CWANA CHAPTER ONE
SETTING THE SCENE

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Key messages

- **About 67.4% of the region is hyper-arid (desert), 7.5% are arid, 17.3% are semi-arid** and 7.6% are dry sub-humid (dry land susceptible to desertification) with high rainfall variability and frequent drought incidences. Most of the deserts in the world are in this region.
- **Natural resources are subjected to tremendous pressure** caused by increasing population (high population growth rate and increased life expectancy), Climate Change, over use of the resources.
  - **Most conflicts in the world are in this region** : Lack of security is resulting in migration in many cases , indigenous knowledge loss, loss of livelihoods
- **About 70% of the available water is used for agriculture** with very low efficient irrigation systems such as basin irrigation. Sustainability of agriculture in CWANA is dependant on more efficient and effective water use. Comprehensive planning to develop effective and efficient water resource development projects within the framework of sound dryland management is essential, particularly in watershed areas.
- **In CWANA, large-scale irrigation projects have emerged during the twentieth century** and on-wards in the Sudan, Egypt and Pakistan. The sustainability of such efforts is becoming problematic as populations grow, demands for water increase, water pollution rises, and conflicts over water use arise.
- **To feed the people in the region, there is a need of 500m3/per person**
- Physical scarcity of water resources is compounded by very low water use efficiency.
- **There is a lack of cooperation in managing most of the shared water resources in the region.**
- **High population growth rate associated to high rates of unemployment are strong driving forces for increased urbanization and migration**. There is high population growth rate in the Arabian Peninsula (3.2%) and the Nile Valley and the Red Sea (2.9%). In North Africa, the average population growth rate is 2%, whereas in the Caucasus the population growth rate is low (1.2%). More than 2/3 of the population lives in urban areas. Overall life expectancy is high: it ranges from 67 years to 73 years in the Arabian Peninsula, West Asia and the Caucasus. However, life expectancy is low (less than 50 years) in a few countries such as Afghanistan.
- **GDP is low and reflects poverty and malnutrition.** In countries dependent mostly on agriculture, between 30 and 40% of the population live on less than US$ 1 per day.

- **There have been an Improvement in standards of living in some countries,** changes in the life style, freer access to market. Thus, tourism has increased the demand on diverse commodities.
- CWANA is characterized by a wide range of diversity in terms of climatic, topographic and edaphic environment resulting in genetic diversity of numerous flora and fauna. CWANA region is

subjected to a fast disappearance of local genetic resources while this region is **the origin of the world domesticated agriculture.**

- The richness of agrobiodiversity in the region could contribute to food security and sustainable agricultural production world wide.
- **There are 2 major types of farming systems : one is more endogenous and relies on mixed farming systems at small scale, and the second one relies on high investment, mono cropping**. Corporate business farming is expanding at the expense of the small scale family farming system. This is accompanied by a shift from traditional farming into business farming that use intensive cropping and agrochemicals. This shift is resulting in a loss of local indigenous knowledge, biodiversity, water pollution, land degradation and loss of livelihoods.
- **Traditional water harvesting systems are still practiced in the semi arid areas** in CWANA although large scale systems (as "Foggaras' in Morocco, Algeria and Tunisia) are deteriorating because of the collapse of local societies.
- **Adequate research on water saving techniques, taking into consideration social aspects, is needed**. A social assessment should be carried out to better understand the social groups likely to use such techniques. Such assessments and consultations with the communities are being carried out in the studies to sustainable management of the Nile watersheds management under the project of "Nile Basin Initiative" of the World Bank.
- **Watershed and political boundaries rarely coincide; as a result, the necessary coordination of land and water management depends upon functional organizations that cannot (can) resolve transboundary issues and water use disputes**. The management of uplands and riparian areas must be coordinated among stakeholders in a way that makes good economic and ecological sense.
- **Special attention should be focused on the management of mountainous, forested watersheds.** These are the highest freshwater yielding areas in CWANA, but they can also be the source areas for torrents and flash floods.
- **In CWANA countries, few resources are allocated to agricultural research.** 0.2% of GDP spent on research in the Arab world while the recommended is 2%.
- **Agriculture Research in CWANA is gradually moving towards farmer demand-driven and problem oriented in most countries.** This is as a result of the various activities by NARS in collaboration with many CGIAR Centers. These activities are supported by many donors aimed at strengthening, furthermore, agricultural research programs which are farmer demand- driven problem-oriented research.
- **Key research areas in CWANA include crops genetics and water harvesting systems and techniques.)**

- **In CWANA, extension systems are generally weak:** However, some countries are putting much effort to improve their extension system, which suffers from shortage of funding, facilities as well as trained man power in addition to brain-drain. Innovations or new techniques are not extended properly, especially in remote areas. Extension efforts with respect to large scale irrigation schemes focus on encouraging farmers to adopt techniques such as use of new varieties, fertilizers, pesticides, herbicides etc.
- **Land tenure, ownership rights and communal on rangeland** are key issues affecting Natural Resource Management and consequently agricultural development in the CWANA.
- **Inefficient infrastructure/storing and processing facilities are available**: there is an over production in many places.
- **Centralized governments, poor transparency, weak community participation in policy and planning (including agricultural policies), political conflicts have hindered authentic sustainable development in the region.**
- **In general, many of the CWANA countries are deficient in expertise in policy formulation, institutional development, research management and in understanding of farming systems, knowledge systems and knowledge dissemination.**
- Traditional knowledge in CWANA countries is disappearing.
- **Women play a central role in Agriculture in CWANA countries, their role is not properly recognized:** poor access to resources (land tenure…), unpaid labor and, gender issues are not high on the national agendas in most of the CWANA countries.
- **Strongly stratified gender relations in farming persist in some parts of CWANA and are inadequately addressed by research programs.** This hampers effective decision-making in the agricultural sector.
- **There is little cooperation between CWANA while there are a number of success stories that can be scaled up and integrated** : such as Waste water treatment and re use in Agriculture in Tunisia, Supplementary irrigation initiative in Tunisia, Women empowerment (Rights) in Tunisia, Coping strategies in Palestine (Water harvesting systems), informal seed sector in Egypt.
- **Illiteracy is high within the farming community in CWANA especially among women which hinders the potential of technology adoption and advancement**

1.1 Profile of the CWANA Region

1.1.1 Overview

The CWANA (Central and West Asia and North Africa) region is complex and vast. It can be mapped according to a variety of criteria including geo-economic and geo-political criteria. In this report, the CWANA region has been divided into the following sub-regions: North Africa, The Nile Valley and the

Red Sea, Arabian Peninsula, West Asia, Central Asia, and the Caucasus since the countries within each zone share similar agroecological characteristics (Tables 1.1.). Where necessary other sub-divisions are discussed, for example when considering riparian systems such as the Euphrates.

The CWANA region 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} west and 80^{o} east and latitudes 43^{o} north and 2^{o} south. It comprises 32 countries, and occupies an area of about 20.9 million km^{2} (15% of the world's area). Over half of the world's dry-land population lives in the CWANA region (Figure 1.1.a).

CWANA includes some of the most inhospitable places on Earth, encompassing a great part of the Sahara Desert and the Empty Quarter of Arabia, Usturit and Kyzilkum deserts. CWANA countries are classified as dry lands susceptible to desertification and mostly drought-prone (UNEP, 1997). They have the fastest growing food deficit records in the world and could face catastrophe if their remaining natural resources are not properly managed and conserved. This makes drought management and mitigation vitally needed in these countries (Karrar, 2002). In CWANA governments have to make difficult trade-offs 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

The CWANA region is characterized by low mean annual precipitation, high inter-annual variability, and high rates of potential evapotranspiration. In over ninety% of the region, annual rainfall is below 200 mm, but in a few areas rainfall can reach over 2000 mm in extreme cases. As precipitation totals decrease, annual rainfall variability increases.

Another feature of rainfall in almost the entire region is its high intensity, which produces flash-flood conditions. Evaporation and transpiration are the causes of major water loss from the land surface of the region. Potential evapotranspiration ranges from 1500 to 3000 mm per year. The Arabian Peninsula, which comprises almost one-quarter of CWANA's hyper-arid zone, experiences annual precipitation deficits between 1700 to 2500 mm. One way of examining the consequences for production systems of the climatic variability in CWANA is to divide the region into ***aridity zones.*** The major aridity zones in CWANA region and their characteristics are shown in table 3:

- *The hyper arid areas*: out of the world's *hyper-arid* area of about 0.9 billion ha, over 86% is in CWANA. Except for irrigated areas such as in Egypt, few groups of nomads live in this zone.

