marginalized groups. The state is often itself in need of reform. In most state institutions there are few incentives, for example, to overcome gender imbalances, the male-dominated engineering culture of water agencies, and elite capture of reforms. This is a political issue and requires leadership at the political level.

Budget allocations reflect government priorities, in turn often reflecting historical inertia and entrenched bureaucracies. If specific allocations target support for women, poverty reduction, and environmental services, for example, these are important steps, especially if accompanied by transparent monitoring. Gender-responsive budgeting provides a means to examine the priorities reflected in budgets at different levels and is being tried in many countries (Budlender 2000; Mukhopadhyay and others 2002).

Historically, **decisions concerning ecosystem management** have tended to favour either conversion of ecosystems or management for a single ecosystem service, such as water supply or food production, often without consideration of the effects on specific groups within society, like rural poor, women or children (Millennium Ecosystem Assessment 2005a). Many ecosystem services do not have a price on the market and are often neglected in policy and decision-making. When ecosystem services becomes scarcer, and as we understand the benefits provided by the entire array of ecosystem services, we also realise that some of the best response options will increasingly involve managing landscapes, including agriculture, for a broader array of services. It will also entail taking greater account of the role of social issues, for example, gender-based roles and poverty, when making decisions about agriculture and water management (World Resources Institute 2005). (Chap 7/ecosystems)

People make de**cisions about water and land use** based on sociopolitical and economic contexts, as well as the physical characteristics of land. Land tenure, markets and commodity prices, and gender relations all affect decision-making. In addition, political environments may be so repressive as to undermine the readiness of land users to develop and implement innovative land and water management practices (Chap 16/Land).

Economic scarcity occurs when there is a need for investments to keep up with growing water demand, but these are constrained by financial or human capacity. Much of the scarcity for people is due to the way institutions function, favoring one group over another, not hearing the voices of various groups, especially women. (Chap 3/trends)

2- Issues

Gender based inequality

Gender-based inequality directly and indirectly limits economic growth and diminishes the effectiveness of poverty reduction efforts. Specifically, women very often experience more difficult, risky and inadequate access to land, water, labour, capital, technologies, and other services. Their ability to thrive within and beyond the agricultural sector is often detrimentally affected by laws, customs and attitudes which bar them ownership of or decision making over water and land. This situation curtails their ability to contribute more to food security, poverty reduction, as well as to enhance their self esteem and status as citizens. Thus, it is essential to remove gender discrimination in water access and use. Another water-dependent group which is highly vulnerable to poverty is rural small-scale fishing communities. The geographical and political isolation which characterizes a large number of these communities is often associated with poor access to public services and infrastructure. (Chap 5/poverty)

Land degradation is driven by the complex sociopolitical and economic context in which land use occurs. Policy and livelihood decisions that fail to account for the long-term relationships between processes and consequences drive degradation. Sociopolitical and economic systems often result in insecure land tenure, political environments can discourage innovation and adaptation, and inequitable gender relationships often distance resource users from management decisions. In some cases, development projects insist on land husbandry techniques that are ill-suited to the environment and poorly matched to local capacity. In other cases, suppression of innovation may be more subtle—innovation is an expression of freedom that may sit uneasily with dominant political thought. (Chap 16/Land)

Women not recognized, nor supported for their role in agriculture,

Relations between men and women are a key component of the sociopolitical conditions that underpin land and water use. Women produce nearly all the food in developing countries. They constitute up to 90% of the rice-producing labor force in Southeast Asia and produce up to 80% of basic household food stuffs in sub-Saharan Africa, where they make a similar contribution to the agricultural labor force (Lado 1992). Despite women's major contribution to cultivation, harvesting, and processing, men—particularly in Africa—retain most ownership, control, and decision-making power over agricultural resources—and even over women's labor (Ellis 2000). Many parts of the developing world are in a state of transition between an economy

dominated by subsistence objectives to a cash and surplus production economy. As cash income assumes a more prominent role in households, many rurally based men migrate to find wage labor, leaving women a greater share of household agricultural responsibilities (von Bulow and Sørensen 1993; Francis 1995). Yet traditional patterns of land ownership and access remain, leaving women with principal responsibility for farming but few decision-making powers.

