CWANA CHAPTER ONE
SETTING THE SCENE

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Key Messages

Context

1. CWANA enjoys the presence of the largest oil reserves in the world, which makes it attractive to international interests and interventions. At the same time, CWANA has many people living below the poverty line.
2. Weak governance and poor human rights have exacerbated the wealth gap among societies and sparked ethnic conflict in many CWANA countries. Tribalism is still dominant, with conflicts, feuds and wars among tribes and ethnic groups, mostly over resources, becoming frequent.
3. About 85% of the region is dry, with highly variable rainfall accompanied by frequent drought: most of the deserts in the world are in this region. Natural resources are under high pressure from a high population growth rate and increased life expectancy, climate change and misuse.
4. Most of the current conflicts in the world are in this region. As a result, migration, population displacement, land degradation, water depletion, loss of biodiversity, disappearance of indigenous knowledge and degradation of livelihoods are becoming the norm in many CWANA countries.
5. Scarcity of water resources is compounded by inefficient water use. Most CWANA countries use more than 80% of their fresh water for agriculture and have inefficient irrigation systems. Most of the commercially produced desalinized water worldwide is in the Arabian Peninsula.
6. While most of the water resources are transboundary, there is weak cooperation to jointly manage the shared water. Current water allocations have not been arrived at through regional agreements, except in the Nile Basin and the Ganges Basin.
7. Most renewable groundwater in the region is already exploited and in some cases overexploited, leading to deteriorating water quality. This region has a large reservoir of fossil groundwater, used by some countries without any formal agreements among the sharing countries.

Well-being

1. High population growth and high rates of unemployment strongly drive increased urbanization and migration.
2. Improvement in living standards in some countries, changes in lifestyle, free access to market and development of tourism have increased demand for diverse agricultural commodities.
3. Uneven distribution of wealth within most CWANA countries leads to the formation of marginalized groups and poverty pockets and stems from several physical, social, economic, educational, ethnic and political factors. The middle class is shrinking and most of its individuals are getting poorer. More than 40% of the people live on less than US $1 a day in CWANA.
4. Access to microfinance to generate income is limited, especially for women.

5. Access to education is limited in many CWANA countries. Poverty and children involved in agricultural work, especially rearing livestock, limit access. In Sudan, where pastoralists move with their herds and families, mobile schools are provided.
6. Relief and emergency interventions are widespread in the region, especially in conflict zones. In conflicts, food for work or small income-generating projects proved better coping strategies than food aid, since food aid tended to perpetuate dependency.
7. In CWANA countries, animal products are major sources of protein, but their prices have increased significantly from increased feed cost. Decreased affordability and increase in poverty have shifted diets toward legumes and carbohydrates. This change in food habits may adversely affect human health.
8. Household farming using plant production and small ruminants is dominant in most CWANA countries, even in urban areas. The social and nutritional value of these systems in alleviating poverty and providing food outweighs its profitability.
9. Seasonal migration is common in many CWANA countries, which increases the pressure on natural resources and affects the social fabric. Most Arabian Peninsula countries have a high percentage of migratory workers in all fields. Jordan and Lebanon have many migratory workers in agriculture. High unemployment and low profitability in traditional farming make seasonal farming within and among states appealing; this depletes the indigenous skills to manage natural resources.

Agriculture

1. Large-scale farming, which relies on high investment and monocropping, is expanding at the expense of small-scale indigenous farming. It leads to loss of agrobiodiversity, land degradation, depletion of water, loss of livelihoods and conflicts over land and water rights.
2. Large areas of the agricultural land in CWANA are subjected to poor soil management, leading to wind erosion, water erosion, nutrient depletion and soil salinization.
3. As a result of globalization and free markets, small-scale farmers in CWANA are becoming less competitive because of low productivity and lack of subsidies, price systems and technical and marketing information.
4. Most CWANA countries are net importers of food, especially cereals. The Arab countries import US $20 billion each year. Imported food costs are rising rapidly and will probably rise further from world competition for food.
5. Agricultural imports in CWANA countries in 2004 reached US $41.8 billion, while agricultural exports did not exceed US $17 billion. CWANA exports fruits, vegetables, dates and olive oil and imports mainly grains. Considering the water scarcity, this appears to indicate unwise water-resource management. However, profitable grain production depends on large-scale land

ownership and mechanization, while fruits and vegetables are less dependent on land and are labor intensive.

Key issues

1. Land tenure, ownership rights and communal rangelands affect natural resource management and, consequently, agricultural development in CWANA. Social and cultural values toward land ownership in most of the region go beyond economic profitability of agriculture. Communal land is overexploited and mismanaged.
2. Poor land-use planning, population growth and urbanization result in loss of agricultural land in most CWANA countries. Large-scale land reclamation projects have been implemented in many to overcome the loss of agriculture land.
3. Most CWANA countries are witnessing land fragmentation and small landholdings, which curtail investment and mechanization. This leads to reduced viability of agriculture and unsound land management. This also exists in tenured land systems.
4. Inefficient infrastructure and marketing and poor postharvest management in CWANA lead to limited profitability and lack of competitiveness.
5. Women play a central role in agriculture in CWANA countries. Their role is not properly recognized; poor access to land tenure, unpaid family labor and gender issues are not high on national agendas.
6. Little cooperation between CWANA countries exists, although some success stories can be made use of: women's empowerment in Tunisia, water-harvesting systems in Palestine, agricultural input packages to small farmers in Egypt.
7. CWANA local genetic resources are disappearing fast, although this region is the origin of the world's domesticated agriculture.

Agricultural knowledge, science and technology

1. In general, little is allocated to research in CWANA countries, less than 0.2% of the GNP instead of the recommended 2 percent. Recently, some real progress has been made in promoting research and development, especially in Qatar and the Emirates.
2. Illiteracy is high within the farming community in CWANA, especially among women. This hinders technology adoption and advancement.
3. Most agricultural research does not reflect the real needs of farmers. However, in some countries, such as Morocco, new efforts have localized research and adapted it to meet the needs of stakeholders.
4. The gap between the results of national and international agricultural research and its usefulness to farmers comes from weak technology transfer, poor dissemination of information and ineffective extension services.

5. Brain drain is widespread in most CWANA countries. It is estimated that about 40% of migrating professionals to the developed countries come from CWANA countries. Lack of local opportunity, poor governance and conflicts drive the brain drain.
6. In most CWANA countries, civil institutions, including small farmer organizations and cooperatives in agriculture, are not promoting authentic agricultural development because of bureaucracy and centralization.
7. Community organizations started in developing household agricultural enterprises, community forests, water harvesting and environmental protection.
8. Most CWANA countries rank low in all good governance indices. Participation, rule of law, transparency, responsiveness, consensus orientation, equity and inclusiveness, effectiveness and efficiency, and accountability are essential for sustainable development in the region.
9. Many CWANA countries are deficient in local expertise in policy formulation, institutional development, research management and understanding of farming systems, knowledge systems and their dissemination.
10. Lack of regulation and enforcement results in overuse of pesticides, including banned ones, which pollutes water and creates health hazards.

1.1 Profile of CWANA

1.1.1 Overview

CWANA (Central and West Asia and North Africa) is complex and vast. In this report, CWANA has been divided into the following subregions: North Africa, Nile Valley and the Red Sea, Arabian Peninsula, West Asia, Central Asia, and the Caucasus, since these countries share similar agroecological characteristics (Figure 1-1). Where necessary other subdivisions are discussed, for example, the Euphrates riparian system.

CWANA extends from the Atlantic Ocean, Mauritania and Morocco, in the west to Pakistan and Kyrgyzstan in the east and from Turkey and Kyrgyzstan in the north to Somalia and Yemen in the south. It falls between longitudes 17^{o}W and 80^{o}E and latitudes 43^{o}N and 2^{o}S. It comprises 32 countries and occupies about 20.9 million km^{2} or 15% of the world. Over half the world's dryland population lives in CWANA (Figure 1-1).

INSERT Figure 1-1. Countries and subregions of CWANA

CWANA includes some of the most inhospitable places on earth. It has a great part of the Sahara, the Empty Quarter of Arabia and the Usturit and Kyzilkum deserts. CWANA countries are drylands susceptible to desertification and mostly drought prone (UNEP, 1997). They have the fastest growing food deficits in the world and could face catastrophe if their remaining natural

resources are not properly managed and conserved. Drought management and mitigation are needed in these countries (Karrar, 2002). In CWANA, governments have to make difficult tradeoffs between short-term benefits and long-term solutions. Droughts always require immediate attention because they threaten human lives, but long-term solutions are necessary.

1.1.2 Ecosystems

1.1.2.1 Aridity zones

CWANA is characterized by low mean annual precipitation, high interannual variability and high potential evapotranspiration. In over 90% of the region annual rainfall is below 200 mm, but in a few areas rainfall can reach over 2000 mm. As precipitation decreases, annual rainfall variability increases.

Rainfall in CWANA is far from uniform. CWANA countries can be classified into four categories according to the average annual rainfall:

- Countries receiving more than 500 mm per year with 120 days of rain and with places surpassing 1500 mm: Kyrgyzstan (533 mm), Armenia (562 mm), Turkey (593 mm), Lebanon (661), Tajikistan (691 mm)
- Countries receiving 300 to 500 mm yearly with 60 to 100 days of rain: Afghanistan (327 mm), Morocco (346 mm), Sudan (416 mm), Azerbaijan (447 mm), Pakistan (494 mm)
- Countries receiving 100 to 300 mm annually with 40 to 70 days of rain, Jordan (111 mm), Kuwait (121 mm), Oman (125 mm), Turkmenistan (161 mm), Yemen (167 mm), Tunisia (207 mm), Iraq (216 mm), Djibouti (220 mm), Iran (228 mm), Syria (252 mm), Somalia (282 mm)
- Countries receiving less than 100 mm each year with fewer than 30 days of rain: Egypt (51 mm), Libyan Arab Jamahiriya (56 mm), Saudi Arabia (59 mm), Qatar (74 mm), United Arab Emirates (78 mm), Bahrain (83 mm), Algeria (89 mm), Mauritania (92 mm)

Rainfall in almost the entire region is intense, producing flash floods. Evaporation and transpiration cause much water loss from the surface. Potential evapotranspiration ranges from 1500 to 3000 mm per year. The Arabian Peninsula, which has almost one-fourth of CWANA's hyperarid zone, has annual precipitation deficits between 1700 to 2500 mm. A way to examine the consequences for agricultural systems in CWANA is to divide the region into aridity zones (Table 1-1):

- The hyperarid zone covers about 0.9 billion ha, over 86% in CWANA. Except for irrigated areas, such as in Egypt, few nomads live in this zone.
- In the arid zone the natural vegetation of short grass and sparse thorn scrub provides some grazing for sheep, goats, cattle and camels. Some wildlife, mostly gazelles and reptiles, live in this zone. Opportunistic rainfed cropping of sorghum and pearl millet is practiced in

depressions and foothills. Nomadic groups live in this zone, which has a low carrying capacity.

- The semiarid zone has both animal and rainfed husbandry and therefore supports millions of rural people and major agricultural industries.
- The subhumid zone contains luxuriant vegetation, from savanna to broken woodland. Productive arable farming is the primary use.

INSERT Table 1-1. Classification of aridity zones

Three more aridity zones occupy small areas:

- The coastal zones have various landscapes, coastal salty marshes, a series of medium-high hills lying a few kilometers away from the sea and open plains traversed by rocky sediments. While arid ecosystems dominate, fertile deltas of agricultural value exist.
- Swamps cover considerable areas in the region. In Sudan, the Sud swamps cover about 12 million ha. These swamps are inundated permanently or seasonally. The seasonally inundated parts are vast meadows of almost pure grass, which maintain much livestock.
- Mountain meadows occur on shallow soil at the higher altitudes and have high rainfall, high humidity and low temperatures. The meadows are rich in grasses, herbs and trees. Plants vary with the altitude, up to about 3500 m. Some of Central Asia and the Caucasus have 1–5 m snowfall. The climate has a short growing season and long, cold winters.