The arid zone: In the arid zone the natural vegetation of short grass and sparse thorn scrub provide a period of grazing for sheep, goats, cattle and camels. One might also find some wildlife, mostly

gazelles and reptiles in this zone. Opportunistic rain cropping of sorghum and pearl millet is practiced in depressions and foothills. Nomadic groups live in this zone which has very low carrying capacity.
The semi-arid zone: The semi-arid zone is distinguished as the zone of both animal and rain-fed husbandry, and, therefore, this ecosystem supports millions of rural people as well as major agricultural industries of the region.
The sub-humid zone: The sub-humid zone contains a variety of luxuriant vegetation types, from Savannah to broken woodland. Productive arable farming is the primary human land use.
There are three more aridity zones but they are marginal in terms of land area comparing to the ones described above. These are:
The coastal zones has various landscapes between the coastal salty marshes of the seas, a series of medium-height hills lying a few kilometers away from the sea, and open plains traversed by rocky sediments. While arid ecosystems dominate these areas, fertile deltas of agricultural value exist.
Swamps: Swamps cover considerable areas in the region. In the Sudan the Sud swamps cover an area of about 12 million hectares. These swamps are inundated either permanently or seasonally. The seasonally inundated parts of the flood plain are vast meadows of almost pure grass, which maintain a large number of livestock.
Mountain meadows occur on shallow soil at the higher altitudes and subjected to high rainfall, high humidity, and low temperatures. The area is rich in varieties of grasses, herbs and trees that vary with altitude up to about 3,500 metres. In some parts of CWANA, Central Asia and the Caucasus, snowfall of 1 to 5 metres takes place. The climate is characterized by a short growing season and long cold winters.

Rangelands occupy about 50% of the area in West Asia. They have low carrying capacity.
Relative humidity plays a vital role in human comfort. Areas close to the coast experience high relative humidity in summer, while other parts of the region experience 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 hyper-arid and arid zones than in the other zones. One of the reasons is that these zones are relatively dry and have vast plains with little vegetation cover over which the wind can blow with unchecked force. These powerful winds erode the soil and lifts clouds of dust thousands of metres into the air. On many days of the year in most of the region the atmosphere is hazy due to the presence of dust.

1.1.3 Water resources

While CWANA covers 15% of the world area, its ***water resources*** are only 2 percent of the total internal renewable water resources of the world (WRI *et al*., 2002), and thereby, it is the most **water-stressed region** in the world. Water availability by CWANA sub-regions 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 rated at 100%. The sub-region has hyper-arid and arid climates with an annual rainfall of less than 100 mm per year. The total available water is about 15 billion m^3/yr. Surface water comprises about 45%, groundwater about 41per cent, desalinization about 12% and agricultural drainage reuse about 2%. Agriculture utilizes about 86% of the available water. Excessive use of groundwater has resulted in sharp declines in groundwater levels and quality deterioration due to seawater intrusion (UNEP, 2002b).

The West Asian sub-region has a water stress index of 83%. The sub-region is mostly arid and semi-arid. The majority of the countries in the sub-region receive less than 250 mm of rain per year. There are two major rivers, the Euphrates and Tigris, which are shared by Turkey, Syria and Iraq. Total available water resources in the region are about 80 billion m^3/ yr (85% surface water, 10% groundwater and 5% agricultural drainage reuse). Agriculture utilizes about 80% of the available water. Effluent, agrochemicals and industrial discharges have seriously affected water quality in the region. CWANA's driest country is Mauritania, where the average annual renewable water resources are less than half billion m^3. Studies indicate that water resources are poorly managed and inefficiently across CWANA. In some areas farmers over-irrigate wheat crops by 20-60%.

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

1.1.4 Status of soils

GLASOD data (UNEP/ISRIC, 1990) show that ***soil degradation*** is widespread in the whole CWANA region. 70% of the degraded soils in North Africa 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 experiences 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 the Sudan. Wind erosion is the most dominant type of soil degradation in the arid zone, while water erosion is dominant in the semi-arid zone.

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

Inefficient use of irrigation water has resulted in **salinization**, alkalization and water logging. More than 50% of the irrigated lands in the Euphrates plains and in Pakistan have been badly affected by salinization and water logging (UNESCWA, 1997). Indeed, Pakistan is among the top five countries in the world that have irrigated land damaged by salinization. About 300 million ha in the CWANA region are affected by soil salinity and alkalinity, nearly 30% of the world saline and alkaline soils (Abrol, *et al.*, 1988). They occur in coastal areas and inland salt-marches. Soil salinity is very 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 south western 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 by mainly 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% of its land surface (Koocheki and Mohalati, 1992). Turkey is seriously affected by water erosion. There are a few areas in Turkey where water erosion is coupled with nutrient depletion and soil salinity.

The Caucasus sub-region is two-thirds desert (the Usturit and Kyzilkum deserts). Soils are commonly salinized. The lowlands are salt accumulation zones and saline soils dominate (Li-yun *et al.,* 1992). Turkmenistan falls within these deserts. There are two large seas, the Caspian and the Aral seas. The Aral Sea is dying because of diversion of input water for agriculture. It shows the most recent example of human-induced environmental degradation in the sub-region (UNEP, 1997). Fortunately, a big portion of Tajikistan is stable under natural conditions. Azerbaijan has varying degrees of water erosion and an extensive area of soil affected by salinity. The eastern portions of the sub-region *i.e*. the whole of Kyrgyzstan suffer varying degrees of water erosion, wind erosion and soil salinization. Surface and gully erosion exacerbate problems of low productivity, further diminishing soil resources, which threatens the future productivity of the land. Water quality can become impaired, which when coupled with high sediment levels, constrains our ability to develop sustainable water resource management. Clearly, actions must be taken on many fronts to develop sustainable solutions and improved management of land and water in CWANA environments.

1.1.5 Agrobiodiversity

Agrobiodiversity or agricultural biodiversity includes all components of biological diversity relevant to food and agriculture. The scope of agricultural biodiversity is defined as follows: “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 micro-organisms, 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 (SBSTTA-05-10). 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 is characterized by a wide range of diversity in terms of climatic, topographic and edaphic environment, genetic diversity of numerous globally important crop species and their wild relatives such as cereals, food legumes, forages, industrial crops, fruit trees and vegetables, and farm animals as well as cultural diversity affecting agriculture. Agriculture began independently in different sites in the region about 12,000 to 11,000 years ago. Then it spread along the Mediterranean (East Mediterranean, North Africa and South Europe), southwards to Egypt and Ethiopian Plateau and eastwards to Central Asia and Indus. Agriculture in CWANA centres upon sheep, goats, cattle, cereals (wheat, barley), and legumes (lentil, pea, vetch), flax, which are early domesticates of Near East (Harlan, 1995). Historical evidence suggests that West Asia and North Africa (WANA) sub-regions 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 genetic diversity necessary for production, orientation and diversification efforts.

Most crops in the Near East were domesticated during the Neolithic period. CWANA is a significant and unique region for plant diversity. Three of the Vavilov's Centre of Origin (i.e., Near Eastern, Mediterranean and Central Asian Centers) extend into the region. This, of course, indicates that CWANA is the one of the centres of origin and/or centre of diversity of several crop plants and many plant species. The wild relatives and landraces of enormous genetic diversity are still found for many of the major crops, including cereals, legumes, industrial crops (fiber and oil crops) pasture and forage plants, fruits and nuts species, and vegetables (Harlan, 1992).

Near Eastern Centres of Diversity (including Jordan, Lebanon, the Palestinian Authority, Syria, southeast Turkey, southern Iran and Iraq extend north eastwards to Caucasus and South to Arab Peninsula) encompass an area of mega diversity of important food crop and pasture species. It is one of the nuclear centres and centre of origin (Vavilov, 1926) where numerous species (notably wheat,

barley, lentil, pea and vetch) of temperate-zone agriculture originated 10,000 years ago (Renfrew, 1969). In Turkey, Harlan (1951) described micro centres for *Amygdalus* spp., *Cucumis melo*, *C. sativus*, *Cucurbita moshata*, *C. 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*. Many fruit trees such as almond, olive and pistachio also originated from this region and have dominated its traditional agricultural systems. They are diverse range of wild relatives and local varieties. The biodiversity in this region is most outstanding for the within-species genetic diversity and the high number of endemic species. Furthermore, the indigenous crops and food plants of the Near East region are known for their resistance to diseases and abiotic stresses, making them a valuable source of genetic material for germplasm enhancement upon which global food security depends.