As **the cash economy grows**, more of women's labor is often taken up growing cash crops controlled by men, potentially taking female labor away from food production and giving men even greater control over the product of women's labor (von Bulow and Sørensen 1993; Mearns 1995). The result is that women, who have the most intimate relationship with the land and who are best positioned to manage it on a daily basis, are often excluded from decisions that affect its use. Paradoxically, women may be even better at land husbandry than men (see box 16.7 later in the chapter). Where higher yields are seen to be generated mainly by men, yield differences are the result mainly of gender inequalities in access to agricultural inputs. In Sub-Saharan Africa women have less access to education (including agricultural training) and to cash for inputs such as fertilizers than do men. Therefore, unequal assets could have a greater impact on food and nutrition security in this region than in others. In Burkina Faso men have greater access to fertilizer and to household and non-household labor for their farm plots. Reallocating these resources to women could increase household agricultural output by 10%–20% (Alderman and others 2003). In Kenya, if female farmers had the same levels of education, experience, and farm inputs as their male counterparts, their maize, bean, and cowpea yields would increase by 22% (Alderman and others 2003). Because women have less control over land and what is cultivated on it, this may also have profound implications for household nutrition. The role of women in livestock rearing and marketing of livestock products is equally important for household food security (see livestock chapter). As the primary caregivers in the developing world, women, through their access to food, may also determine children's nutritional well-being. (Chap 16/Land)

The fish-related activities represent a vital element of the day-to-day struggle to acquire or increase economic and social empowerment. However, the struggle is often exacerbated by the fact that women are rarely recognised as legitimate stakeholders in the sector and the management process and their specific needs or aspirations are not systematically integrated in the design of fisheries and aquaculture policies and management. (Chap 13/Fisheries)

In the face of ever increasing demand for water, **the rights of the poor** are not being mediated properly nor are they been prioritised. There is a chronic inability of smallholder farmers, specifically women farmers to have their economic interests articulated in political forums. This is also true of a large number of fishing communities. As a result of the multiple use of water, there are a large number of stakeholders among government agencies and the private sector who have a keen interest in water allocations (including river flow management). As water becomes scarcer, the conflict over water allocations, rights and entitlements at household, watershed, and basin levels is bound to increase. New water basin institutional arrangements will be required to assure both efficiency and equity in use of basin water resources and to protect the interests of the poor. Existing and new institutions and policy processes will have to count with the active participation of currently voiceless stakeholders to assure that the water sector effectively

incorporate into policy decisions the rights and visions of these stakeholders (e.g. women, fishing folks). (Chap 5/poverty)

Rights and power

The **poverty Chapter** (Chap 5) suggests the application of livelihoods analysis because it recognizes that access and control over assets are gendered. For example, women often have more insecure land and water rights, more limited education and influence, and suffer the double burden of combining domestic and productive activities.

Currently, rural poor people's access to water, particularly to water for agriculture, tend not to be based on **formal, legally backed rights**, but rather on informal or customary rights, e.g. associated with ownership to land where water springs or flows, or based on social relations to owners of land, or to local water committee members. If such forms of access are not recognized and accommodated in efforts to reform water governance, the likelihood is that the rural poor stand to lose their access to water for agriculture (Bauer, 1997; Pradhan et al., 1996). In particular, women confront severe issues in accessing land as this often depends on upon land ownership. Gender inequalities in land thus reproduce inequalities in access to water as well as livelihood opportunities in general. (Chap 5/poverty)

The local-level context in which **land use** occurs reveals important dynamics between different actors at this scale. This includes **power relationships** between men and women and the importance of tenure—the guarantee of access to resource bases—as a pivotal component in the way land is used and managed. (Chap 16/Land).