Rangelands occupy about half the area in West Asia. They have low carrying capacity. Relative humidity is vital for human comfort. Areas close to the coast have high relative humidity in summer, while other parts of the region have high relative humidity only during the rainy season. The Arabian Peninsula is one of the hottest and driest regions of the world, with daytime temperatures often exceeding 50^{o}C (De Pauw, 2002). Wind is more active in the hyperarid and arid zones than in the other zones. One reason is that these zones are relatively dry and have vast plains with little vegetation, over which the wind can blow unchecked. These powerful winds erode the soil and lift clouds of dust thousands of meters into the air. On many days in most of the region the atmosphere is hazy from dust.

1.1.2.2 Water resources

While CWANA covers 15% of the world area, it has only 2% of internal renewable water resources (WRI et al., 1998), making it the world's most water-stressed region. Water availability by CWANA subregion in the year 2000 was classified as follows: North Africa catastrophically low, Nile Valley and the Red Sea very low, Arabian Peninsula catastrophically low, West Asia

very low, Central Asia and the Caucasus low. In the Arabian Peninsula, the water-stress index is 100%. The subregion has hyperarid and arid climates with an annual rainfall less than 100 mm.

The total available water is about 15 billion m^3 annually. Surface water comprises about 45%, groundwater about 41%, desalinization about 12% and agricultural drainage reuse about 2%. Agriculture uses about 86% of the available water in CWANA. Excessive use of groundwater has resulted in sharp decline in its amount and quality because seawater is intruding (UNEP, 2002b).

West Asia has a water stress index of 83%. The subregion is mostly arid and semiarid. Most countries in the subregion receive less than 250 mm of rain per year. Two major rivers, the Euphrates and Tigris, are shared by Iraq, Syria and Turkey. Total available water resources are about 80 billion m^3 each year, 85% surface water, 10% groundwater and 5% agricultural drainage reuse. Agriculture uses about 80% of the available water. Effluent, agrochemicals and industrial discharges have seriously affected water quality. CWANA's driest country is Mauritania, where the average annual renewable water resources are less than 0.5 billion m^3. Water resources are poorly managed and inefficient across CWANA. In some areas farmers over-irrigate wheat crops 20 to 60%.

Water scarcity must be dealt with before any development can be sustained. Any development in CWANA must recognize that vegetation and soils are sensitive to intensive use. Once degraded, many decades are needed to restore the production and hydrologic function of these ecosystems. Low and erratic precipitation prevents the rapid reestablishment of vegetation, leaving a degraded landscape exposed to water and wind erosion for a long time.

1.1.2.3 Status of soils

Data from the Global Assessment of Human Induced Soil Degradation (GLASOD) (UNEP/ISRIC, 1990) show that soil degradation is widespread in the whole CWANA region. In North Africa, 70% of the degraded soils are through wind erosion, 20% water erosion and 10% through nutrient depletion and soil salinization. Soil erosion is a widespread problem in North Africa, with severity highest at the western and eastern ends of the Atlas and Riff mountains. In the lower parts, centuries-old, traditional soil conservation techniques are breaking down. The Nile Valley of Egypt has substantial chemical degradation problems, involving both salinization and nutrient depletion. In many of the upland areas of the Nile Valley and the Red Sea, land degradation has reached critical levels (UNEP, 1997). About 64 million ha of soils are degraded to varying degrees in Sudan. Wind erosion is the dominant cause of soil degradation in the arid zone, while water erosion is dominant in the semiarid zone.

Nutrient loss affects all climatic zones of Sudan (Ayoub, 1998). Most of Somalia is affected by wind erosion, with a small area in the southern part affected by water erosion. In Yemen, 50% of the soils are affected by water erosion and 20% by wind erosion. High to very high severity of nutrient depletion is taking place in the sandy soils of Sudan, the Arabian Peninsula and Central Asia. The dominant cause of soil degradation is wind erosion in the Arabian Peninsula and West Asia, covering almost 60% of the degraded area, followed by soil salinization, 30%, and water erosion, mostly in Syria and Lebanon.

Inefficient use of irrigation water has resulted in salinization, alkalization and waterlogging. More than 50% of the irrigated lands in the Euphrates plains and in Pakistan have been badly affected by salinization and waterlogging (UNESCWA, 1997). Indeed, Pakistan is among the top five countries in the world with irrigated land damaged by salinization. About 300 million ha in CWANA are affected by soil salinity and alkalinity, nearly 30% of the world's saline and alkaline soils (Abrol et al., 1988). They occur in coastal areas and inland salt marshes. Soil salinity is severe in the Euphrates and Tigris valleys of Syria and Iraq. The southern part of Pakistan is affected by wind erosion and soil salinity, while the northern part is affected by water erosion. Afghanistan is mostly affected by water erosion, while the southwestern part is affected by wind erosion and soil salinity. The bulk of Iran is affected by wind erosion. Its northern and western parts are affected mainly by water erosion. Soil salinity is also widespread and most severe in areas bordering Iraq and Afghanistan. The total area of salt-affected soils in Iran is about 15% (Koocheki and Mohalati, 1992). Turkey is seriously affected by water erosion; a few areas have water erosion coupled with nutrient depletion and soil salinity.

The Caucasus is two-thirds desert, the Usturit and Kyzilkum deserts. Soils are commonly salinized. The lowlands are salt accumulation zones and saline soils dominate (Zhang et al., 1992). Turkmenistan lies within these deserts. There are two large seas, the Caspian and the Aral. The Aral Sea is dying because its input water is diverted for agriculture. It shows the most recent example of human-induced environmental degradation in the subregion (UNEP, 1997). Fortunately, a big portion of Tajikistan is stable under natural conditions. Azerbaijan has various degrees of water erosion and extensive soils affected by salinity. The whole of Kyrgyzstan suffers various degrees of water erosion, wind erosion and soil salinization.

Surface and gully erosion exacerbate problems of low productivity, further diminishing soil resources, threatening the future productivity of the land. Water quality can become impaired, which when coupled with high sediment levels, constrains developing sustainable water-resource management. Clearly, action must be taken on many fronts to develop sustainable solutions and improve management of land and water in CWANA.

1.1.2.4 Agrobiodiversity

Agrobiodiversity or agricultural biodiversity includes all components of biological diversity relevant to food and agriculture: “Agricultural biodiversity is a broad term that includes all components of biological diversity of relevance to food and agriculture. It encompasses the variety and variability of animals, plants and microorganisms, at the genetic, species and ecosystem levels. They are necessary to sustain key functions of the agroecosystems, their structures and processes for, and in support of, food production and food security. So it refers primarily to genetic variability in cultivated plants and domesticated animals together with their progenitors and closely related wild species growing and evolving under natural conditions. Plants and animals gathered from, and hunted in, the wild are also included in this term.”

CWANA has a wide range of diversity in climate, topography and soils; genetic diversity of many globally important crops and their wild relatives, such as cereals, food legumes, forages, industrial crops, fruit trees and vegetables and farm animals. Its cultural diversity affects agriculture. Agriculture began independently in different sites about 12,000 to 11,000 years ago. It spread along the East Mediterranean, North Africa and South Europe, southwards to Egypt and the Ethiopian Plateau and eastwards to Central Asia and Indus. Agriculture in CWANA centers upon sheep, goats, cattle, cereals (wheat, barley), and legumes (lentil, pea, vetch), flax, which are early domesticates of the Near East (Harlan, 1995). Historical evidence suggests that West Asia and North Africa (WANA) are among the most important domestication centers, from where small ruminant production expanded to other parts of the world. The small ruminants found in the region represent a rich source of the genetic diversity necessary for production, orientation and diversification efforts.

Most crops in the Near East were domesticated during the Neolithic period. CWANA is significant and unique for plant diversity. Vavilov's (1926) Near Eastern, Mediterranean and Central Asian centers of origin extend into the region. This, of course, indicates that CWANA is a center of origin or diversity of several crops and many other plant species. The wild plant relatives and landraces, with enormous genetic diversity, are still found for cereals, legumes, fiber and oil crops, pasture and forage plants, fruits, nuts and vegetables (Harlan, 1992).

Near Eastern centers of diversity, including Jordan, Lebanon, Palestine, Syria, southeast Turkey, southern Iran and Iraq, extend northeast to the Caucasus and south to Arab Peninsula. They encompass a megadiversity of important food crop and pasture species and have a nuclear center and center of origin (Vavilov, 1926). Here numerous species, notably wheat, barley, lentil, pea and vetch, of temperate zone agriculture originated 10,000 years ago. In Turkey, Harlan

(1951) described microcenters for *Amygdalus* spp., *Cucumis melo, Cucumis sativus, Cucurbita moshata, Cucurbita pepo, Lens culinaris, Lupinus* spp., *Malus* spp., *Medicago sativa* and other *Medicago* spp., *Onobrychis viceaefolia, Phaseolus vulgaris, Pistachio* spp., *Prunus* spp., *Trifolium* spp., *Vicia faba, Vitis vinifera*. Almond, olive and pistachio trees also originated from this region and have dominated traditional agricultural systems. They have diverse wild relatives and local varieties. The biodiversity in this region is most outstanding for within-species genetic diversity and the many endemic species. Furthermore, the indigenous crop and food plants of the Near East are known for their resistance to disease and abiotic stress, making them a valuable for germplasm enhancement, upon which global food security depends.

Central Asia is also an important center of diversity in cultivated plants. It has the richest species and intraspecies diversity for many globally important crops. Agriculture must have reached this center from the Near East about 5000 BCE (Zeven and de Wet, 1982). Major crops include apple, apricot, peach, pear, plum, grape, almond, pistachio, pomegranate, fig, wheat, barley, rice, maize, sorghum, bean, chickpea, tomato, potato, onion, garlic, coriander and melon. Industrial and stimulant crops cotton, sugar beet, groundnut, sesame and tobacco are also cultivated.

1.1.3 Climate change

The vulnerability of CWANA to variable rainfall and drought is compounded by the anticipated effects of global climate change.

Drylands, CWANA included, are net sources of CO_2 (Sombroek, 1995) from overuse of plant resources. Annual CO_2 emissions of CWANA total about 1.8 billion tonnes—about 7.8% of the world's emissions. Inventories of greenhouse gases show most emissions in most CWANA countries come from burning fossil fuel. In Sudan and Somalia, CO_2 emissions can be correlated to changes in land use, particularly deforestation. CO_2 can be sequestered through better soil management. In some Central Asian countries almost half the emitted CO_2 was absorbed, 90 million tonnes, by changing land use (UNDP et al., 2003). Some atmospheric pollution caused by human activity is related to oil production and export, fertilizers, cement factories and motor vehicles.

Seasonal sand and dust storms contribute to air pollution in the region. The US Environmental Protection Agency (US EPA, 1996) estimated annual dust fallout of about 1000 tonnes per km^2 along the coast of Kuwait. Dust storms absorb pollutants, such as pesticides, and transport them long distances. Transboundary air pollution is an emerging issue in the region. Climate change will potentially have major effects on the Nile Delta and Darfur (Box 1-1).

Insert Box 1-1. Climate change: the Nile Delta and Darfur.