Central Asia is also one of the important centres of diversity of cultivated plants, and the richest in specific and intraspecific diversity for many globally important agricultural crops. Agriculture must have reached this centre from Near Eastern Region about 5000 BC (Zeven and de Wet, 1982). Major crops of this region include fruits like apples, apricots, peaches, pears, plums, grapes, almonds, pistachios, pomegranates and figs; cereals (wheat, barley, rice, maize, sorghum), food legumes (beans, chickpea), vegetables (tomato, potato, onion, garlic, coriander), melons, industrial, and stimulant crops (cotton, sugar beet, groundnut, sesame, tobacco) are cultivated in the region.

1.1.6 Climate change

The vulnerability of CWANA to rainfall variability and drought incidents is compounded by the anticipated impacts of ***global climate change***. Dry lands, CWANA included, are net sources of ***CO_2*** (Sombroek, 1995) due to over-utilization of plant resources. Annual CO_2 emissions of CWANA total about 1.8 billion metric tones - about 7.8% of the world's emissions. Inventories of greenhouse gasses emissions show that most of the emissions in the majority of the CWANA countries are due to fossil fuel burning. In Sudan and Somalia CO_2 emissions can be correlated to changes in land use, particularly deforestation. CO_2 sequestration opportunities are available via better soil management. In some Central Asian countries almost half of the emitted CO_2 was absorbed (90 million metric tones) by changes in land use (WRI et al., 2002). Among the atmospheric pollutions caused by human activities in the Region are those related to oil production and export, fertilizers and cement factories and motor vehicles.

Seasonal sand and dust storms contribute to air pollution in the region. EPA (1996) estimates an annual dust fall out of about 1,000 tonnes/km^2 along the coast area of Kuwait. The dust storms absorb pollutants such as pesticides and can transport them long distances. Trans-boundary air pollution is an emerging issue in the region.

One example is about the effects of climate change on the Nile Delta.

Insert Box 1

Another example is about the impact of Climate Change on Environment.

Insert Box 2.

1.1.7. Geo-economics

Agricultural imports constitute approximately one-fourth of CWANA's total merchandise imports, reflecting the region's vulnerability to food insecurity. Between 1991and 1996, 15 countries displayed 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 with disregard of the future and posterity. Extending cultivation to marginal and sub-marginal lands, overgrazing of village commons (common property resources) and indiscriminate cutting of vegetation of fodder and fuel are the easiest options. Farmers depend on subsistence farming to eke livelihoods on a fragile resource base, accelerating the process of desertification in many countries. If the cycle goes on without suitable interventions, the process may no longer be reversible.

CWANA countries with respect to their per-capita GDP (low income < US$ 1500, medium-income > US$ 1500 and < US$ 6000, high-income > US$ 6000) can be classified as follows: All the Central Asian and Caucuses countries (8 countries) are low-income countries, followed by all the Nile Valley and the Red Sea countries (6 countries). In the North African sub-region 4 are classified as low-income, and one (Libya) is classified as a high-income country. In West Asia, 3 countries are classified as low-income, and 3 as medium-income. As for the Arabian Peninsula, all 6 countries are classified as high-income countries. The greater majority (88%) of the high-income countries are the oil-producing and exporting countries, representing about 4% of CWANA's population. 63% of the CWANA countries are classified as low-income countries with 85% of the of the region's total population. Table 1.4 provides further economic indicators for the Arab countries. Table 5 explores the situation of Arab countries with respect to economic indicators by country.

Though agriculture is a major employer in the CWANA countries (50% of the labor force), its share in the GDP is only 13%. Such share is lowest in the region's high-income countries (3%) and can go up to 60-80% of the GDP in some low-income CWANA countries (Rodriguez, 1997).

CWANA countries may be classified in three types (Table 1.6): Countries with the share of agriculture in GDP less than 10%: mostly the Gulf countries. Natural resources are scarce and agriculture is not developed because of this constraint. This is why countries such as UAE and Saudi Arabia have to import staple products. But those countries are rich because of their oil income and there is no

problem in importing staple products. They do not really need to increase their agricultural production although in case of political crisis, the food weapon could be used against them. The case is different for Jordan and Djibouti: agriculture is limited because of natural resource scarcity, they have to import staple products but they do not have oil wealth.

Agriculture remains important in countries with the share of agriculture in GDP between 10 and 20%. Nevertheless, most of these countries are dependant upon imports of staple products. It means that a high percentage of labor in these countries is still employed in agriculture and that the population density is high compared to the agricultural production. This discrepancy is due to natural resources scarcity but also to the unequal access to resources as well as to the low productivity of labor. Countries as Iran and Algeria can afford imported staple products because of the oil income. Morocco, Egypt, Tunisia and Yemen are in a different situation as they do not have oil. The share of agriculture in GDP in the case of Lebanon is also between 10 and 20% because agriculture industry is still important. Farmers have got access to resources (land and water) and farms are family owned. Lebanon is not dependant on imports for major staple products. Although population has increased over the last 30 years, migration has been regulating the equilibrium between resources and population density in that case. The Caucuses countries, though with the share of agriculture more than 20% of the GDP, are still dependant on imports of major staple food as land tenure is still uncertain and not secure.

Among the low-income countries, per capita accessibility to arable land is about one hectare, of which 40% is irrigated and 60% is rain-fed. The estimated daily income of an average farming family is about US$ 2.82 (Rodriguez and Thomas, 1998).

1.1.8. Ability to save

The marginal propensity to consume is high among poor household i.e. their marginal propensity to save is zero or minus (dis-saving). At the national level, the national saving rate induces level investment otherwise the nation has to borrow (dissaving).

There is a discrepancy between countries in terms of national saving rates as shown in Table 1.7. The national local saving was high in Jordan (24.4%) in 2001 due to 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 (World Bank, ????) . Syria achieved the highest rate of local saving (30%) in all Arab countries in 2002.

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 twenty percent in Kuwait, Jordan, Morocco, Egypt

and Tunisia and varied from 19% to 17% in Bahrain, Oman, Yemen and Syria, and was less than 10% in Lebanon in 2003 (Table 1.4).

Total Arab external investment is around $1400 billions. Almost half of this is Saudi Arabian investment, and the other half comprises almost all the other OPEC Arab countries. This investment is either direct investment or in bonds and stocks. Foreign investment in Arab countries was estimated by about $8616 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, the country will be able to invest without borrowing or need of external investment which will lead to a high economic growth rate.

The highest mean of annual real growth rate of gross domestic product (GDP) (IMF, 2005) was 9.9% in Qatar in 2004. While Kuwait and Sudan achieved the second highest annual real growth rate of 7.2% GDP for each country in 2004. Lebanon, Bahrain, Saudi Arabia and Mauritania had real growth rate of around 5% GDP in 2004. The rest of the countries in the Arab region has a real growth rate around 2.0 to 3.0% (Table 1.5). Some of the Arab countries rely on their own funds; others require loans. Lebanon has the highest level of debt. The informal economy system is not counted in GDP.

1.1.9 Geo-politics

The CWANA region is subject to several geo-political disputes. A key example is about a shared sea among some Central Asian countries. The Aral Sea.

Insert Box 3.

1.2 Wellbeing

1.2.1 Demography

The management strategy of a government towards its environment and to economic planning depends on its perception of the resources it has available and the changes which are likely to occur in the future. As resources use is linked to people, an understanding of population change is a crucial aspect of any planning. The spread of health care and simple hygiene precautions followed the end of the World War II. Infant mortality went down and life expectancy went up. The net effect was rapid population growth. By the turn of the 20th century, the population of CWANA was estimated at 710 million, about 12% of the world population.

Population growth rates vary among CWANA sub-regions and among countries. During the twentieth century, the populations of Turkey, Egypt and Iran more than quadrupled. Table 1.8 shows discrepancies between countries and sub regions in terms of population growth rate.

The Arabian Peninsula, West Asia and the Caucasus have the highest ***life expectancy*** at birth of 73.3, 67.7, and 67.5 years, respectively. 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 7.6 in Yemen, 7.2 in Oman, and 6.9 in Afghanistan. The percentage of population in the 15 to 65 year age group varies among member countries. In Ethiopia and Eritrea it is around 50%, in the UAE around 69.4%, Turkey 66% (WRI, 2002).