One aspect of **poverty alleviation and equity** that has been hotly debated, but with relatively little progress is the access, use and benefit of water for women (Boelens and Zwarteveen (2002). It is now well established that women are more likely to devote a high proportion of their income on food and health care for children than men. There are well documented cases where women have been disenfranchised by poorly targeted irrigation development, mainly in Africa (Van Koppen, 2000) but also in Asia (Udas and Zwartveen, 2005).) Irrigation management transfer and similar decentralization schemes can have unintended negative consequences, for example, by strengthening local strongmen (Klaphake 2005; Mollinga, Doraiswamy, and Engbersen 2004) or giving men unequal power over women (Meinzen-Dick and Zwarteveen 1998). (Chap 10/irrigation)

Special case of irrigation: issues and impacts

There are often tensions when **irrigation structures** are used for **multiple uses**. Above all, this is related to poor people's strong dependency on diversified agriculture-based livelihoods which are highly water-dependent by nature. For the poor, water is water irrespective of its designed designations. Lack of access to infrastructure is compounded by gender hierarchies, which render poor women primary responsible for domestic supplies. Without proper infrastructure, women in Africa alone spend 40 billion hours per year (Catley-Carlson cited in Source Weekly 2005) to provide water for their households. Women have certainly little other choice than using any nearest source, whether this is planned as 'well', 'irrigation canal' or 'drain' or 'village pond'. (chap 5/poverty)

Most **irrigation** reforms have focused on one type of institution or organization: reform of water bureaucracies, irrigation management transfer to water user associations, development of water markets, or the introduction of river basin authorities. Almost invariably these reforms have ignored gender issues. This is like building on a single pillar. (Chap 6/policies)

Chap 10/irrigation → Box 3: Gender and irrigation: issues that matter
Gender performance can be assessed by understanding how womens' perceptions and needs are reflected in the social structure and institutional arrangements for irrigation management. Some specific questions to better target irrigation service to women are:

a. Do women have recognized access to land and water?
b. Are women represented in formal water user associations?
c. How are women's needs expressed and communicated?
d. Is it safe for women to irrigate at night?
e. Do irrigation schedules accommodate women's needs for flexibility?
f. How can structures be improved so that women can easily operate them?
g. Are irrigated plots close to households?
h. Do women have the same access to credit and inputs as men?
i. Are separate financial mechanisms required?
j. Are household nutritional needs being met by the chosen cropping pattern?
k. Is the importance of backyard gardening recognized and adequately promoted?

Irrigation reduces poverty more effectively in some settings than in others, depending on a number of conditioning factors, ... Improved equity and security of rights to land and irrigation resources matter for larger poverty impacts. Where land and water equity exists, irrigation has relatively larger poverty reducing impacts (Brabben et al. 2004, and Hussain 2005). (Chap 10/irrigation)

Groundwater irrigation may be more equalitarian. Especially in Asia, there is overwhelming evidence to show that, when compared to government managed large canal irrigation projects which have created pockets of prosperity in command areas, the groundwater boom has demonstrated greater inter-personal, inter-class and inter-regional equity in access to irrigation, and thereby, to benefits of intensive agriculture (Shah 1993; Debroy and Shah 2003). Bhattarai and Naranamoorthy (2004) and Moench (2003) have shown with Indian data that rural poverty rations in Indian states are inversely related with groundwater irrigated areas. Researchers like van Koppen and Parthasarthi , Safiliou (2002) have found that women have little to say or do in canal irrigation (van Koppen 1998; Shah, et al , 2000). However, numerous studies in Asia, Africa and Latin America show that wherever women explore opportunities for livelihood improvement through small holder agriculture or livestock, groundwater is commonly involved. Conversely, poor women and men are the first to get hit hard in instances of groundwater depletion or quality deterioration. (Chap 11/groundwater)

There are gender implications of using **wastewater**: (1) the high labor input for vegetable cropping is usually supplemented by female household members, and (2) certain tasks like weeding and transplanting, are mostly done by women which could expose them to longer periods of contact with wastewater under certain cropping systems, like rice. There could be transfer of pathogens to other family members

after field work if basic standards of hygiene are not maintained when women prepare meals. This applies mostly to households, which can maintain otherwise high sanitary conditions. In most low-income countries, this is however not the case and wastewater is only one pathogen source among many. In some areas, women have the monopoly of vegetable marketing, and are the key to successful risk reduction interventions at the market level. They are also responsible for domestic water management in most parts of the developing world and are the worst affected when wastewater pollutes water sources used for domestic supply. Women are central to improving hygiene practices at household level and can contribute to effective risk reduction through improved food preparation practices. (chap 12/Marginal Quality Waters)