1.1.4 Macroeconomic indicators

1.1.4.1 Gross domestic product (GDP) and agriculture's share

The GDP varies among the countries from US $889 in Yemen to US $22,420 in United Arab Emirates (UAE). Most countries fall in the range of US $2,000–7,000; oil-producing countries have an average of US $16,657 (Table 1-2).

INSERT Table 1-2. Population and GDP.

Though agriculture is a major employer in CWANA countries, with 50% of the labor force, its share in the GDP is only 13%. This share is lowest in the high-income countries, 3%, but can be as high as 60 to 80% in low-income countries (Rodriguez, 1997).

Countries with agriculture less than 10% in GDP, mostly the Gulf countries, have scarce natural resources and agriculture has not developed because of it. Countries, such as United Arab Emirates and Saudi Arabia, have to import staple products (Table 1-3). But, because they are rich from their oil income, they have no problem importing staple products. They do not really need to increase agricultural production, although in case of political crisis, the food weapon could be used against them. Jordan and Djibouti have scarce natural resources, nor do they have oil wealth. CWANA countries may be classified in three types.

INSERT Table 1-3. Agriculture as share of the total GDP and major imports.

Agriculture remains important in countries with agriculture in GDP between 10 and 20%. Nevertheless, most of these countries are dependent upon importing staple products. A large percentage of labor is employed in agriculture and the population density is high compared with agricultural production. This discrepancy is from natural resource scarcity, unequal access to resources and low productivity of labor. Countries such as Algeria and Iran can afford imported staple products because they have oil income. Egypt, Morocco, Tunisia and Yemen do not have oil. The share of agriculture in GDP in Lebanon is between 10 and 20% because agriculture is still important. Farmers have access to land and water and the farms are family owned. Lebanon is not dependent on imports for major staple products. Although population has increased in the last 30 years, migration has maintained the equilibrium between resources and population density. The Caucasus countries, although agriculture is more than 20% of the GDP, are still dependent on imports of major staple food because land tenure is uncertain and not secure (FAO, 2005). Nevertheless, in Tajikistan, agriculture has accounted for one-third of the economic growth since 1997 and has made a major contribution to the fall in rural poverty.

1.1.4.2 National saving and investment

The national saving rate induces level investment, otherwise the nation has to borrow (dissaving). National saving was high in Jordan, 24.4% in 2001, from external financial transfers. The saving rate was around 15.4% in Egypt in 2001 and the accumulation of capital as a percentage of GDP was about 17% in 2002. Syria achieved the highest rate of local saving, 30%, of all Arab countries in 2002 (AOAD, 2003). The percentage of saving of the GDP was the highest in Qatar (54.5%), Libya (46.1%), Emirates (38.4%) and Algeria (44.3%) in 2003. It was around 20% in Egypt, Jordan, Kuwait, Morocco and Tunisia and was less than 10% in Lebanon in 2003 (World Economic Forum, 2005).

Total Arab external investment is around US $1,400 billion. Almost half of this is Saudi Arabian investment. The other half comes from almost all the other OPEC Arab countries. This investment is either direct or in bonds and stocks. Foreign investment in Arab countries was about US $8,616 million in 2003. More than one-quarter of this foreign investment, 26.4%, is in Morocco and about 15.7% in Sudan. The remainder, 57.9%, is invested in the remaining Arab countries. Since Syria has achieved a high saving rate, it will be able to invest without borrowing or external investment, which will lead to a high economic growth rate.

1.1.5 Geopolitics

CWANA is subject to several geopolitical disputes. A key example is a shared sea among some Central Asian countries, which is becoming diminished (Box 1-2).

INSERT Box 1-2. The Aral Sea

1.2 Well-being

1.2.1 Demography

The management strategy of a government toward its environment and to economic planning depends on its perception of the resources it has available and the likely future changes. As resource use links people, an understanding of population change is crucial to planning. The spread of health care and simple hygiene followed the end of the World War II. Infant mortality went down and life expectancy went up. The effect was rapid population growth. By 1900, the population of CWANA was estimated at 710 million, about 12% of the world population.

1.2.1.1 Population distribution and population growth rates

The total population of CWANA as of 2005 was about 724 million (Table 1-3). Rural population, which is increasing, is about half of the total (World Bank, 2006).

Population growth rates vary among CWANA subregions and among countries. During the twentieth century, the populations of Egypt, Iran and Turkey more than quadrupled. Discrepancies in population growth rate among countries and subregions (UNDP et al., 2003) range from less than 2% in Algeria, Azerbaidjan, Caucasus, Iran, Kuwait, Kyrgyzstan, Morocco, Tajikistan, Tunisia, Turkey, Turkmenistan and United Arab Emirates, to 2.9% in the Nile Valley, 3.3% in Jordan, Libya and Saudi Arabia, 3.7% in Yemen and 4.2% in Oman.

1.2.1.2 Life expectancy

The highest life expectancy at birth is in the Arabian Peninsula, 73.3 years; West Asia, 67.7 years; and the Caucasus, 67.5 years, have . Afghans have the lowest life expectancy in CWANA — less than 50 years. Total fertility rates in CWANA vary from as low as 2.3 to 2.5 in Azerbaijan and Turkey to as high as 6.9 in Afghanistan, 7.2 in Oman and 7.6 in Yemen. The percentage of the population in the 15–65-year age group varies among member countries. In Ethiopia and Eritrea it is around 50%, in Turkey 66% and in the United Arab Emirates around 69.4% (UNDP et al., 2003).

1.2.1.3 Literacy

Central Asia and the Caucasus have the highest literacy rates in CWANA. Surprisingly, more than 98% of the population was literate in all countries in this subregion. Pakistan has the lowest literacy rate, 49%, in the subregion of Southwest Asia, with a significant difference between males, 61%, and females, 35%. Low literacy rates were observed for Yemen, 49%; Egypt, 55%; and Sudan, 59%, in Nile Valley and the Red Sea subregions. In North Africa, Morocco and Mauritania have the lowest literacy rates, about 50%. Comparatively better literacy rates were observed in the Arabian Peninsula—the lowest was Oman 74% and the highest, Qatar, 89%.

1.2.1.4 Access to potable water and sanitation

The percentage of the population with access to potable water varies from as low as 12% in Afghanistan to a high of 98% in Tunisia, with 94% in Lebanon and 90% in Iran. Variations among urban and rural areas in access to safe drinking water are great in many countries. In Morocco, 94% of the urban population has access to safe drinking water, while only 18% of the rural population enjoys it. In Tunisia the situation is much better. Safe drinking water is provided to all of the urban population and 95% of the rural population. Fairly high percentages of both urban and rural populations in Algeria, Iran, Lebanon, Pakistan, Saudi Arabia and Syria have access to safe drinking water.

CWANA countries have discrepancies in the percentage of populations with adequate sanitation. It is rated high for some countries: Algeria 91%, Iran 81%, Oman 78%, Syria 83%, Tunisia 80%;

low for some: Egypt 32%, Morocco 41%, Pakistan 47%; and very low for others: Somalia 12%, Sudan 22%.

1.2.1.5 Employment and unemployment

Unemployment rates in 1999–2001 reached about 29.8% in Algeria, 14.9% in Tunisia, 15.5% in Jordan, 11.6% in Morocco, Syria and Yemen, and 9.2% in Egypt. An increase in unemployment in households will increase the dependency ratio. It may encourage the use of child labor, increase poverty and increase inequality of income distribution. In Arab countries, children under the age of 15 constitute about 40% or more of the population, which increases the dependency ratio and might speed the rate of population growth unless it is controlled. Landless and nearly landless people are not necessary poor; off-farm income can compensate for daily needs. Nonfarm income, such as salaries and wages, may offset decreasing sources of income from the land. Internal and external migrations of unskilled laborers seeking work fluctuate according to oil prices. The lessening demand for unskilled labor in Arab countries particularly affects poor households. Also crises affect poor households, such as the tourism crisis in Egypt in 1997 (IMF, 2005).

In 1997, unemployment in Tajikistan was 2.4% for men and 2.9% for women. Unemployment was defined as persons aged 15 and older without paid jobs. In 2005, Afghanistan had unemployment rates of 7.6% for men and 9.5% for women; Azerbaijan 7.6% for men and 9.5% for women; Iran 10% for men and 17% for women; Pakistan 6.6% for men and 12.8% for women; and Turkey 10% for both men and women. No data were shown for Turkmenistan and Uzbekistan (Harvard College Library, 2007).

The lowest unemployment rates by far were in Tajikistan. Afghanistan and Azerbaijan had similar unemployment rates. In Iran and Pakistan, the difference in unemployment rates between men and women was wide; in Turkey, they were equal.

The underground economy as a component of informal work is big, but it is not counted in GDP. Also food and income aid from rich to needy persons through charity is large in the Arab world, but it is not counted either.

1.2.2 Poverty

1.2.2.1 Per capita income

Per capita income is an important economic indicator. Per capita income of the world was estimated at US $5,516, with an annual growth rate of 2.90%. If low per capita income is less than US $1500, medium between US $1,500 and US $6,000 and high income greater than US

$6,000, CWANA countries can be classified accordingly. All eight Central Asian and Caucasus countries and all six Nile Valley and the Red Sea countries are low income. In North Africa four are low income and one, Libya, is high income. In West Asia, three countries are low income and three medium income. All six Arabian Peninsula countries are high income. Most high-income countries, 88%, produce and export oil; they represent about 4% of CWANA's population. Over half, 63%, of CWANA countries are low income, with 85% of the region's population.

Highest per capita income was recorded for the Arabian Peninsula countries. Much higher than the world average, per capita income of the United Arab Emirates is US $23,770. It also has one of the lowest per capita annual growth rates, 1.60%. Kuwait has the second largest per capita income, US $19,506. Bahrain follows with US $12,473; Saudi Arabia, US $9,608; and Oman, US $8,423. While these oil-rich Arab countries are classified high income according to the World Bank classification, the great majority of CWANA countries are considered lower middle income.

Countries belonging to Central Asia and the Caucasus have low incomes. The lowest income recorded was for Tajikistan, only US $118, with an annual growth rate of 9.40%. Kyrgyzstan also had a small per capita income, US $350. Kazakhstan had the largest in the subregion, US $1,966.

Pakistan had the lowest per capita income in Southwest Asia, US $556, with an annual growth rate of 4.2%. The second lowest, about double that of Pakistan, was for Syria, US $1,180. The largest per capita incomes in the subregion were for Iran, US $2,104, and Jordan, US $1,888.

In North Africa, Libya had the highest per capita income, US $4,965; Tunisia had US $2,366, followed by Algeria, US $2,062, and Morocco, US $1,394. The lowest was Mauritania, US $450 (World Bank, 2006).

1.2.2.2 Income distribution and poverty

Although average economic growth rates have been favorable, the high population growth rate of these last decades, 2.3%, has resulted in only a small net improvement. Moreover, there is now evidence of persistent income and nonincome inequality, which seriously limits prospects for propoor growth. The lack of data on income distribution over time limits considerably any research on the evolution of income distribution in this part of the world. Only a snapshot for the last decade can be given. The gap between the 10% of the population with the highest income and the 20% with the lowest income is tremendous. The greatest inequality is in Iran, where the highest 10% has 33.7% of the total national income and the lowest 20% has only 5.1%. Tunisia, Turkey and Turkmenistan have similar income distribution. In Algeria, Kazakhstan, Tajikistan and

Uzbekistan this gap is less profound. According to the same data, Finland, Japan and Norway had smaller gaps for the same period, 22 to 23% for the highest 10% and 10 to 11% for the lowest 20 percent.