The percentage of the population with access to ***potable water*** varies from as low as 12% in Afghanistan to as high as 98% in Tunisia, 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 urban population has access to safe drinking water, while only 18% of the rural population enjoys safe drinking water. In Tunisia the situation is much better. Safe drinking water is provided to 100% of the urban population and 95% of the rural population. Fairly high percentages of both the urban and rural population in Syria, Saudi Arabia, Pakistan, Lebanon, Iran and Algeria have access to safe drinking water. The percentage of the populations with adequate sanitation*, for some of the CWANA region countries,* is shown in Table 1.9. It is rated high for some countries as Algeria and very low for some countries as Pakistan.

1.2.2. Health indicators

Infant birth-weight provides an indicator of nutritional status. The percentage of low-birth-weight infants varies in the CWANA region (Table 1.10). High infant mortality rates of 92 to 154 per 1000 live birth are recorded in Mauritania and Afghanistan. These rates are almost twice the average rate of the world (57 per 1000 live birth). The majority of the remaining countries in the CWANA region had values lower than the world average.

In a recent publication, “The State of Food Insecurity in the World 2006”, the Food and Agriculture Organization reviewed progresses and setbacks in hunger reduction around the world since 1990–92 as the established baseline period (FAO, 2006). Taking the prevalence of undernourishment as an indicator, the report shows that the Near East and North Africa are the only sub-regions in which both the number and proportion of undernourished have risen since 1990–92, albeit from a relatively low base. The absolute number of undernourished is the smallest of all the developing country regions. It is following the significant reduction in the numbers of undernourished achieved during the 1970s. Undernourishment is expected to increase in the Near East and North Africa by 2015.

Among countries of the region, (excluding Afghanistan and Iraq, for which available data are tenuous)[1], only Tajikistan and Yemen recorded very high levels of food insecurity in 2001-2003: an estimated 61 percent of the population of Tajikistan suffered undernourishment, and more than one third of the Yemeni population was chronically undernourished. In the remaining countries, except Armenia, Sudan, Uzbekistan and Pakistan who are facing the most serious food insecurity problems, the prevalence of undernourishment lies below 10 percent. Ten CWANA countries, such as Jordan and Morocco, are showing an increase in both prevalence and in absolute number of undernourished people between the baseline period and 2001-2003. The most alarming figures are found in Kazakhstan and Uzbekistan, where both the proportion and the number of the undernourished have increased by more than seven folds and four folds, respectively.

On the other hand, twelve other CWANA countries, such as Syria and Egypt, have succeeded in reducing the prevalence of the undernourished in 2001-2003 in comparison to the baseline period. However, only four countries in the region are on track towards achieving the MDG target. The most successful are Kyrgyzstan and Kuwait, both of which, starting from a relatively high prevalence of hunger, have cut the number of undernourished by at least two thirds. **Armenia**, which in 1993–95 had the highest prevalence of undernourishment (52 percent) in the region, has already halved its number of hungry people, but at 29 percent of the population the prevalence remains disturbingly high.

1.2.3. Employment and unemployment

Unemployment rates reached about 29.8% in Algeria, 14.9% in Tunisia, 15.5% in Jordan, around 11.6% in Morocco, Syria and Yemen, and 9.2% in Egypt in 1999 –2001 (Table 1.5). An increase in unemployment levels in households will increase the dependency ratio. It may encourage the use of child labor, increase of poverty, and increase in inequality of income distribution. In Arab countries, children under age of 15 constitute about 40% or more of the population, which increases the dependency ratio and in future might speed the rate of growth of population unless it is controlled. Landless and nearly landless people are not necessary poor, as off-farm income can compensate for their daily food and non-food needs. Non-farm income such as salaries and wages may be offset decreasing sources of income from the land. Internal and external migrations of unskilled labors seeking for work, fluctuate according to oil prices. The lessening in demand for unskilled labor in Arab countries particularly affects poor households. Also crises such as the tourism crisis in Egypt in 1997 affect poor households, in this case in Red Sea and Upper Egypt (IMF, 2005).

[1] Data from the following individual states: Iraq, Afghanistan, Palestine, Djibouti, Somalia, Bahrain, Oman and Qatar were unavailable in the FAO report

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

Most inflation rates in Arab countries were moderate or low except in Egypt (8.1%) and Yemen (12.5%) in 2004. Inflation rates have negative effect on stable incomes like salaries, wages and pensions. Consequently, inflation will increase poverty and inequality in income distribution in Arab countries (Tables 1.4 and 1.5 above). Inflation is either caused from cost-pull inflation or demand-pull inflation, but on either ways poor and low middle class incomes will be more affected. Also economic reforms applied in the region usually cause increase in inflation especially at the beginning. According to data from IMF, collected from Arab governments showed that the inflation rate in Algeria was about 38% in 2002 and around 19.5% in Morocco in 2001 and at least 10.4% in Egypt in 2003.

1.2.4. Food security

The definition of food security according to Food and Agriculture Organization (FAO) is the availability, accessibility, safety and sustainability of food. The definition of food security according to Arab Organization of Agricultural Development (AOAD) is the same as the FAO definition, but the Arab Organization added first self- sufficiency between Arab countries, then from the rest of the world.

The self sufficiency ratio is not a measure for food security if the country is capable of importing foods. The most important factor is the availability of foreign currency to import the 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 auto-consumption and the price of factors of production.

Arab countries imported food for about $18.5 billion in 2003 and reached around $20 billion per year. If this amount of money is used for investment in production, marketing and manufacturing of food in Arab countries, the total cost might be less than $20 billion. The investment should be distributed in each country according to their comparative advantages with the continuity of intra-Arab trade. [Nasser 2006]

In high and high moderate groups of per capita share of GDP (7 countries), food production is almost low or zero especially in grains, legumes, sugar, oil and fats and milk and dairy products in 2003. While the other low moderate and low groups of per capita share of GDP have better self sufficiency

ratios in most of food groups except Djibouti which produces only some meat and fish and zero elsewhere in the food groups.

Arab countries are net importers of food. Nearly 68.1% of the net quantity imported of food was grain, about 15.0% was milk and dairy products, 7.7% was sugar, and 4.1% was oil and fats, while the rest was 5.1% of group foods in 2003 (Figure 1.2).

The food gap in the Arab region ranged between 42.0% and 51.4% in the period of 1993 – 1997. But because of the increase of population and other variables, food gap increased and ranged between 56.2% and 71.1% in years 1998 – 2003 i.e. the Arabs are relying more on other countries to feed their growing population (Figure 1.3). Sudan adopted a severe economic reform (ERSAP) since 1992. While real GDP growth rate increased and the economy started to improve poverty increased because of the Kuzent's effect, civil war and reduction of foreign aid. But due to the discovery of oil and prevalence of peace in parts of the country, economic situation improved and might reduce poverty and inequality of income distribution.

Sudan has abundant of mineral, human resources and agricultural land (about 46% of all agricultural land in the Arab area). Agriculture represented 18.1% in the GDP and large share of export and the work of 80% of the population, but the highest share of GDP was services, which is almost non-tradable services (72.8% of GDP) in 2002. The industrial sector including agri-industries achieved a high growth rate and reached around 23.1%. Industry is held by private and public sectors in Sudan, with government monopoly of some agri-products in production and marketing areas.

Sudan is almost self-sufficient in food groups. Sudan could be the food basket to all Arab countries. But there is a link between abundances of natural resources and poor growth [Fatah 2000]. Also there is a lack of institutions for marketing and financing and lack of infrastructure. These factors lead to low endowments factors and low performance. This situation is not only in Sudan, it 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. But more than half of the working members in rural areas migrated, consequently agricultural production declined. Also, government expenditure was mainly on defense and security and loans repayment. Consequently government expenditure on health, education and other social services was limited. [Mahran, ????].
There is protein gap in Libya, although there is natural feed sources, but because of drought and over-grazing, the government built 11 concentrated feed factories. Their capacity was about 963.6 thousand tons per year. But their actual production reached only around 367 thousand tons in 2003.

About 92% of the ingredients were imported, besides, the factories were not working with full capacity, therefore, prices of locally produced concentrated feed were higher and less in quality than the imported feed (Aldiak and Ahmed, 2005).