The failure to properly treat and manage wastewater worldwide is directly responsible for adverse **health** effects (Table 1). In low-income countries, women and children are most vulnerable to water-borne diseases.
Table 1 Annual global mortality (number of deaths) and disability adjusted life years (DALYs) lost due to some diseases of possible relevance to wastewater use in agriculture (modified from WHO Revised Guidelines, 2006). (Chap 12/MQW)

The export-oriented policies adopted by an increasing number of countries in search of foreign exchanges have also been a major catalyst for private investors to develop commercial high-value large scale fish production systems. These new export-oriented commercial strategies, however, raise concerns about **local food security** where supplies of fish are no longer available to local populations, as a direct source of cheap animal protein and also as a support for the livelihood of small-scale fish processors, including a large number of women (e.g. Abila 2003). (chap 13/fisheries)

3- Solutions

The central message of the Comprehensive Assessment is that we need fundamental changes in how agricultural water is developed and managed. We need to internalize the agriculture-water-poverty-gender-environment nexus, to make real progress toward the Millennium Development Goals. (Chap 6/Policies & institutions)

Targeting investments differently

The negative effects of past agricultural management on ecosystem services and the need to produce more food for an increasing human population provide an unparalleled challenge for many sectors of society. This challenge may be met if there are further large-scale investments to i) improve agricultural management practices; ii) increase the availability of techniques that can minimise adverse environmental impacts; iii) enhance our understanding of ecosystem-agriculture interactions; and iv) reduce existing poverty and social inequities, including issues of gender, health and education that directly or indirectly affect ecosystem management decisions. (Chap 7/ecosystems)

The net welfare effects of investments in AWM depends individually and/or synergistically on investments in related agricultural science and technology, economic reform and trade liberalization, conducive policies and institutions, the provision of public goods, quality of governance such as the prevailing social power relations, gender roles and degree of participation of the poor in the decision making process, enhancement of human capital, and the natural resources endowment and climate. (in Chap 5/poverty)

Techniques and approaches

Pro-poor techniques range from a combination of agronomic and water management practices to raise yield of grains in high potential areas, to strategies that increase value per unit of scarce water; to strategies that reduce vulnerability to drought, polluted water, or loss of allocation. Most water productivity interventions can be tailored to benefit the poor. For example, efforts to reduce the cost of drip irrigation have made it affordable for smallholders. Certainly more effort is needed to tailor practices to the requirements of women, who are taking an expanded role in agriculture. Adapting water systems for home gardens and domestic needs (Moriarty et al, 2004), improves nutrition and contributes to better health, thus improving the productivity of water, and can greatly help rural women. Uptake of these practices depends on a host of socio-economic factors. (Chap 8/water productivity)

In Chap 10/irrigation, Table 6(Focus for investment by type of irrigation system) provides examples of possible investment focus in relation to irrigation within the typology of irrigation systems, with reference to different stages of development of irrigation and water resources. It looks at equitable investments.

Solutions:

1. **Increasing water productivity**, especially in terms of value produced per unit of water can be important for poverty reduction (competing explanations). Increasing the value derived per unit of water, especially in terms of opportunities for employment, income generation, nutrition, and opportunities for women, are important for poverty reduction. But specific steps must be taken to ensure that these gains reach the poor, especially rural women, and are not captured by wealthier or more powerful users only. (Chap 8/water productivity)
2. **Ensure secure access to water for agriculture** for poor women and men through targeted investments in pro-poor technologies such as low cost technologies, water capture, storage and delivery. The nutritional impact of the adoption of micro-irrigation technologies is particularly worth noting. Following the adoption of bucket kits, poor farm families in India and Nepla, especially women farmers, were able to improve their vegetable and fruits intake (Namara et al. 2005, Upadhyay and Samad 2004) (Chap 5/poverty)
3. until recently, at least in South Asia, adoption of drip and sprinkler irrigation technologies has been confined to 'gentlemen farmers' managing coffee or tea planatations or orchards and wine yards. However, more recent trend has been for ultra-small farmers, often women, to take to **micro-irrigation technology**. For long, micro-irrigation systems were capital intensive because they included sophisticated control gadgets appropriate for large farms. NGOs and irrigation equipment companies are now discovering that Asian farms can do without these expensive gadgets; as a result, costs of micro-irrigation systems are dropping to a fraction of what they were a decade ago. Many NGOs are promoting low-cost micro-irrigation systems to poor farmers in Asia and Africa. (Chap 11/groundwater)
4. Design and develop water resources infrastructure using a **multiple use systems perspective** to maximize benefits per unit of water for poor women and men (e.g. domestic water and gardening for better nutrition, fish and irrigation systems, livestock and crop integration). Such a multiple-