Poverty is a big problem in most CWANA countries. Linked to the incapacity of the urban economy to offer salaried work to most of the active population, 15–65 years of age, these countries face severe poverty problems. However, poverty statistics are not available for all CWANA countries and headcount indices have been estimated for only a few countries. The poverty line and survey year varies from country to country, so comparison among the countries should be treated with caution.

During the 1990s, half the populations in Mauritania (North Africa), Armenia, Azerbaijan and Kyrgyzstan (Central Asia and Caucasus) were under the national poverty line. In Pakistan, Turkey and Uzbekistan the share of the population under poverty line was a little less than 30%, while in Algeria, Morocco, Jordan and Egypt, it was between 12 and 19 percent. Tunisia stands out as the country with the fewest poor; its national population under the poverty line was only 8 percent. In all the countries that delivered a poverty headcount ratio, except Armenia and Azerbaijan, poverty is more widespread in rural than in urban areas. The tertiary sector together with informal activities offers more opportunity for urban populations to be better off than rural populations. Most rural areas are becoming more isolated from cash-generating activities with a consequent negative impact on rural poverty. In the countries where undernourishment is high (more than 35%) the percentage of poor people is high and the GDP per capita very low.

Reduced demand for labor in the Gulf states has exacerbated the rising unemployment in the region. This has had a dramatic impact on remittances from migrant workers, especially in Egypt and Yemen, who provided much of the Arab casual labor. Unfortunately, data are not available for all CWANA countries, to assess the real gravity of the current situation.

In 2004, most inflation rates in Arab countries were moderate or low, except in Egypt (8.1%), and Yemen (12.5%. Inflation has negative effect on stable incomes, like salaries, wages and pensions. Consequently, inflation will increase poverty and inequality in income in Arab countries. Inflation can be either cost-pull or demand-pull, but poor and lower middle class incomes will be more affected. Also, economic reforms in the region usually increase inflation, especially at the beginning. Data from the International Monetary Fund (IMF) and collected from Arab governments showed the inflation rate in Algeria was about 38% in 2002, about 19.5% in Morocco in 2001 and at least 10.4% in Egypt in 2003 (IMF, 2005).

1.2.2.3 Human poverty index and human development index

The data for 2002 indicate that eight countries ranged between 30 and 48 on the human poverty index (Table 1-2), on a scale of 0–100, where the higher the score the more severe the poverty. Data calculated for the human development index for 2004 ranged from a low of 0.492 for Yemen to a high of 0.871 for Kuwait, on a scale of 0 to 1. Two-thirds of CWANA countries have a human development index higher than 0.7. Oil-producing countries have on average a human development index of 0.82, considered high in CWANA (World Bank, 2006).

1.2.3 Food security

The definition of food security, according to the Food and Agriculture Organization of the United Nations (FAO), is the availability, accessibility, safety and sustainability of food. The self-sufficiency ratio is not a measure for food security if the country is capable of importing food. Most important is the availability of foreign currency to import food, in addition to foreign food aid. Grain storage capacity is important. Beside the purchasing power of per capita income—the real per capita income—farmers rely on the food they produce and factor in what it costs to produce it.

1.2.3.1 National food security

Agricultural imports constitute about one-fourth of CWANA's total merchandise imports, reflecting the region's vulnerability to food insecurity. Between 1991 and 1996, 15 countries had negative per capita food production growth rates (FAO, 2001). Oil-producing countries in CWANA are fast becoming world's largest importers of food. In their quest to meet their priorities and obligations, people are driven to look at what is available today and disregard posterity. Extending cultivation to marginal and submarginal lands, overgrazing village common property and indiscriminately cutting vegetation for fodder and fuel are the easiest options. Farmers depend on subsistence farming to eke livelihoods on a fragile resource base, accelerating desertification in many countries. If the degradation continue, it may be irreversible.

Agricultural imports in CWANA countries reached US $41.8 billion, while agricultural exports did not exceed US $17 billion in 2004 (Figure 1-2) (FAO, 2006c). The main commodities exported were fruits and vegetables, dates and olive oil, while the main imports were grains. Considering the water scarcity in the region, this indicates unwise water-resource management. However, profitable grain production depends on large-scale land ownership and mechanization, while fruits and vegetables depend less on land and are labor intensive. Arab countries are net importers of food. In 2003 about 68.1% of imported food was grain, while other food groups were much less: milk and dairy products (15.0%), sugar (7.7%), and oil and fats (4.1%).

INSERT Figure 1-2. Agricultural exports and imports

Because of the increase in population and other variables, the food gap between consumption and production increased and reached 40% in 2003. The Arab countries are relying more on other countries to feed their growing population.

In 2003, in the seven countries with high and high-moderate per capita GDP, food production was low or zero, especially in grains, legumes, sugar, oil and fats, and milk and dairy products in 2003. Other countries with low-moderate and low per capita GDP have better self-sufficiency in most foods, except Djibouti, which produces only some meat and fish and foods in no other groups (AOAD, 2003).

Sudan is almost self-sufficient in food. Sudan could be the food basket for all Arab countries, but there is a link between abundance of natural resources and poor growth. Also, it lacks institutions for marketing and financing, and it lacks infrastructure. These lead to low endowment and low performance. This situation also prevails in some other Arab countries. Sudan is reviewing laws of investment to encourage foreign direct investment.

Migration to Arab oil countries decreased poverty in Sudan. More than half the workers in rural areas migrated, so agricultural production declined. Also, government expenditure was mainly on defense, security and loan repayment. Government expenditure on health, education and other social services was limited.

Although it has natural feed sources, Libya has a protein gap. Because of drought and overgrazing, the government built 11 concentrated feed factories. Their capacity was about 963,600 tonnes per year. Actual production reached only about 367,000 tonnes in 2003. About 92% of the ingredients were imported. Since the factories were not working at full capacity, prices of local concentrated feed were higher and poorer quality than imported feed.

1.2.3.2 Food security in relation to health status

In 2003, 3 to 5% of the population was undernourished in nine CWANA countries, 6 to 10% in six, 23 to 37% in five; in Tajikistan, 61% of the population was undernourished (FAO, 2006d).

Infant birth weight provides an indicator of nutritional status. The percentage of low birth weight infants varies in CWANA. It ranges from less than 10% in Algeria, Iran, Jordan, Kuwait, Morocco, Oman, Saudi Arabia, Tunisia, Turkey, Turkmenistan and United Arab Emirates, 15 to 20% in Sudan and Afghanistan, to 25% in Pakistan. High infant mortality rates of 92 to 154 per 1000 live births are recorded in Mauritania and Afghanistan. These rates are almost twice the average

world rate, 57 per 1000 live births. Most of the remaining CWANA countries had values lower than the world average.

Among countries of the region and excluding Afghanistan and Iraq, for which data are tenuous, only Tajikistan and Yemen recorded very high food insecurity in 2001–2003. About 61% of the population of Tajikistan suffered undernourishment and more than 33% of the Yemeni population were chronically undernourished. Pakistan, Sudan and Uzbekistan faced the most serious food insecurity the prevalence of undernourishment lies below 10 percent. Ten CWANA countries, such as Jordan and Morocco, show an increase in both prevalence and in absolute number of undernourished people between the baseline period and 2001–2003. The most alarming figures are in Kazakhstan and Uzbekistan, where the proportion of the undernourished has increased sevenfold and the number increased more than fourfold.

On the other hand, 12 other CWANA countries, such as Egypt and Syria, succeeded in reducing the prevalence of the undernourished in 2001–2003 compared with the baseline period. However, only four countries are on track toward achieving the Millennium Development Goal target. The most successful were Kyrgyzstan and Kuwait. Both started from a relatively high prevalence of hunger, but have cut the number of undernourished by at least two-thirds. In 1993–1995, Armenia had the highest prevalence of undernourishment (52%) in the region. It halved its number of hungry people, but at 29% the prevalence remains disturbingly high.

The lowest dietary energy supplies occur in countries with the lowest GDP per capita, such as Armenia, Pakistan, Sudan, Tajikistan and Yemen (FAO, 2006c). Capital stock in agriculture per worker is highly correlated to the agricultural value added per worker according to nourishment (Figure 1-3). It means that the value added per worker increases as the capital stock per worker increases. Countries where the percentage of undernourishment is more than 35% have the lowest value added per agricultural worker and the lowest capital stock per worker. Capital stock per worker and value added per worker are appropriate for assessing undernourishment.

INSERT Figure 1-3. Capital stock in agriculture

1.3 Status of Agriculture

The proportion of arable land in CWANA is less than the world average and varies considerably among countries. Most, 62 percent, of the arable lands in CWANA are in Iran, Kazakhstan, Morocco, Pakistan, Sudan and Turkey. With Afghanistan, Algeria, Egypt, Iraq, Saudi Arabia, Syria, Tunisia and Uzbekistan, these countries have over 90% of the arable CWANA land. The remaining 18 countries have 10% of the arable land of the whole region.

1.3.1 Agricultural livelihood strategies

1.3.1.1 Production systems

A major characteristic of agriculture in CWANA is that it combines traditional subsistence farming with large-scale agrobusinesses. Traditional farming systems rely on labor, use few chemicals and pesticides, and use local landraces. Most traditional farming systems can be considered organic farming. However, production from of traditional systems is low compared with large-scale farming. Some small initiatives in Lebanon, Palestine and Tunisia focus on promoting organic farming, but labeling, certification and marketing need further development. In the future, demand for organic farm products is expected to increase. This might open a new window of opportunity for such products if they have proper labeling, certification and marketing. Indigenous farming relies on mixed systems at a small scale. The second farming system relies on big investment and monocropping. Corporate business farming is expanding at the expense of the small-scale family farm system. It is accompanied by a shift from traditional farming into business farming and uses intensive cropping and agrochemicals. This shift results in a loss of indigenous knowledge and biodiversity and increases water pollution, land degradation and loss of livelihood.

Most CWANA people live in hyperarid to semiarid zones. Population densities are generally less than 1 per km^2 in the hyperarid zone, except in Egypt, less than 5 per km^2 in the arid zone and about 10 per km^2 in the semiarid zone. About 72% of the population depend on agriculture, 7% on livestock and 21% on the urban areas for their livelihood. Rural people living in CWANA can be roughly classified into nomadic, seminomadic, transhumant and sedentary populations. Nomadic people are found in pastoral groups, which depend on livestock for subsistence and, whenever possible, farming as a supplement. Following the irregular rainfall, they migrate in search of pasture and water for their animals. Seminomadic people are also found in pastoral groups, which depend largely on livestock and agricultural cultivation at a base camp, where they return for varying periods. Transhumant people combine farming and livestock production during favorable seasons, but might migrate seasonally along regular routes when forage for grazing diminishes. Sedentary farmers practice rainfed or irrigated agriculture.

Land use is often a form of agroforestry or agrosylvopastoralism, as in western Sudan where the gum arabic tree, *Acacia senegal*, is cultivated along with sorghum or millet and raising small ruminants. Often, there is little distinction between a farmer and a pastoralist. People living in drylands take into account the local limitations and adapt to suitable and feasible land use in seeking a livelihood. However, the delicate balance achieved through traditional farming and livestock production is easily upset; this is shown by a general deterioration of grazing lands in drylands. A main cause of this deterioration—often referred to as desertification in its most severe

form—is the overpopulation of people and their livestock, coupled with the deregulation in access and use of rangelands, forests and land. Agricultural cropping and pastoralist become competitive, rather than complementary, forms of land use.

1.3.1.1.1 Major production systems in North Africa and the Middle East

The production systems in North Africa and the Middle East are diverse. The most productive systems are able to nourish or provide livelihoods for many people. The biggest portion (85%) of the area is covered by less productive systems: pastoral farming (3 people km^{-2}) and sparse farming (6 people km^{-2}). The most productive agriculture is concentrated in the remaining 15% of the land area because of greater land and water resources.