1.3. Status of agriculture

1.3.1. Agricultural livelihood strategies

1.3.1.1. Production systems

The majority of the CWANA population lives in hyper-arid to semi-arid zones. Population densities are generally less than 1/km^2 in the hyper-arid zone (except in Egypt), below 5/km^2 in the arid zone, and about 10/km^2 in the semi-arid zone. Approximately 72% of the population depends on agriculture, 7% on livestock and 21% on the urban areas for their livelihoods. Rural people living in CWANA can be roughly classified into nomadic, semi-nomadic, 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 distribution of rainfall, they migrate in search of pastures and water for their animals. Semi-nomadic people are also found in pastoral groups which depend largely on livestock and practice agricultural cultivation at a base camp, where they return for varying periods of time. Transhumant populations combine farming and livestock production during favorable seasons, but seasonally they might migrate along regular routes when forage for grazing diminishes in the farming area. Sedentary farmers practice rain-fed or irrigated agriculture.

Land use practices are often a form of agroforestry or in case of western Sudan where gum arabic tree *Acacia senegal* is cultivated along with sorghum/millet and raising small ruminants it is agrosilvo-pastoral in structure and function. In practice there is often little distinction between a farmer and a pastoralist. People living in dryland environments generally take into account the limitations of the local conditions they confront and adapt to whatever land use is suitable and feasible in seeking their livelihood. However, the delicate balance that is achieved through traditional forms of farming and livestock production is easily upset; this is shown by a general deterioration of grazing lands in dryland regions. A main cause of this deterioration - often referred to as desertification in its most severe form - is the over-population of people and their livestock coupled with the deregulation in access and use of natural resources (rangelands, forests, land etc.) where 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 quite diverse (Table 1.11). The indicator for assessing their productivities is the population density: the most productive systems are the ones able to nourish or to provide livelihoods to a large number of people. The biggest portion of

the area is covered by the less productive systems, the pastoral farming system and the sparse farming system (85% of the area of the region): the first one carries a population density of 3 inhabitants per square kilometre and the second one carries a population density of 6 inhabitants per square kilometre.

It means that the most productive agriculture is concentrated in a very small area (15% of the total area). This is due to the resource scarcity, mainly land and water.
The population density in the first production system described (large scale irrigated sub system) is the highest. The total cultivated area in those systems is irrigated. It means that in the Middle East and North Africa, irrigation is one of the ways for intensification. But there are others. We have also high population densities for the two systems 'highland mixed farming system' and 'rain-fed mixed farming system'. In these systems, there are family owned farms and there is integration between agriculture and livestock which is essential for income diversification and soil fertility management. In addition, those systems are quite diversified as they integrate cereal and legume cropping; fruit tree cropping, fodder cropping and livestock. Those systems are productive because of the availability of natural resources: soils, rainfall.

Obviously resource scarcity is determining the level of productivity of each system as well as natural resource management. There are two major elements that should be looked at if the aim is the intensification of agriculture in this region:

- Availability of natural resources and,
- Access and control of these natural resources.

As mentioned above, a large part of the land in the Middle Eastern and North African region is located in arid and semi-arid regions characterized by water scarcity. In the arid zone reliable agriculture is possible through irrigation and nomadism. Rain-fed agriculture is widespread in the semi-arid zone. Percentage of irrigated area with respect to cultivated area and type of land and water management for each of the major production systems is shown in Table 1.12.

As water resources are scarce, irrigation efficiency is one of the main indicators to consider. It is quite low and rarely exceeds 50%.Production systems might be intensified by improving irrigation efficiency through a better resource management and through introduction of new technical innovations especially irrigation water saving techniques. Table 1.13 shows irrigated area with respect to cultivated area and irrigation efficiency.

1.3.1.1.2. Major production systems in Central Asia

In Central Asia, there are many countries from the former Soviet Union except. In the countries from the former Soviet unions, there are a lot of land issues. The transition in terms of land allocation and land reform and restructuring as well as the transition to open markets has not been achieved yet. Land issues have negative effects on production systems. The main production systems Central Asia are shown in Table 1.11. The most productive production systems 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/wheat farming system. These are due to the introduction of high yielding varieties, mechanization and use of agrochemicals products, which has boosted agricultural production. As shown in Table 1.13, the level of intensification of these two systems is very high as the ratio of irrigated area to the total cultivated area is very important. 86% of the cultivated area is irrigated with population density of about 40 inhabitants per square kilometer.

As for the sub region of the Middle East and North Africa, we have been focusing on the two major elements that seem to determine agricultural production and therefore food security: land and water. The percentages of irrigated area towards cultivated area as well as the type of land and water management are shown in table 1.13. There is a scope for extending irrigated area and therefore agricultural production especially in Turkey. All conditions are set, socially and economically to boost up the agricultural production in that country and among them, the political will, water resources, water resource management policies and irrigation projects as the GAP project ?. There is very limited potential to extend irrigated area in Pakistan and Afghanistan as water resources are decreasing (especially ground water resources). Intensification of agricultural production may then occur by introducing new techniques of water resource management (storage, water saving practices). Although, the share of irrigated areas towards 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 it has been done in the past. Nevertheless, cultivated areas can be extended through mostly rain-fed and small-scale irrigation. To have sustainable agricultural production, land tenancy should be secured and farmers should access and control their land use.

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 in the statistics whilst 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 farmers' work in the field. Among the factors that diversify contributions to agriculture are agricultural production systems (some of them are 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; ethnic, religious, cultural and social norms. Despite these variations some common trends in the CWANA region can be detected.

Women' contribution to agricultural work is important as shown in Table 1.14. The involvement of women in agriculture may put strains on her domestic duties including child rearing, housekeeping, cleaning, cooking, and fetching water and fuel and fuel wood. Women contribution to agricultural labour varies from 28% to 70% (Table 1.14). This can be related, among other things, to the growing number of female-headed households due to male out-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 since revenues from migrated relatives are often not sufficient for survival. In Syria women, particularly from low-income households, constitute a large share of seasonal agricultural workers (FAO 2003) and the highest rates of participation are found in the age bracket 15-24 (Ramsis Farah 1999). In the 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 half of the men's wages (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 perform mainly manual, time consuming and labor intensive work on the farm, while 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 post-harvest operations such as threshing, selecting, and storing. Men's work in crop production is mainly preparing the land, irrigating, spraying, mechanical harvesting, and marketing the produce. Duties connected to livestock rearing differ by animal and mainly women take care of small livestock. Herding and marketing are generally male duties. Fishery and agroforestry are mainly male tasks. In Egypt fisheries and fish marketing are primarily men's tasks while more than half of the labour in fish processing is performed by women who also contribute in net-making, maintenance and repair (FAO 1996). Despite their substantial agricultural work, women have a limited control and ownership of resources and revenues (Table 1.16). Statistics about assets entitlement and access are scanty and rarely gender-disaggregated.

Generally, women's owned plots are smaller than men's. In Syria 7% of women own animals and 1% own agricultural machinery (FAO website). According to the CEDAW report in Yemen female farmers do not control land, water, agricultural equipment, credits and capitals (CEDAW Yemen).

Some critics have highlighted the reasons for the under-representation of women's involvement in agricultural work particularly in Muslim countries (El-Fattal 1996). These are, they hold, the associations of women with domestic spaces to the exclusion of outdoor activities such as work in the

fields; association of agricultural work with wage labor while women are mainly in the un-paid sector; and association of farmers with plot holders while women work in the fields but are rarely landowners. In many land and agrarian reforms, there has been an increased concentration of property entitlements, access and control in the hands of the male heads of households as well as assigned access to men to basic agricultural resources such as water, seeds, and fertilizers, distributed by governmental agencies. Lacking control over, and entitlement to, production means and sources 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 impacts on their control of revenues and decision making power.

The increasing number of female headed households, visible in many countries of the CWANA, seems to correspond to an increase in women's workload and a decrease in their independence. But in some cases, women get empowered because of men' absence. They participate in decision making at least by managing small budgets, their mobility is increased as they sometimes go to the market to sell their products even if they still rely on male relatives for major decisions such as the sale of an animal (cow, veal…..) (CNEA, 1996). The feminization of agricultural labor increased the rates of women's work in the unpaid and informal systems and their employment in the wage labor sector still characterized by gender-based wage differentials, precariousness, and lack of social services thus also vulnerability. The increase in household workload involves also children who contribute their share to the detriment of 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 male users limiting, together with social biases, women's and children's access to technological improvements. In Syria, the introduction of agricultural technology from the 1960s often increased women's and children's drudgery by strengthening the gender division of labor that assigned the mechanized work to men only leaving the manual one to women and children.
An example is the feminization of agriculture in Darfur.