use water planning and design approach takes poor women's and men's multiple water needs as starting point. This approach recognizes that when rural communities themselves construct wells, village tanks, household storage, and other water infrastructure they typically do so for multiple uses. These uses encompass drinking water, water for food processing and other domestic purposes, sanitation, livestock, small-scale horticulture, cropping, fisheries and aquaculture, tree growing, beer making and other small water-dependent businesses, and ceremonial uses. (chap 5/poverty)

5. Conservation agriculture is of key importance in efforts of upgrading rainfed agriculture among the world's resource poor farmers. It reduces traction requirements (by tractors, or animal draught power), which saves money and is strategic from a gender perspective, as it generally gives women, particularly in female-headed households, a chance to carry out timely and effective tillage. (Chap 9/rainfed)

Governance & representation

Because water is generally regarded as a public good, the **state** has a duty to ensure its sustained availability and enduring quality. It is often easy for users to enjoy benefits of water use while passing on environmental and social costs to others, leading to problems of equity, groundwater mining, pollution of drainage water, poor health of farm workers and contamination of consumer products. The state must play a strong role in regulating these externalities. (chap 10/irrigation)

Since the water allocation process is inherently a political process, **effective representation** is crucial. A major challenge for the coming decades is to develop strong and effective representative voices on behalf of those stakeholders who are presently underrepresented (Ostrom et al, 1993, Blomquist 1993). These include small farmers, women, and the environment. (Chap 10/irrigation)

The critical message of the **Chapter 14/fisheries** is that the single sector approach to the improvement of water productivity should be avoided. One mechanism to achieve this is to promote forums for scenario-based negotiations, under which the needs of fisheries (and different groups within fisheries) can be better integrated with those of agriculture and other sectors. Those forums should in particular facilitate the establishment of inter-sectoral consensus mechanisms to negotiate land and water uses amongst groups and gender, to resolve such conflicts as the impacts of land use on water quality and quantity or those between floodplain reclamation for agriculture and fisheries. (Chap 14/fisheries)

New policy emphases on institutions and gender. Much policy that relates to land use and degradation suffers from a lack of integration. For example, policies to tackle one aspect of land use, such as conservation, may fail to anticipate spin-off consequences, such as resettlement, which suddenly increase local population density and results in land degradation. Policy needs to anticipate indirect consequences. Of particular concern, here, are impacts on institutions and gender. (Chap 16/Land)

Recognizing the **role of women in local institutions** may be particularly crucial for achieving successful resource management (box 16.7). As already noted, nearly all the food in developing countries is produced by women, and evidence presented here and previously suggests that women can manage resources equitably (Alderman and others 2003). (Chap 16/Land)

Box 16.7 Women's leadership of community forestry leads to improved watershed management. Nepalese forest policy encourages women to take a leading role in forest management, and there are several examples of forests being effectively managed by women. The first women's forest users' committee was formed in 1990. By 2002, 442 of 10,901 forest users committees in 53 districts were women's groups. The women's groups range from 11 members to 843 members.
Women appear to take a broader view of managing forest resources than do men. The women's committees apply the concept of ecological sustainability to the management of community forests, taking into account the multiple needs that communities have for forest resources. For example, women instituted the protection of Ahal, ponds in which domestic buffalo swim downstream of the forest. They established nurseries to promote agroforestry in forests and villages to increase wood availability. In contrast, male-dominated committees tended to protect forests simply by restricting access, without taking into account the needs of the community for fuel wood and fodder. This often led to continued exploitation and degradation of forest margins.
Source: Pranita Bhushan, Nepal Water Conservation Foundation, Nepal, personal communication. (Chap 15/Land).

Improving access

The long term strategy to ease pressure on **groundwater** resource may be to shift populations out of agriculture. In the medium term, key priorities in Sub-Saharan Africa and Latin America are to develop groundwater for improving the livelihoods of poor men and women farmers but in a regulated and planned manner. (Chap 11/groundwater).