The population density in large-scale irrigated agriculture is the highest. The total cultivated area is irrigated. In the Middle East and North Africa, irrigation is a way to intensify agriculture. Highland mixed farming and rainfed mixed farming also have high population densities. These systems have family farms and integration between agriculture and livestock, essential for income diversification and managing soil fertility. They are diversified because they integrate cereal and legumes, fruit trees, fodder and livestock. These systems are productive because of the availability of good soils and rainfall.

Obviously, resource scarcity determines the productivity of each system and its natural resource management. In the arid zone reliable agriculture is possible through irrigation and nomadism. Rainfed agriculture is widespread in the semiarid zone. Two major elements should be looked at to intensify agriculture in this region:

- Availability of natural resources
- Access to these natural resources and control of them

The percentage of irrigated area, cultivated area and type of land and water management varies with production system (Table 1-4). As water resources are scarce, irrigation efficiency is important, but it is low and rarely exceeds 50 percent. Production might be intensified by improving irrigation efficiency through better resource management and introduction of technical innovations, especially irrigation water-saving techniques.

INSERT Table 1-4. Irrigated area and land management in MENA

1.3.1.1.2 Major production systems in Central Asia

In Central Asia, many countries from the former Soviet Union have a lot of land issues. Land allocation, land reform and restructuring and the transition to open markets have not yet been

achieved. Land issues have negative effects on production. The most productive in central Asia are the highland mixed rice and wheat farming systems. Those systems, set in Pakistan and Afghanistan, have benefited from the Green Revolution, especially the rice or wheat farming system. High-yielding varieties, mechanization and agrochemicals boosted agricultural production. These two systems are highly intensified and the ratio of irrigated area to the total cultivated area is large: 86% of the cultivated area is irrigated, with a population density of about 40 people per km^2.

Similar to the Middle East and North Africa, two major elements determine agricultural production and food security: land and water. There is scope for extending the irrigated area, and therefore agricultural production, especially in Turkey. All conditions are set, socially and economically, to boost agricultural production in Turkey. It has the political will, water resources, water-management policies and irrigation projects, such as the GAP. Pakistan and Afghanistan have only limited potential to extend irrigated area because water resources are decreasing, especially groundwater. Intensification of agricultural production may occur by introducing new water-storage and water-saving practices. Although, the share of irrigated areas in cultivated areas is very low (10%) in the countries of the former Soviet Union, there is no scope for implementing large-scale irrigation schemes as in the past. Nevertheless, cultivated areas can be extended mostly through rainfed and small-scale irrigation. To have sustainable agricultural production, land tenancy should be secured; farmers should access and control their land.

1.3.1.2 Role of women in agriculture

In CWANA, agricultural work is mostly performed in small-scale households and often involves all family members. The work of women, however, is little reported and that of children is even more rarely noted. Analysis of the statistics on agriculture in CWANA suffers from the great diversity of situations that characterize male and female farm work. Among the factors that contribute to agriculture are production systems, some labor intensive; social and marital status, age, household composition and economic status, availability of male or female labor; mechanization of the work and farm size; and ethnic, religious, cultural and social norms. Despite these variations some common trends in CWANA can be detected. Involvement of a woman in agriculture may put strains on her domestic duties, including child rearing, housekeeping, cleaning, cooking, and fetching water and fuelwood. Women contribute 28 to 70% of agricultural labor. This can be from, among other things, the growing number of female-headed households because of male migration or war. Together with performing domestic and agricultural work of the household, in some countries these female farmers have started looking for off-farm work. Revenue from migrated relatives is often not sufficient for survival. In Syria, women, particularly from low-income households, constitute a large share of seasonal agricultural workers. The

highest rates of participation are in the 15–24-year age bracket (Ramsis Farah, 1999). In other CWANA countries, women over 40 are often more involved in agriculture than younger ones. In Syria, 44% of women work for a wage, while 56% work as unpaid farm labor. If paid, women usually receive lower salaries than men. In Egypt and Yemen, women earn roughly two-thirds of men's wages. In Iran, they earn 46% of male salaries, while in Lebanon they earn 50% (FAO, 1995). Women from poorer and smaller households are usually more involved in agriculture and are more likely to work off-farm for daily wages than those from richer households.

Women mainly perform manual, time-consuming and labor-intensive work on the farm; mechanized work is generally a male task. Women are usually responsible for horticultural crops and agroprocessing. They are involved mainly in planting seeds or transplanting seedlings, harvesting, picking fruit and vegetables, and postharvest threshing, selecting and storing. Men mainly prepare the land, irrigate, spray, mechanically harvest and market the produce. Duties connected to livestock rearing differ by animal. Mainly, women take care of small livestock. Herding and marketing are generally male duties. Fishery and agroforestry are also mainly male tasks. In Egypt fisheries and fish marketing are primarily men's tasks, while more than half of the labor in fish processing is performed by women, who also contribute in making, maintaining and repairing nets (FAO, 1996). Despite their substantial agricultural work, women have limited control or ownership of resources and revenues. Percentage of land area owned by women ranges from none in Oman, about 5% in Syria and Lebanon, 11% in Jordan and 24% in Egypt. Statistics about asset entitlement and access are scanty and rarely separated by gender. Generally, women own plots smaller than men's. In Syria, 7% of women own animals and 1% own agricultural machinery. According to the report of the Convention on the Elimination of All Forms of Discrimination Against Women in Yemen (CEDAW 2001), female farmers do not control land, water, agricultural equipment, credit or capital.

Some critics have highlighted the reasons for the underrepresentation of women's involvement in agricultural work, particularly in Muslim countries (El-Fattal, 1996). These are the association of women with domestic spaces to the exclusion of outdoor activities, such as work in fields; association of agricultural work with wage labor, while women are mainly unpaid; and association of farmers with plot holders—women working in the fields are rarely landowners. Many land and agrarian reforms have increased concentration of property entitlements, access and control in the hands of the male heads of households and assigned access to men for basic agricultural resources, such as water, seed and fertilizer, distributed by government agencies. Lacking control over, and entitlement to, production often implies restricted access to loans and social security, limited autonomy and decision-making power, and, eventually, curtailed ability to achieve food security. Women's limited access to markets also affects their control of revenue and decisions.

The increasing number of female-headed households, visible in many countries of CWANA, corresponds to an increase in women's workload and a decrease in their independence. In Pakistan and Sudan, 25% of households are headed by women, 16% in Egypt and Morocco, 13.6% in Yemen, 11% in Lebanon, Oman and Tunisia and 6% in Iran, Jordan, Syria and Turkey (FAO, 1995; Hartl, 2003).

In some cases, women become empowered because men are absent. They participate in decision making by managing small budgets and their mobility is increased because they sometimes go to the market to sell their produce, even if they still must let male relatives make major decisions, such as selling a cow (CNEA, 1996). The feminization of agricultural labor increased the rates of women's work in the unpaid and informal systems. Their employment in wage labor is still characterized by gender wage differentials, precariousness, lack of social services and vulnerability. The increase in household work involves children, who contribute their share of work, to the detriment of their school attendance, free time, health and other children's rights.

Finally, despite women's increasing involvement in the fields, agricultural machinery is still usually designed for men, limiting, together with social biases, women's and children's access to technological improvements. In Syria, the introduction of agricultural machinery from the 1960s often increased women's and children's drudgery by strengthening the gender division of labor. Men were assigned mechanized work, leaving manual work to women and children.

1.3.2 Agricultural land use

A detailed examination of the aridity zones shows that over 4 million km^2 of land in CWANA is available for good cropping and animal husbandry (Table 1-5). The greatest land use is permanent pasture, 550 million ha. Cropland and forests are 141 million ha and woodlands 124 million ha. Most of the permanent pastures and forests and woodlands are in the Nile Valley, Sudan and Somalia. Central Asia and North Africa are also rich in croplands and permanent pastures. Among the low-income countries, per capita accessibility to arable land is about 1 ha, of which 40% is irrigated and 60% rainfed. The estimated daily income of an average farming family is about US $2.82 (Rodriguez and Thomas, 1998). By 2025, the lowest per capita cropland—less than one-tenth of a hectare—will be in the Arabian Peninsula and the Nile Valley. There is great disparity in cropland per capita among countries within a subregion. For example, cropland per capita in Sudan, 0.448 ha, is eight times higher than in Egypt, 0.053 ha. These are expected to be reduced to 0.0313 ha for Egypt and to 0.277 ha for Sudan by 2025, if current trends of population growth and land degradation continue.

INSERT Table 1-5. Land use

There has been no appreciable overall increase in cropland in the last three decades. In 2005, the area of arable and permanent crops is 5.6% in North Africa, 10% in Central Asia, 1.9% in the Arabian Peninsula and 16.3% in the Middle East (FAO, 2006b). Cereal production increased slowly in North Africa, about 50% between 1975, 18.5 million tonnes, and 2005, 28 million tonnes. Central Asia had an appreciable increase in cereal production up to 1990, 31.5 million tonnes, but since then production has fallen sharply, dropping back by 2005 to the 1975 figure of 19 million. In the Arabian Peninsula cereal production increased steadily and peaked in 1990 at 4.9 million tonnes, three times that of 1975, 1.5 million tonnes; it has now dropped to twice the figure of 1975. Cereal production in Mashreq (Iraq, Jordan, Lebanon and Syria) performed well between 1980 and 1995: 9 million tonnes, but dropped to about 130% of the 1975 figure, 5 million tonnes (FAO, 2006a).

Sustainable land use is a challenge to all people living in drylands. Problems in CWANA include desertification, inadequate knowledge of more productive land-use practices, political marginalization and low investment. People also confront major problems in attaining sustainable land use because of inadequate knowledge of alternative land-use practices. Many people observe a “tradition” in agriculture not always matched by similar, traditional, approaches toward forestry, wildlife ranching and ecotourism, all of which have become profitable enterprises in many dryland regions of the world. This lack of appreciation can be a barrier to innovation in land use, especially on marginal agricultural land. Such barriers are often overcome through farmer education, extension services, and, most of all, through demonstrating the benefits of more diversified land use.

The drylands of the region suffer from the vicious cycle of low productivity, low investment and, as a result, poverty. Investments, apart from those made for irrigated agriculture, are relatively small. Low productivity, low investment and land degradation often lead to desertification and are responsible for regional poverty and income disparity. The poverty and hunger prevalent in some CWANA countries, like Sudan, are poignant examples of this situation. Other critical problems include the inherent problems of water scarcity, tenure considerations and ineffective development policies. Improving this situation requires that a variety of technical and institutional problems be solved. An example would be increasing the investment in appropriate agriculture, alternative land-use practices and other appropriate, income-generating interventions. Other solutions include designing strategies for risk management and implementing programs for more equitable land distribution and income.

As noted, CWANA is climatically diverse, mainly with hyperarid, arid and semiarid zones. The region has highly variable and uncertain climates. Climatic variability and associated floods and droughts result in increased risks of crop failure and reduced food security. While precipitation in many CWANA countries averages 200–500 mm annually, suitable for some crops, the extreme fluctuation in precipitation from year to year make such averages irrelevant. We cannot depend upon average precipitation to plan agricultural and natural resource development or urban expansion. As a result of low and erratic precipitation in the drylands, ephemeral or intermittent streams are the norm. Flash floods from intense rainfall are highly variable and are common in many CWANA countries. Dry stream channels may become torrents within hours of convective storms that occurred several kilometers upstream.