Insert Box 4.

1.3.2. Agricultural land use

A detailed examination of the aridity zones in CWANA demonstrates that over 4 million km^2 of land in CWANA is available for good cropping and animal husbandry (Figures 4, 5 and 6). Table 1.17 shows land use in CWANA by sub-regions. The greatest portion of land use is under permanent pasture (550 million ha). Cropland and forests and woodlands are 141 and 124 million ha, respectively. The majority of the permanent pastures and forests and woodlands are in the Nile Valley (in Sudan and

Somalia). Central Asia and North Africa are also rich in croplands and permanent pastures. Taking population data likewise from WRI et al. (1998) the following figures for croplands per capita have been calculated. By 2025, the lowest per capita croplands - less than one-tenth of a hectare - will be in the Arabian Peninsula and the Nile Valley. It is important to note that there is great disparity in cropland per capita between countries within a sub-region. For example, cropland per capita in Sudan is eight times higher than in Egypt (0.448 and 0.053). These values are expected to be reduced to 0.0313 for Egypt and to 0.277 for Sudan by the year 2025, if current trends of population growth and land degradation continue.

There has been no appreciable overall increase in croplands during the last three decades . However, Table 1.18 shows that cereal production increased slowly in North Africa by about 50% between 1975 and 2005. In Central Asia, there was an appreciable increase in cereal production up to 1990, but since then production has fallen sharply, dropping back to the 1975 figure by 2005. In the Arabian Peninsula cereal production increased steadily and peaked in 1990 to three-fold of that of 1975 production, but it has now dropped to two-fold of that of 1975. Cereal production in Mashreq (Jordan, Syria, Iraq and Lebanon) performed well between 1980 and 1995, but dropped to about 130% of the 1975 level

Sustainable land use is a challenge to all people living in dry land environments. Problems faced by people in CWANA include desertification, inadequate knowledge of more productive land-use practices, political marginalization, and low levels of investment. However, people can also confront major problems in attempting to attain a level of sustainable land use because of their inadequate knowledge of alternative land use practices. Many people observe a ‘tradition’ in agriculture that is not always matched by a similar traditional approach toward other land uses such as forestry, wildlife ranching, or ecotourism, all of which have become profitable enterprises in many dryland regions of the world. This lack of appreciation can be a barrier to the initiation of innovation in land use, especially on marginal agricultural lands. Such barriers are often overcome through farmer education, extension services, and, most of all, through demonstrating the benefits obtained through more diversified land-use activities.

The dry lands of the region suffer from the vicious cycle of low productivity, low levels of investment, and, as a result, poverty. Investments, apart from those made for irrigated agriculture activities, are relatively low. Low productivity, low levels of investment, and land degradation often leading to desertification are responsible for regional poverty and income disparities. The poverty and hunger prevalent in some CWANA countries like Sudan are poignant example of this situation. Other critical problems include the inherent problems of water scarcity, tenure considerations, and ineffective developmental policies. Improving this situation requires that a variety of technical and institutional

problems be solved. An example would be increasing the level of investments 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 levels of income.

As noted, the CWANA region is climatically diverse, falling mainly with hyper-arid, arid and semi-arid zones. The region experiences a high degree of variability and uncertainty in climatic conditions. Climatic variability and associated floods and droughts result in increased risks of crop failure and hence reduced food security. While precipitation in many CWANA countries averages between 200-500 mm/yr, which is suitable for some crops, the extreme fluctuation in precipitation from year to year make such averages of little use. The implication is that we cannot depend upon average precipitation values for planning agricultural and natural resource development, or for planning urban expansion. As a result of low and erratic precipitation in the dry lands, ephemeral or intermittent streams are the norm rather than perennial streams. Flash floods due to high-intensity rainfall are highly variable across the landscape and are common in many of the CWANA countries. It is not uncommon for dry stream channels to become torrents within hours of convective storms that may have occurred several kilometers upstream.

Land use and water are inextricably linked together, but are not often managed in concert with one another. Watershed management offers the framework for achieving this integrated management approach to increase or sustain food and natural resource production while protecting the soil and water resources upon which this productive capacity depends (Brooks *et al.* 1997). Implicit in this approach is the recognition that land use in uplands affects the flow and quality of water reaching downstream areas; in contrast, water resource development (*e.g.* reservoirs, canals, and others) 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 the institutions and organizational arrangements needed to achieve the integration and inter-sectoral cooperation upon which implementation depends (Kundzewicz, 1997). Understanding and coping with the linkages 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 region, we must recognize and be able to work with the variable and often unpredictable precipitation and water yield characteristics that typify these regions.

Soil erosion reduces the productivity of upland watersheds and the resultant sediment that reaches stream channels can adversely impact reservoirs, water conveyance systems, and water quality in downstream riparian corridors. This issue is one of the typical environmental problems of the

downstream countries of the Nile valley. However, soil erosion in the highlands could be interpreted as a 'good thing' for lowland agriculture, as a source of nutrients. For example, the annual flooding of the Nile in Egypt was the basis for productive agriculture, which has been disrupted by the Aswan High dam.

In all dry lands under intensive use, some common issues and problems arise that need to be addressed through management. Foremost, dry lands have commonly been viewed in the past 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 is often used to describe areas that have become desert-like in their appearance as a result of human-induced degradation. To some extent, emerging programs to combat desertification have helped generate the political, economic and technical support that is needed to reverse land degradation. However, there are certain inherent characteristics of dry lands that place limits on the potential for agricultural, natural resource and urban development. There are also conditions that make watersheds vulnerable to degradation, and that constrain our ability to restore or rehabilitate the land.

1.3.3. Livestock and fisheries

For many livestock owners in CWANA region, livestock is a sign of wealth and social prestige. Therefore, herd number counts more than herd quality. Livestock husbandry is mainly on natural pastures and extensive nomadic grazing. Most of these pastures are of poor quality due to frequent droughts and overgrazing. The number of cattle in the region goes up to 124 million heads constituting about 9% of the world cattle. Sheep, goats and camels number about 320 million heads (30% of the world total), 189 million (23% of the world total), and 14 million heads (68% of the world total), respectively. 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 heads), Pakistan (83 million heads), and Iran (81 million heads). Camels are mostly in Somalia (7 million heads), Sudan (3 million heads) and Mauritania (1.4 million heads). Buffaloes total about 31 million heads, which reach 18% of the world total. Over 80% of CWANA's buffaloes are in Pakistan, and 13% are in Egypt (FAOSTAT, 2007).

Annual meat production from livestock in CWANA is estimated at 6.5 million tonnes (55% from cattle and buffaloes, and the rest from small ruminants). CWANA consumes about 24% of the world meat from small ruminants. 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 (FAOSTAT, 2007). The biggest producer of meat in the region in 2003 was Pakistan (1.89 million

tonnes) followed by Iran (1.6 million tonnes), Egypt (1.45 million tonnes) and Turkey (1.35 million tonnes). Buffaloes total about 31 million heads, which reach 18% of the world total.
Fish catch in CWANA was 1.3 million tonnes in 2002, Egypt caught half of that amount followed almost equally by Pakistan and Iran, and each caught about 17% of CWANA catch. Egypt and Pakistan got their fish mostly from freshwater, while Iran got its fish equally from freshwater and marine (FAOSTAT, 2007).

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. The development of water resources is thought to spread the burden of livestock over a wider area and in this way would reduce overgrazing. This approach 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 system was the next to be tried. Three land tenure systems were progressively established in the Region following independence from foreign rules. These are: 1) government lands that are not subject to any public use; 2) government lands subject to public use such as tribe or village or group of individuals; and 3) private lands registered in the name of individuals. Most CWANA countries have established state ownership of rangelands during the 20th century. The rangelands of Sudan, Syria, Iran, Jordan and Algeria, to mention a few, were considered government properties, with the recognition of tribal rights to use these rangelands. On the other hand, Tunisia and Morocco recognized and established the collective properties of tribes to the land as early as 1918, but soon after its independence, Tunisia opted to promote privatization of common land. Some of these reforms were accompanied by measures to promote the settlement of nomadic pastoralists; as well as to improve rangeland management by limiting stocking rate, establishing reserves, and banning the cultivation and uprooting of shrubs in the rangelands (Nedjraoui, 2001). This led to a clash of interests and the measures could not be applied.