Solutions in Chap 5/Poverty:

1. Clarify **water rights** bearing in mind that to poor men and women collective water rights might be preferable to individual rights. One important way to increase the security of local water rights is to assign the rights to collectives rather than individuals. Data from Chile, Ecuador and Peru shows that assigning water rights to individuals may create unstable situations, which in turn negatively affects indigenous water rights and livelihoods. Formal individual water right, which is currently mushrooming in SSA and Latin America, negatively affects the poor and women.
2. Assure that **institutional and legal frameworks**, guarantee rural people and marginalised groups' participation in all phases of policy development and decision making on infrastructure investments.

Livelihood Diversification

Promote **sustainable livestock and fishing activities** (including fish processing and trade) as important sources of livelihood diversification and food security, especially for women. (Chap 5/poverty)

Increased emphasis needs to be placed on the **multi-functionality of agro-ecosystems** to support food production and ecosystem resilience. However, it will not be economically and ecologically successful without a greater level of information and understanding about the way in which agro-ecosystems generate multiple ecosystem services, the value of maintaining biodiversity, habitat heterogeneity and landscape connectivity in agricultural landscapes, as well as more emphasis on social issues such as the role of gender. (Chap 7/ecosystems)

One key lesson has been the potential of smallholder dairying to enable rural and **peri-urban farming** women to increase their disposable income the production and sale of dairy products in India (Upadhyay, 2004), Kenya (Muriuki, 2002; Staal et al., 2001), Ethiopia (Box 2) and Tanzania (Kurwijila, 2002). These opportunities to improve the livelihoods of women and help bring them out of poverty depend on effective investment in and use of water resources, and issue discussed later in this chapter. (Chap 14/livestock)

The benefits associated with **animal keeping** and the related roles in managing livestock water interactions are highly gendered – a fact that requires adequate consideration in attempts to improve Livestock Water productivity (LWP). LWP does not imply intent to maximize the number of livestock or production of animal products and services. It also opens opportunities to produce the same benefits with fewer animals and reduced demand for agricultural water. Van Hoeve and Van Koppen (2005), have assessed the gender dimensions of the LWP framework and concluded that any efforts to improve animal production must take into account these gendered difference among livestock producing communities.

Knowledge, education, research

Information, knowledge, and the capacity to use it are critical to successful integrated water management and appropriate reforms. But the availability of reliable data transformed into credible information is often limited. In many cases the desired data do not exist (long time series of hydrological and meteorological data, density of measurement networks, gender-disaggregated household data, policy impact studies). (Chap 6/policies)

Despite **health and environmental** risks, the farmers prefer using wastewater because it is a reliable source of irrigation water and nutrients, and generates economic benefits. Because women are involved in both agriculture and household chores of food preparation, special attention must be paid to include women in **education programs** that promote hygiene and address risk minimization methods. Special care should be given to gender when designing education programs to enhance farmer and consumer safety when irrigating and when consuming crops produced with wastewater. In many farm households, women are directly involved in agriculture besides being responsible for food preparation the primary irrigators and the preparers of meals. Women also might have limited time available for attending special classes or training sessions. Educational efforts pertaining to wastewater will be most successful if they are designed to match the roles and availabilities of men and women in farming communities. (Chap 12/Marginal Quality Waters)

Prioritize publicly **funded agricultural research** that is geared towards the needs and circumstances of the men and women (e.g. how to enhance productivity in marginal areas, drought tolerant crop, salt tolerant crops, etc). (Chap 8/water productivity)

A crosscutting research topic of critical importance is how to promote greater attention to equity, including gender issues, poverty reduction, innovative ways of implementing integrated water supply systems at local levels, scale-up of new low-cost small-scale water technologies and improvements in the productivity of rainfed agriculture, and integration of ecosystem services and provision of other essential water services. (chap 6/policies)

The priority for research and action in the groundwater theme will be three: [a] expanding groundwater use for food security and livelihoods in a planned and scientific manner; [b] ensuring inter-personal and gender equity in groundwater access and use; and [c] putting in place systems for monitoring, data collection and regulation well ahead of the stage when environmental problems become overwhelming. (Chap 11/groundwater)