Land use and water are inextricably linked but often are not managed in concert. Watershed management offers the framework for achieving integrated management to increase or sustain food and natural resource production while protecting the soil and water (Brooks et al., 1997). This approach recognizes that land use in uplands affects the flow and quality of water downstream. Water resource development in the form of reservoirs and canals can affect the type and intensity of land use throughout a watershed. Transforming this recognition into effective solutions, however, is currently hampered by inadequate policies and an absence of institutions and arrangements needed to integrate sectoral cooperation, upon which implementation depends (Kundzewicz, 1997). Understanding and coping with the links between land use and water is critical. Water should be viewed as the most valuable product of the land and the one resource upon which all other production depends. In discussing needs and opportunities for enhanced management of CWANA, we must recognize and be able to work with variable and often unpredictable precipitation and water yield.

Soil erosion reduces the productivity of upland watersheds. The sediment that reaches stream channels can adversely affect reservoirs, water systems and water quality in downstream riparian corridors. This is a typical environmental problem in downstream countries of the Nile Valley. However, soil erosion in the highlands could be interpreted as a “good thing”, a source of nutrients for lowland agriculture. For example, the annual flooding of the Nile in Egypt was the basis for productive agriculture, now disrupted by the Aswan High dam.

In all drylands under intensive use, common issues and problems arise that need to be addressed through management. Foremost, drylands have commonly been viewed as wastelands, not worthy of economic concern or political attention. Global concerns about desertification over the past few decades have, however, focused more attention on dryland

issues and the need for land-use reform. “Desertification” often describes areas that have become desert-like from human-induced degradation. To some extent, emerging programs to combat desertification have helped generate the political, economic and technical support needed to reverse land degradation. However, certain inherent characteristics of drylands place limits on the potential for agricultural, natural resource and urban development. Conditions also make watersheds vulnerable to degradation and curtail our ability to restore or rehabilitate the land.

1.3.3 Livestock and fisheries

For many livestock owners in CWANA, livestock is a sign of wealth and social prestige. Herd numbers count for more than herd quality. Husbandry is mainly on natural pastures and extensive nomadic grazing. Most of these pastures are poor from frequent droughts and overgrazing. The number of cattle in the region goes up to 124 million head, about 9% of the world’s cattle. Sheep number about 320 million head, 30% of the world total; goats about 189 million (23%); and camels about 14 million head (68%). Cattle are most abundant in Sudan (38 million), Pakistan (24 million), Turkey (10 million) and Iran (9 million). Small ruminants abound in Sudan (90 million head), Pakistan (83 million) and Iran (81 million). Camels are mostly in Somalia (7 million head), Sudan (3 million) and Mauritania (1.4 million). Buffalo total about 31 million head, 18% of the world total. Over 80% of CWANA's buffaloes are in Pakistan and 13% are in Egypt (FAO, 2006a).

Annual meat production from livestock in CWANA is estimated at 6.5 million tonnes, 55% from cattle and buffalo, and the rest from small ruminants. CWANA consumes about 24% of the world small ruminant meat. Additional 5.5 million tonnes of meat came from fish, poultry, and game, making total meat production 12 million tonnes in 2003, about 5% of world meat production (FAO, 2006a). The biggest producer of meat in the region in 2003 was Pakistan with 1.89 million tonnes; followed by Iran (1.6 million tonnes); Egypt (1.45 million tonnes); and Turkey (1.35 million tonnes).

Fish catch in CWANA was 1.3 million tonnes in 2002. Egypt caught half of that with Pakistan and Iran almost equally catching about 17% of the CWANA catch. Egypt and Pakistan got their fish mostly from fresh water; Iran got its fish equally from marine and fresh water (FAO, 2006a).

1.3.4 Policies and interventions in rangeland management

The primary concern for governments of the region is to develop policies to check overgrazing, a problem recognized by all. Developing water resources was thought to spread the burden of livestock over a wider area and reduce overgrazing. This could work only if livestock populations were stabilized. But, uncontrolled by governments, the livestock population is rising steadily in most CWANA countries. The inevitable result is more overgrazing. Land tenure was the next to

be tried. Three land-tenure systems were progressively established in the region following independence from foreign rulers:

- government lands not subject to any public use
- government lands subject to use by a tribe or village or group of individuals
- private lands registered to individuals

Most CWANA countries established state ownership of rangelands during the twentieth century. The rangelands of Algeria, Iran, Jordan Sudan and Syria, to mention a few, were considered government property, with tribal rights to use these rangelands recognized. Tunisia and Morocco recognized and established collective properties of tribes to the land as early as 1918. But soon after its independence, Tunisia chose to promote privatization of common land. Some of these reforms were accompanied by measures to promote settlement of nomadic pastoralists, improve rangeland management by limiting stocking rate, establish reserves, ban cultivation and ban uprooting of shrubs in rangelands. As these measures led to a clash of interests, they could not be applied.

The attempt was to organize pastoralists to sustainably use common rangelands through state ownership and state cooperatives, herder cooperatives, community cooperatives and comanagement of community rangelands. Governments also built roads to facilitate moving herds and access to markets. Expanded road network and improved transportation subjected areas high in biodiversity and in good range condition to grazing pressure never before experienced; pastures near the most popular routes were overgrazed.

To help herders reduce drought losses, governments through WANA introduced drought-management policies, such as feed subsidies and credit rescheduling. While these interventions succeeded in protecting incomes in drought years, they introduced a bias to keep livestock numbers high, which accelerated rangeland degradation. This protection undermined adjusting herd size to annual climatic variation and increased herd size. In parallel, policies such as subsidizing agricultural inputs, like fuel or tractors, were not restricted geographically, and they favored crop encroachment in pastoral areas.

After several decades of rangeland management through promoting rehabilitation measures, planting shrubs and cactus, and preventing grazing, most experts agree that rangelands are still degrading and solutions should rely on institutional change and tenure reform. Approaches promoting natural resource management in local communities or “co-management” of resources under the regime of common property rights are relatively new in the region. Implications of the initiatives have not been discussed extensively (Dutilly-Diane, 2006). In Sudan, it was

recommended in the mid-1950s that rangelands be allocated and registered to tribal owners. This was considered crucial because until individuals or groups knew the benefits of new or improved ranges would be theirs, all efforts to develop rotational grazing would fail (Wallach, 1989).

1.4 Key Issues

1.4.1 Ecosystems

Some 85% of the CWANA land area is considered desert and dryland susceptible to desertification; 70% of the region's agricultural areas are arid or semiarid, and only 35% is cultivable. During the last 20 years many CWANA countries have suffered long-term droughts, with various degrees of severity: Afghanistan, Iraq, Iran, Jordan, Morocco, Oman, Pakistan, Sudan, Syria, Tajikistan, Tunisia and Turkmenistan (FAO, 2001). The successive droughts that hit CWANA countries have devastated plant, animal and human lives alike. Livestock herders suffered most as incomes fell sharply and vulnerability to food shortages increased dramatically.

Desertification continues to be the most significant environmental issue in most of CWANA. It has affected wide areas of rangeland. Soil erosion in excess of 20 tonnes ha^{-1} per year is common in many areas. There is a close correlation between drylands and the location of areas that are likely to be affected by desertification in the future. This correlation may be explained by the peculiar vulnerability of fragile dryland environments to wind and water erosion, soil salinization, and loss of vegetation by overgrazing by livestock, overcutting of fuelwood and trees, and other excessive uses of the land and natural resources, and also by the deregulation of natural resource management. The prevailing climate also exerts persistent stress on both soil and vegetative resources. Relatively little disturbance can cause instability and imbalance, leading to desertification. Drought, overgrazing, clearance of woody species and tillage are the principal causes of rangeland degradation. In North Africa up to 90% of the area is affected by desertification (UNEP, 1997).

Key issues pertaining to soils are degradation through water and wind erosion and through nutrient loss. Salinization, waterlogging and alkalization are major issues in irrigated areas, especially in large-scale irrigated schemes.

1.4.2 Population growth and demography

Population in CWANA will be about 1.2 billion by 2025; it is expected to reach 1.6 billion (17% of the world population) by 2050. The population is rapidly becoming urbanized in many countries of the region. By 2020 the percentage of the urban population to the total population will be 93% in Oman, 91% in Libya, 90% in Saudi Arabia and UAE, 85% in Turkey and 75% in Tunisia. In some

countries of the region such as Afghanistan the urban population will remain under 30% (UNDP et al., 2003).

1.4.3 Water scarcity and its implication for agricultural production systems

Scarcity of water is the chief challenge to agricultural development in almost all CWANA countries. Freshwater scarcity threatens CWANA's ability to achieve food security, alleviate poverty and improve human health. Land scarcity compounds the problems of water scarcity, making people more vulnerable to the extremes of droughts and floods and leading to widespread exploitation of natural resources.

1.4.4 Access and use of agrobiodiversity

Due to the megadiversity of crop species in CWANA, major crops, wild relatives and landraces vary significantly in the region. They are important sources of useful genes for several characters such as adaptation to extreme conditions of abiotic stress, resistance to pests and diseases, high quality, and factors affecting productivity. They also play an important cultural and social role, and they secure evolutionary continuity.

The richness of agrobiodiversity and the existence of low-input farming systems in the region is key to food security and sustainable agricultural production in the region as well as outside. Many farmers in CWANA countries cannot afford expensive external inputs such as fertilizers, pesticides or seed of improved varieties adapted to the particular ecological and economic situation. Plant genetic diversity, at both intra- and interspecific levels, is crucially important in CWANA farming systems. So this existing diversity helps stabilize farming systems by maintaining the wide range of crop diversity.

Domestic animals contribute to food and agriculture in many ways, providing meat, milk and milk products, eggs, fiber, and fertilizer for crops, manure for fuel, and essential draft power. They are an extremely important economic resource, reducing risk, generating employment, and evening out seasonal farm labor demands. Some 4,000 breeds of cattle, horse, donkey, pig, sheep, buffalo, goat, chicken and duck have been developed and used worldwide. Animal genetic resources of breeds and strains and wild or semi-domesticated relatives are important, their diversity being insurance against future adverse conditions. Farmers and breeders have successfully selected animals for a variety of traits and production environments, using their genetic diversity extremely effectively.

But because of the Green Revolution that took place in Pakistan and the adoption of high-yield varieties, genetic resources in the CWANA region are being degraded. The shift from small-scale

to large-scale farming systems using technical packages that feature mechanization and chemicals is contributing to biodiversity loss. Many governments are unaware that they should establish gene banks to conserve local varieties. The situation with livestock seems to be better. Foreign breeds, especially of cattle, have been imported in many countries but their adoption has been slow because they need large amounts of feed that farmers cannot afford. So farmers are still rearing local breeds of cattle, sheep and goats.

1.4.5 Climate change

According to the Intergovernmental Panel on Climate Change **(**IPCC, 2001), CWANA is among the most vulnerable regions in the world in predicted decreases in water and food security. Changes in rainfall and temperature patterns could also alter biodiversity, with many species not being able to adapt or migrate. However, the consequences of global climate change on agriculture and ecosystems are uncertain. The most likely impact on CWANA, based on various simulation models, is adverse consequences for its semiarid zone. These models show that doubling the CO_2 concentration in the atmosphere will induce the following:

- In West Asia and the Arabian Peninsula, temperatures are projected to increase by approximately 4 ^{o}C. Rainfall and soil moisture will decrease.
- In Central Asia temperatures will increase substantially in winter. More rainfall and a slight increase in soil moisture levels will result. Summer changes include a 6 ^{o}C temperature increase, greatly varied changes in precipitation and a general decrease in soil moisture (Williams and Balling, 1994).
- In North Africa, the Nile Valley and the Red Sea, grain yields are projected to decrease, further diminishing food security. Desertification will be exacerbated by reductions in average annual rainfall and increased evapotranspiration. Significant extinctions in plant and animal species are projected, importantly affecting rural livelihoods (UNEP, 2002b).