The next step to be tried was to organize pastoralists in order to sustainably utilize common property-rangelands. These were state ownership and state driven cooperatives, herder-driven community cooperatives, community-based cooperatives, and co-management of community rangelands. Governments have also developed roads to facilitate herd mobility and access to markets. Road expansion and improved transportation have subjected areas high in biodiversity and in good range condition to high levels of grazing pressure never before experienced, overgrazing pastures near the most popular routes.

To help herders reduce the drought losses, governments through the WANA region have introduced drought management policies, such as feed subsidies and credit rescheduling. While these

interventions have succeed in protecting incomes of the producers in drought years, they introduced a bias in livestock producer reaction in those periods to keep livestock numbers high leading to the acceleration of the rangeland degradation (Hazell et al., 2001). Effectively, this protection net undermined the process of adjusting flock size to annual climatic variation resulting in herd size increase. In parallel, because subsidizing agricultural inputs such as fuel or equipment (tractors) was not restricted geographically, these policies favored crop-encroachment in pastoral areas (Pratt et al., 1997).

After several decades of rangeland management through the promotion of rehabilitation measures (plantation of shrubs and cactus; grazing prevention), most experts agree to say that rangelands are continuously degrading and solutions should rely on institutional changes, and on tenure reforms. Approaches promoting the devolution of natural resource management to local communities or the 'co-management' of the resources under the regime of common property rights are relatively new in the region. Implications of such initiatives have not been discussed extensively (Dutilly-Diane, 2006). In the Sudan, it was recommended in the mid-1950s that rangelands had to be allocated and registered to tribal owners. This recommendation was considered crucial, because until individuals or groups knew that 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

85% of the CWANA land area is considered deserts and dry lands susceptible to desertification. 70% of the region's agricultural areas are arid or semi-arid, and only 35 % of the region's land are cultivable. During the last 20 years many CWANA countries have suffered long-term droughts, with varying degrees of impacts. These countries were 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 the CWANA region. It has affected wide areas of range lands. Soil erosion in excess of 20 tonnes/ha/yr is common in many areas. There is a close correlation between the dry lands and the locations 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, over-cutting of fuel-wood and trees, and other excessive uses of the land and natural resources by people as well as 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 as a result. Drought, overgrazing, clearance of woody species and tillage are the principal causes of rangeland degradation (Figure 4). In North Africa up to 90% of the area is affected by desertification (UNEP, 1997).

In terms of soils, major key issues are soil degradation through water erosion and wind erosion and nutrient loss. Salinization as well as water logging and alkalization are major issues in irrigated areas, especially large scale irrigated schemes. .

1.4.2. Population growth and demography

The population of the CWANA region will be about 1.2 billion by 2025 and expected to reach 1.6 billion (17% of the world population) by the year 2050. The population is becoming rapidly 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% (WRI *et al*., 2002).

1.4.3. Water scarcity and its implication on agricultural production systems

Scarcity of water is the chief challenge to agricultural development in almost all CWANA countries. Fresh water scarcity threatens the 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. Climate change

According to the IPCC, the CWANA region is among the most vulnerable regions in the world in terms of 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, there is uncertainty over the consequences of global climate change on agriculture and ecosystems. The most likely impact, based on various simulation models, is adverse consequences for the semi-arid zone of CWANA. These models show that a doubling of CO_2 concentration in the atmosphere will induce the following:

In West Asia and the Arabian Peninsula sub-regions temperatures are projected to increase by approximately 4 ^{o}C. Rainfall and soil moisture will decrease.
In the Central Asian sub-region 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, highly varied precipitation changes and a general decreases in soil moisture (Williams and Balling, 1994).

In North Africa and the Nile Valley and the Red Sea sub-regions grain yields are projected to decrease diminishing further food security. Desertification will be exacerbated by reductions in average annual rainfall and increased evapo transpiration. Significant extinctions in plant and animal species are projected with important effects on rural livelihoods (UNEP, 2002b).
The type of climate change expected will have a major impact on dry land soils, where most of the salinization processes will occur. These soils are inherently vulnerable to degradation processes, since they have low levels of 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.

1.4.5. Land and water access, tenure and management

Land and water access is much differentiated in the CWANA region and generally unequal. Very few countries have conducted land reforms in the past. Turkey is the only country where a land reform has occurred in 1945. Major measures have been applied under the rule of Mustafa Kemal in 1926: the tithe has been abolished in 1925 and the former tenures located on the state owned land have been given to farmers (Dufumier, 2004). A land reform has been conducted in Syria in the North Eastern region (Deir Ezzor and Rakka) in irrigated areas : although many problems arose after the Syrian government distributed the land to farmers, the access to land was more or less equal. It created the basis for production.
In the case of Algeria and of the former Soviet Union republics, the transition to a market economy is not accomplished yet and land regime is still uncertain as the former state owned farms have completely disappeared and as conditions to access to land property are not very clear.
In many countries, a capital intensive model of agricultural development has been adopted (Morocco, Tunisia, Jordan) 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.

1.4.6. Infrastructures and financing for agricultural development

The capitalistic model mentioned above has spread in many countries thanks to the development of infrastructures. There are discrepancies in terms of infrastructure within the CWANA region. In countries where there has been adoption of market oriented agriculture, infrastructure has been improved although there are still pockets of subsistence farming. In countries as Syria, where agricultural policies were set to lead to self sufficiency, roads and highways are linking production areas to the major marketing centres.

1.4.7. Local knowledge

Local knowledge has been generated for centuries: it is an empirical knowledge based on farmers' experience. According to the ecosystems they live in, communities have developed different kinds of knowledge. Local knowledge generation is quite diverse and it varies according to local conditions: physical conditions as climate, soil, vegetal cover but also social and economic conditions (social organization, culture). Local knowledge encompasses agricultural practices and techniques as cropping patterns and animal husbandry but also resource management systems as water harvesting systems or water management systems, range land management systems. Tools (as plows.) used locally by small scale farmers have also been generated thanks to the evolution of local technology. Local Biodiversity management and conservation is also considered as part of local knowledge.

Some research has been done on biodiversity management and conservation, water management systems (especially in arid areas) and range land management systems but very few on local agricultural techniques and practices (as cropping patterns for example).
Local knowledge is likely to be transferred ; it can be easily transferred from farmer to farmer as it has been generated at small scale level. It means that, most of the time, farmers do not need major investments to adopt this local knowledge.

As mentioned above, there are aridity zones in the CWANA region. As aridity is widespread in the region, local knowledge in terms of water management and conservation is quite developed. There are community managed irrigation networks, water and land conservation systems as 'Tabias' and 'Jsour' in Tunisia that 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 water catchments built manually, aiming at harvesting rain waters.

Those systems are not maintained anymore and are going on degrading as other job opportunities with higher opportunity costs are available in nearby regions. Communities are collapsing because of resource scarcity and because of the evolution of technologies: they do not play the same role in resource management as the one they used to play because most of resource management activities are large scale resources (as dam construction, land reclamation…) and are carried out by Government agencies. Local water management systems at village or community level have almost disappeared. Farmers are still maintaining small water management works at the farm level.
Highly sophisticated irrigation networks have been set up by communities in areas where the main constraint has been water scarcity. Those irrigation systems were based on community organization : village dwellers were contributing to the maintenance of those systems (Foggaras): they used to clean up drainage canals as well as 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 have been carried out (as dams, drilling) and new irrigation systems have been adopted : in Southern Morocco, water for irrigation was coming from the Atlas Mountain and communities developed irrigation areas down stream (Draa Valley and Tafilelet). They had they own techniques for water catchments, conveyance and management: those techniques were adapted to local conditions (labor available for digging and maintaining the canals, water flows, social organization). In the 1970s, the Government built two dams up stream and created huge irrigation schemes down stream: communities could not manage anymore irrigation, the water dose available per hectare decreased; profitability was not as high as before. The combination of all the factors mentioned above with the Bayoudh disease caused a decrease in date fruit production (Ben Zid, 2002).

In Morocco, Date palm production has declined by 80% beginning of 1920 (Ben Zid, 2002). This decline is due to the change of the production system: the former system was viable because of the cheap labor available used for the maintenance of the irrigation system. In 1920, labor migration to France and to Northern Morocco started so there was no as much labor available as before and it affected the whole system.