The type of climate change expected will have a major impact on dryland soils, where most of the salinization will occur. These soils are inherently vulnerable to degradation, since they have low biological activity, organic matter and aggregate stability. The resilience of the dryland ecosystems to deficits in moisture, temperature extremes and salinity is still inadequately known.

1.4.6 Land and water access, tenure and management

Land and water access is greatly differentiated in CWANA and generally unequal. Few countries have conducted real land reform, but Turkey did in 1945. Major measures were applied under the rule of Mustafa Kemal in 1926: the tithe to the landholder was abolished in 1925 and the former tenures located on state-owned land were given to farmers (Dufumier, 2004). Land reform was conducted in irrigated areas in the governorates of Deir Ezzor and Rakka in northeastern Syria.

Although many problems arose after the government distributed land to farmers, access to it was more or less equal. It created the basis for agricultural production.

In Algeria and the former Soviet Union republics, the transition to a market economy has not yet been accomplished and land regime is still uncertain as the former state-owned farms have completely disappeared and conditions for gaining access to land are not clear.

Many countries such as Jordan, Morocco and Tunisia have adopted a capital-intensive model of agricultural development at the expense of small-scale farming systems. This model is capitalistic and export oriented and based on private property rights of water and land.

The Green Revolution increased agricultural production, as for example in Pakistan: “The Green Revolution generated tremendous increases in yields, particularly in large agricultural irrigated plains where cropping intensity was high because of efficient water management. But even in the regions where the Green Revolution occurred, small-scale farmers could not invest to develop their production systems and to progress. Although the Green Revolution can be extended in terms of yield and production to other areas where natural resources are available … it will not alleviate poverty neither provide food for hundreds of millions of small scale farmers” (Mazoyer, 2001).

1.4.7 Infrastructure and financing for agricultural development

The capitalistic model mentioned above has spread in many countries thanks to infrastructural development. There are discrepancies in infrastructure within CWANA. In countries where market-oriented agriculture has been adopted, infrastructure has been improved although there are still pockets of subsistence farming. In countries like Syria, where agricultural policies have led to self-sufficiency, roads and highways link production areas to major marketing centers.

1.4.8 Governance

Good governance is characterized by participation, rule of law, transparency, responsiveness, consensus orientation, equity and inclusiveness, and effectiveness, efficiency and accountability. Several indices are used worldwide to measure governance, and aid has been tied to good governance indices. Most CWANA countries rank low in all these indices. For most CWANA countries, the environmental governance corruption index is below 4, in a scale from 0 to 10, where 0 is most corrupt. Most CWANA countries rank below average in the environmental policy and freedom index (Kaufmann et al., 2003).

1.4.9 Local knowledge

Local knowledge has been generated for centuries; it is empirical, based on farmer experience. According to the ecosystems they live in, communities have developed knowledge that is quite diverse. It varies according to physical conditions such as climate, soil and vegetal cover but also social and economic conditions. Local knowledge encompasses agricultural practices and techniques concerning cropping patterns and animal husbandry, and also resource management systems like water-harvesting, water-management and rangeland-management systems. Small-scale farmers have also manufactured locally used tools such as plows. Managing biodiversity and conservation is also considered part of local knowledge.

Some research has been done on biodiversity management and conservation, water management systems (especially in arid areas) and rangeland management systems but very little on local agricultural techniques and practices such as cropping patterns. Local knowledge can easily be transferred from farmer to farmer as it has been generated at a small scale. Generally, farmers do not need major investments to adopt it.

As aridity is widespread in the region, local knowledge about water management and conservation is quite developed. Community-managed irrigation networks, water- and land-conservation systems such as *tabias* and *jsour* in Tunisia are mostly located in arid areas in southern and central Tunisia where rainfall does not exceed 200 mm. Water- and land-conservation systems are mostly small-scale catchments built manually to harvest rainwater.

Those systems are no longer maintained and are disintegrating as other job opportunities with higher opportunity costs are available in nearby regions. Community technologies no longer play their traditional role in managing resources because most present-day activities are large scale, like constructing dams or reclaiming land, and are carried out by government agencies. Village or community water-management systems have almost disappeared, but individual farmers still maintain their own small water works.

Highly sophisticated irrigation networks have been set up by communities in areas where the main constraint has been water scarcity. Irrigation systems were based on community organization; village dwellers contributed to their maintenance (*foggaras*) by cleaning up drainage and irrigation canals. Local grassroots organizations were in charge of water management and distribution. In the beginning of the 1970s, because of the evolution of technology, major water-harvesting works of dams and drilling were carried out, and new irrigation systems have been adopted.

In southern Morocco, water for irrigation came from the Atlas Mountains and downstream communities in the Draa Valley and Tafilaelt developed irrigation areas. They used their own techniques for capturing, conveying and managing water—techniques adapted to the local conditions of labor available for digging and maintaining the canals, water flows, and social organization. In the 1970s, the government built two dams upstream and created huge irrigation schemes downstream. Communities could no longer manage irrigation, the amount of water available per hectare decreased, and profitability was not as high as before. The combination of these factors plus Bayoudh disease among date palms caused a decrease in date fruit production (Ben Zid, 2002).

Moroccan date palm production has declined by 80% since the 1920s (Ben Zid, 2002). This decline is because the production system changed. The former system was viable because cheap labor was used to maintain the irrigation system. In 1920, laborers started migrating to France and northern Morocco, so less labor was available, affecting the whole system.

Because Bayoudh disease had decreased date production, farmers tried to keep date palm biodiversity by growing and multiplying indigenous cultivars that bore disease resistant genes.

Farmers have their own way to distinguish date palm varieties, which is quite different from the researchers' method. They characterize leaves as well as fruits. Researchers use only one criterion: the fruit. A farmer in Algeria has written an index classifying various parts of the date palm tree (Bakkay and Tirichine, 2005). Written in Amazigh and Arabic and published by the High Secretariat of Amazigh in Algiers, it will be translated into French. Such an index will be helpful in identifying the cultivars most resistant to diseases and in combining farmers' and researchers' knowledge. It will be a tool for setting up future biodiversity management programs in the Maghreb.

All parts of the date palm tree are used: leaves are used for building materials and sometimes to make tools for fishing (IPGRI, 2005). Fruits are classified according to their ripeness and are processed accordingly: some are dried and stored and some are eaten fresh (IPGRI, 2005). Date fruits are processed into different highly nutritive products (ICRA, 2003).

In arid areas and rangelands, farmers and village dwellers know the biology of many range species as well as their location according to topography and soil features. They know therefore where to take their flock to pasture according to the season.

Because the vegetal cover is degraded from the heavy pressure on range resources combined with climate change and other external factors—development of agriculture and introduction of new techniques like drilling—some species are threatened and pastoralism itself is declining. Local knowledge related to pastoralism is disappearing; young men no longer work as shepherds in rangeland areas but seek job opportunities in other areas or regions. Local knowledge on range species is not documented and will thus be lost.

In North Africa, farmers were growing local cultivars of cereals. The French occupiers developed national research systems at the beginning of the twentieth century to breed varieties or cultivars adapted to their needs. National research centers worked mostly on wheat that would produce flour suitable for bread making.

Cereal breeding went on even after the North African countries got their independence. At that time, research centers focused on producing high-yield varieties adapted to mechanized techniques, which have gradually replaced locally bred cultivars. Indigenous wheat cultivars are still grown in remote hilly areas where there is no mechanization. The plants are usually short and easy to mow manually. They are also resistant to fungi and disease. They are usually grown by resource-poor farmers.

Farmers over centuries have developed different cropping patterns for wheat to optimize production and manage risk. In area where rainfall is more than 500 mm, wheat density is quite high (more than 100 kg ha^{-1}). In arid areas, farmers usually grow barley, not wheat, as it is more resistant to drought. Barley is grown for two purposes: farmers can get grain and it can be pastured—so they limit losses if it does not rain enough. Barley harvest is low (40 to 50 kg ha^{-1}). If rainfall is not as high as expected, livestock pasture the barley crop.

1.4.10 Social equity and gender

New processes that are transforming the rural areas of CWANA and bringing women to the forefront of agricultural work are not directly reflected in adjustments to either the legal system or prevailing social habits. On the contrary, discriminatory gender practices in agriculture persist to date.

1.4.11 Capacity development

The region needs to develop its capacity in a number of areas. Higher agricultural education, irrigation water management and conservation and use of plant genetic resources can all play major roles in increasing food security, alleviating poverty and meeting the Millennium Development Goals in the region if capacity is adequately built.

The new challenge for universities in developing capacity is in agricultural education for sustainable rural development and for strengthening rural communities. Higher agricultural education has contributed to the growth and modernization of agricultural production. It has focused on professional development of those responsible for agriculture and rural development. Curriculum and management adjustments have not paralleled this growth (Atchoarena, 2006).

Interaction with the farmer and farmer organizations or with the private sector has not been a university priority. Participatory research has been negligible and therefore the effect of research results has been moderate. To maximize the benefits from research at institutions of higher agriculture education, agricultural information systems and transfer technology units need to be put in place and links made to national, regional and international systems.

Many research results can be transferred or extended, but the community is not presently benefiting from them because the resulting technology is not being transferred or made available to the beneficiaries and the stakeholders.

Agriculture is central to rural development and poverty alleviation. Unfortunately the ministries of Agriculture in many regions have not been able to take an active role in developing national strategies for generating jobs, improving livelihoods and alleviating poverty. Human resources in this area are lacking, and neither the universities nor the national agricultural research centers have provided the expertise or initiated effective programs in this aspect.

The region lacks expertise in impact studies, and in monitoring and evaluation. Lack of this expertise has kept important emerging technologies or practices from being disseminated in the field.

Expertise on risk analysis and assessment and on national commitments and benefits from international agreements and conventions is also lacking. Cooperation among institutions of higher education in agriculture with international and regional agriculture centers and organizations will reduce the gap in these areas. There is a lack in institutionalization of the participatory and community-based research and technology dissemination approaches in universities and research institutions. There are no policies for strengthening public–private partnerships.

Large areas in CWANA region suffer severely from poor water management; inefficient irrigation and drainage practices and technologies; lack of knowledge and know-how on the part of

farmers, farmer associations, and service providers; and institutional weaknesses. The problems in meeting growing water needs stem not only from water scarcity, but also from weak water-management capacity. With agriculture using a high percentage of the world's available water, improvement in capacity building at every level—from farmers to government—is required.

Genetic resources are important for food security. Since CWANA harbors a wealth of plant genetic resources, we are giving them special attention. Capacity development in this area focuses too heavily on technical training. Management and strategic planning, fund raising, public awareness and policy have not been considered in the past. What the capacity-building needs are of the plant genetic resource centers or the farmers has not been identified. Initiatives are not assessed and there is the risk of overemphasizing capacity needed in some areas and underestimating that in others.

1.4.12 Marketing and policies

Marketing is seen as a main element (or a main constraint) in developing the agricultural sector in the region. It affects the improvement of livelihoods of the rural population and rural development in general. Marketing opportunities and market participation are related to the sustainability of the farming and production systems, mainly for the poor. Markets in CWANA lack facilities—they are sometimes gathering places rather than markets; they lack regulations—or at least the existing regulations are not enforced; and conditions are not competitive—the marketplace suffers from collusion and bilateral negotiation. Importers and exporters have high transaction costs. Some markets are extremely protected from foreign competition, as in the Gulf region.

Locally, production is scattered and there is no marketing chain. Quality control is not well developed and the consumer has no role. Transport costs are high for small-scale farmers; few farmer organizations are able to transport and market agricultural products in bulk. Some commodities, like citrus, tomatoes, peppers, dates, have seen a major increase in yields—sometimes overproduction. Because there are no local storage and processing facilities and because farmer organizations are not as structured and strong as is needed, middlemen control farm-gate prices. Hence small-scale farmers do not get good prices and cannot invest in their system and repeat it the following year.

1.5 Status of Agricultural Knowledge, Science and Technology

1.5.1 Knowledge

Since the beginning of human settlement, major civilizations have started at the shores of rivers and lakes. Water is an important factor in initiating a human settlement. At the desert edge and in valley areas where water ran in winter but were dry most of the year, how to manage water

resources became a big challenge to the builders of settlements. How to collect and store winter floodwater and use it during dry seasons was extremely important and valued knowledge. Ancient peoples had simple tools and techniques to build water-collecting systems adequate to support their demands during the dry months. This knowledge and associated techniques were developed over time, and efficient water-harvesting systems were installed in some parts of the desert. Indeed, CWANA contains the ruins of many civilizations who were pioneers in water harvesting such as the Maareb civilization in Yemen and the Nabateans in Jordan. These civilizations have left a heritage of rainwater-harvesting knowledge that helped people sustain themselves in the harsh environment of the drylands. Over time water-harvesting techniques have been developed and modified to adapt to different geomorphologic and climatological situations. Some are discussed here.

In areas where the catchments are significantly large, macroharvesting systems are implemented that have large-scale collecting and distributing schemes. For local and small catchments, smaller water-harvesting systems are more suitable.

One technique of micro water harvesting developed and used for rangelands enhancement is to build a series of check dams and contour lines to concentrate runoff water for wild vegetation. This technique results in effective rainfall many times actual rainfall. In Jordan, such techniques have been adopted in various parts of the country. Research is being conducted to see their efficiency and sustainability, mainly in enhancing rangeland. One popular technique is earth bunds (or *hafira*) (10,000–50,000 m^3). Water collected in the earth bund is used for watering livestock and sometimes for domestic use in remote areas, as in Sudan. The bunds were dug and managed by local communities in the past, but now the government uses earth-moving machines to dig them. The bunds are maintained by governments and some NGOs.

For crop production and in wet areas, terraces are built to serve two purposes: to stabilize soil from erosion and to harvest runoff. These techniques have been practiced for thousands of years in Yemen.

1.5.2 Science and technology

Investments in agricultural science and technology have expanded rapidly during the last four decades. Major technical and institutional reforms have occurred, which have shaped the pattern of developing and disseminating technology. In the early 1970s, the Consultative Group on International Agricultural Research (CGIAR) was established and national agricultural research systems (NARS) were greatly strengthened. During the 1980s and 1990s, partnerships among CGIAR centers and NARS were established, including the ecoregional consortia.

Historically, research has been conducted on the role of organic matter in soils, the development of reduced tillage systems, the use of on-farm organic resources in combination with inorganic fertilizers and the role of legumes in biological nitrogen fixation. Similarly, there has been research in integrated pest management (IPM) and in weed and pest control. These topics are of little interest to the private sector and are in danger of neglect by public research institutions. In most CWANA countries, agricultural research is not a priority. Levels of funding do not meet international requirements. Internationally, 2% of the GDP is allocated to research, but not in CWANA. NARS are short of financial support and personnel, which has emigrated from some countries. Some particular features of the international agenda are these:

- The global research agenda is gradually moving from a focus on individual crop performance to a growing acceptance of the importance of increased system productivity. This is viewed largely in terms of better-managed interactions among diversified farm enterprises, sustainable resource management, and improved targeting of technologies toward women farmers and poorer households.
- Perhaps even more importantly in the long term, institutional modalities are now shifting. From a public sector focus, largely led by the international system, more emphasis is now being given to public–private partnerships driven mainly by client demands. These changes are being accompanied by a growing understanding of farmers' problems and opportunities and a greater willingness to blend indigenous knowledge and modern information.
- Growing investments in biotechnology aim to increase agricultural research productivity and have the potential to revolutionize production practices by generating customized crop varieties. While national and international public funding available for agricultural research and extension systems has gradually decreased, private sector biotechnology research has attracted considerable support. Most of this research is likely to focus on profit-generating inputs, export crops and agroprocessing.
- Research on water resources has mainly focused on water management, water saving, and new sustainable processes to reuse wastewater and desalinize salty water.

Some examples of research conducted in CWANA are outlined here:

- One of the first research institutions in CWANA was in Sudan. Started in 1907, it concentrated only on cotton research during the British administration. After independence, it focused on diversification and intensification; food crops were introduced as part of agriculture research programs. The fields covered were soil management, crop husbandry, crop protection, and plant and animal breeding. In the 1940s, 1950s and 1960s a lot of research was conducted and published in international journals. Now little is published. Research concentrates only on irrigated crops, neglecting rainfed crops, although the rainfed

area (mechanized and traditional) is ten times the size of irrigated areas in Sudan. Research on livestock is meager, concentrating mainly on veterinary issues as opposed to increasing production. Nowadays, the agricultural research situation in Sudan is bleak because of the lack of funds, the brain drain and partisan issues. Agricultural research once was of the responsibility of the Ministry of Agriculture, but it has now been transferred to the Ministry of Science and Technology. The implications are not positive; the connection between farmers and extension agents has been considerably weakened.

- In Jordan, one of the pioneer specialized research institutes in agriculture is the National Center for Agriculture Research and Technology Transfer, whose field stations serve as research and demonstration farms. Research is mainly to develop drought-resistant varieties of cereals and legumes and to breed livestock. Field stations disseminate findings. Seeds of improved varieties are produced in large scale for farmer supply. The Ministry of Agriculture has an extension division whose agents (animal production engineers, plant production engineers, soil engineers) provide advice to farmers and consult with them. The main constraint is financial; all research depends on international funds. Most work has been on developing and selecting varieties for rainfed farming adapted to arid lands, mainly barley and wheat. Government funds mainly concentrate on extension.
- Irrigation systems have been developed to encourage efficient irrigation. Most developments have focused on adapting and transferring new irrigation techniques, such as drip and sprinkler irrigation, which during the 1980s took over from traditional practices using basin irrigation. These new techniques were first introduced by the Jordanian Ministry of Agriculture and its extension system, with institutions and regulations set up to discourage farmers from using more water. Another incentive for adopting irrigation techniques that use less water is it saves pumping, as most farming activities depend on groundwater pumped from deep aquifers. For surface-water users, the main reason to consume less water is that they must pay for the water they use. To encourage take-up of new technologies, new irrigation techniques are introduced into research stations. Over time, people start seeing the benefits of saving water and the ease and practicality of operating these techniques versus the traditional basin and channeling system. Where costs are saved by using less water, the incentive to use water-saving techniques is strong. However, when water is free or the cost is not tied to the amount of water used, farmers prefer the easier traditional basin techniques. This is typical for countries with abundant water or government-subsidized irrigation water.
- Egyptian farming systems represent all the different situations: Nile River water is channeled to the farming areas where farmers get it for free and most irrigation systems are basin. In the farming areas using groundwater two systems are in operation. One is that the government digs wells and pumps the water into channels to the farming areas at no cost to the farmers. In this system mostly basin irrigation is used. The other is that farmers have their own wells

and pump their water; almost all use efficient irrigation systems that save pumping costs. These technologies are associated with added costs to the farming system. Most of the time, the saving in water pay this cost, but sometimes farmers do not have the initial start-up costs. In such cases government may intervene to help farmers adopt these irrigation water-saving techniques. Indeed, one of the major tasks of the agricultural credit fund in Jordan is to provide soft loans, with a subsidized interest rate, to farmers to adopt the new technology. In Tunisia, government greatly subsidizes adoption of new irrigation techniques.

- With increased domestic water and sanitation requirements, more treated wastewater is reused for agricultural production. Research is carried out on reusing reclaimed, treated wastewater for restricted irrigation (forage, wood trees …). This reuse of treated wastewater differs from country to country and is mostly carried out where water resources are limited and in high agricultural demand. Some countries, such as Tunisia, have had good experience and use treated wastewater in farming on a large scale; others, like Jordan, are now testing; but the experience of most CWANA countries is limited.
- With the evolution of structural engineering, humankind is able to build massive structures that can dam tremendous amount of water. In the last century, a number of mega dams were built on major rivers, allowing people to regulate water flow and farm all year round with water for dry cycles. Examples are the Aswan High dam in Egypt and the Ataturk dam in Turkey. There are also several medium-size dams designed for agricultural and electricity purposes, and small-size dams (as in Tunisia) for agriculture.

1.5.3 Extension and systems of technology transfers

Agricultural research and extension services are not playing their important roles adequately in many CWANA countries. A prominent reason is that in many countries funds have not been adequate to maintain salaries at reasonable levels, leading to an increase in absenteeism as scientists take up other jobs to supplement their income. As a result, extension services have suffered. Both research and extension services in many CWANA countries depend heavily on donor funding. Given the fragile economies and extensive demands on the public sector countries, donor support for research and extension will continue to be important for some time to come.

Links between farmers, extension agents and research systems in many CWANA countries are weak. Often researchers interact little with extension services and farmers, and do not reflect their priorities in the research agenda. In some cases the national research program is defined by donors or individual researchers and may have little relation to farmer needs.

In other cases, farmers never learn about new technologies the research systems develop because effective mechanisms to transfer innovations from research to the extension system do not exist. Finally, the extension services have often failed to reach farmers because their communication strategies are not effective. Thus, extension services often miss the farmers who would benefit the most from good advice—the women farmers who are responsible for the great majority of agricultural output in most CWANA countries.

Even when farmers recognize that new technologies will raise productivity, they are often reluctant to bear the risks associated with a new approach. Methods are needed to reduce the risk that farmers face when adopting new technologies and to increase their access to sound rural financial services, including savings, credit and insurance.

Finally, research and extension systems must be opened to more providers, strengthening links between universities, NGOs, private firms, and others. Presently they lack coordination.

Present evaluation of research activities is not appropriate. Applicability of research findings should be evaluated. Presently, evaluation is only on the number of papers published and not on how research findings have reached farmers. In some places, research is farmer driven but its results do not go back to farmers because extension is weak.

Some messages for technology transfer are sent through the print media, radio and TV, but the messages are too technical as sent and cannot meet a wide range of farmer needs. Demonstration plots are rare and it is seldom feasible to scale up the new techniques. Farmers have no money for hiring labor, integrating new techniques, developing a marketing chain for new products.

Technology transfer occurs mostly through agricultural development projects as government agencies do not have financial or human resources to carry out adequate extension programs. There are some success stories about adopting new techniques, but they are rare and the impact of such projects is still limited. The Watershed Management Project, an FAO project implemented in three Tunisian governorates (Kairouan, Siliana and Zaghouan), introduced a type of water reservoir in the project area (FAO, 2004). Farmers settled in other regions adopted the same way of building their water reservoirs. This new technique has not been scaled up because capital is usually lacking within the small-scale farmer community. Sometimes there is farmer-to-farmer technology transfer through group farmer visits to groups of farmers in other regions, but more often transfer occurs in an agricultural development project. Resources are available while the

project is ongoing, but after it closes, there is no way to up-scale widely the new techniques the project has promoted.

Interest in agricultural education is decreasing. Education is becoming more knowledge based than skilled based. Little critical thinking is required, and the curriculum lacks multidisciplinary aspects. There is no holistic vision. Governments are not hiring people any more. The main problem in the region that made past extension initiatives fail is that too many people are working in the ministries of agriculture, resulting in inefficiency and poor allocation of human resources.