In the case of Morocco, because of the decrease of date production caused by the Bayoudh disease, farmers tried to keep date palm biodiversity by growing and multiplying indigenous cultivars, bearing resistant genes to diseases.
In case of date palms, farmers have got their own way to characterize the different date palm organs which is quite different from the researchers' way (Nasr, to be published). They differentiate the different cultivars by characterizing those different organs: leaves as well as fruits. Researchers use only one criterion to differentiate the varieties: the fruit. An index (Bakkay, 2005) classifying and denominating the different organs of the date palm tree has been written by a farmer in Algeria. It has been written in Amazigh and Arabic and it will be translated to French. It has been published by the High Secretariat of Amazigh in Algiers. Such index will be helpful to identify most resistant cultivars to diseases and to unify farmers and researchers' knowledge. It can be a tool for setting up future biodiversity management programs in the Maghreb region.

All date palm tree products an by products are used: leaves are used for building houses or making carpets (roofs) or sometimes in fisheries to make tools for fishing (IPGRI, 2005). Date fruits are classified according to their ripeness and are processed accordingly: some of them are dried up and stored and some of them are just kept and eaten as they are (IPGRI, 2005). Date fruits are processed and different products highly nutritive are produced: honey, jam (ICRA, 2003).

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

Because of the degradation of vegetal cover due to the high pressure on range resources combined with climate change and other external factors (as the development of agriculture and the introduction of new techniques as drilling), some of these species are threatened and pastoralism itself is declining. Because of the decline of this activity, local knowledge related to it is disappearing: young men do not work as shepherds anymore in range land areas and go to look for job opportunities in other areas or regions. The local knowledge on range species is not documented and it will be lost when these species will be fully degraded.

In North Africa, farmers were growing local cultivars of cereals. The French occupiers developed National Research Systems in the beginning of the XXth century in order to breed varieties or cultivars adapted to their needs. National Research Centers worked mostly on wheat to get flour easy to make into bread.

Cereal breeding went on even after the North African countries got their independence. Then, research centers focused on producing high yield varieties. Locally bred cultivars have been gradually replaced by those high yield varieties adapted to mechanized techniques (high straw). Indigenous wheat cultivars are still grown in very remote hilly areas where there is no mechanization. The plants are usually short and easy to mow manually. They are also rustic, resistant to fungi and other diseases. They are usually grown by resource poor farmers.

In wheat cropping, farmers developed over centuries different cropping patterns in order to optimize their production and to manage the risk. In area where rainfall is more than 500 mm, wheat density is quite high (more than 100 kg per ha). In very arid areas, farmers usually do not grow wheat but barley which is more resistant to drought than wheat. Barley is grown for two purposes: farmers can get a grain production from it and it can be pastured so they limit losses if it does not rain enough. Barley density is very low (40 to 50 kg per ha). If rain fall is not as high as expected, the barley crop is pastured by the livestock.

1.4.8. Social equity and gender

New processes that are transforming the rural areas of the CWANA bringing women to the forefront of agricultural work are neither directly reflected in adjustments neither to the legal system nor to the prevailing social habits. On the contrary, gender discrimination practices in agriculture persist to date.

1.4.9. Capacity development

This sub-chapter discusses some of the capacity development issues needed in the CWANA region. Higher agricultural education, irrigation water management and conservation and utilization of plant genetic resources can play a major role in increasing food security and alleviation and meeting the Millennium Development Goals in the region if proper capacity developments are in the place. Enhancing the role of the universities in capacity development, the new challenge is from agricultural education for sustainable rural development and for strengthening rural communities. Higher agricultural education has contributed to the growth and modernization of production agriculture and has focused on professional development for those responsible for agriculture and rural development. Curriculum and management adjustments did not parallel this growth (Atchoarena, 2006).

In CWANA region interaction with the farmer and the farmers organization and the private sector has not been on the priority of the universities. Participatory research has also been negligible and therefore the impact has been of moderate magnitude. To maximize the benefits from the research at institutions of the higher agriculture education, agriculture information systems and transfer technology units need to be started and links made to the national, regional and international systems.

There are many research results which can be transferred or extended but the community is not benefiting from them because the technology is not being transferred or made available to the beneficiaries and the stakeholders.

Poverty Alleviation: Agriculture is central to rural development and poverty alleviation. Unfortunately the Ministries of Agriculture in many regions were not able to take an active role in the development of national strategies generating jobs, livelihood improvement and poverty alleviation. There is a lack of human resources in this area and neither the universities nor the national centers provided the expertise or initiated effective programs in this aspect.

The region lacks expertise in the impact studies, monitoring and evaluation areas. Lack of this expertise has hampered the realization of the importance of several emerging technologies or practices in the field of agriculture.

Expertise on risk analysis and assessment and national commitments and benefits from international agreements and conventions is also lacking. Cooperation among institutions of higher agriculture education; 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 more than x percent of the world's available water, improvement in the capacity building at every level –from farmers to government- is required taking human and institutional processes.

Genetic resources are very important for food security and since CWANA region harbors a wealth of plant genetic resources, we are giving special attention to this resource. In the CWANA region, capacity development in plant genetic resources is too much focused on technical training. Management and strategic planning, fund raising, public awareness and policy have not be considered in the past. There is no identification, in terms of capacity development of the needs of the Plant Genetic Resource Centers neither of the farmers' needs. There is a lack of monitoring and evaluation of capacity development: capacity development initiatives are not assessed and there are risks of overemphasizing some capacity areas and underestimating others.

1.4.10. Markets and policies

Marketing is seen as a main condition (or a main constraint) to the development of the agricultural sector in the region. Marketing is also seen as condition to rural development in general and to the improvement of the livelihoods conditions of the rural population. Marketing opportunities and market participation is related to the sustainability of the farming and production systems mainly for the poor. Markets in the CWANA region are lacking facilities (they are sometimes gathering places rather than markets), lacking regulations (or at least the enforcement of existing regulations) and missing competition conditions (suffering from collusion and bilateral negotiation). In other situations, there are some markets that are highly protected from foreign competition (the case of the Gulf region) which is also a source of high transaction costs mainly to importers and exporters. Quality control is not well developed and the role of consumer is quite missing.

At local level, production is scattered and there is no marketing chain. Transport costs are very high for small scale farmers; there is no (or very few) farmer organizations able to transport and to market agricultural products in bulk. For some commodities, as citrus, tomatoes, peppers, dates, there have been a major increase in yields and sometimes, there is an over production. Because of the lack of storage and processing facilities at the local level and because farmer organizations are not as structured and strong as needed, middle men are controlling farm gate prices. Hence small-scale farmers do not get good prices and cannot invest nor reproduce their system the following year.

1.4.11. Access and use of agro biodiversity

Due to the mega-diversity of crop species in CWANA, major crops and wild relatives and land races have significant variation in the region. They are important sources of useful genes for several characters such as adaptation to abiotic stresses including extreme conditions, resistance to pests and diseases, quality characteristics, and other factors affecting productivity. They are also playing an important role at cultural and social level, and they are securing the continuity of the evolutionary processes.

The richness of agrobiodiversity and the existence of low input farming system 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, both at intra and inter-specific levels, is a crucially important part of CWANA farming systems. So this existing diversity helps to provide stability for farming systems at the local, national and regional as well as global levels through the maintenance of a 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 draught power, they are extremely important economic resources to reduce farmers risk exposure, generate employment, and even-out seasonal farm labor demands. From most important species of cattle, horse, ass, pig, sheep, buffalo, goat, chicken and duck around 4 000 breeds have been developed and used worldwide (CBD, 2002). Animal genetic resources (animal species, breeds/strains and populations as well as their wild or semi-domesticated relatives used for food and agricultural production of CWANA, the diversity of fauna and local breed of farm animal of the region are also important being insurance for future adverse conditions and the genetic diversity of these species has been used extremely effectively. Farmers and breeders have successfully selected animals for a variety of traits and production environments.

But, because of the Green Revolution which took place in Pakistan and the adoption of high yield varieties, there is a degradation of genetic resources in the CWANA region. The shift from small-scale farming systems to large-scale farming systems using technical packages (mechanization, use of chemicals) is contributing to biodiversity loss. Many governments are not aware that they should establish gene banks for local breed conservation. The situation seems to be better in regards with livestock. Foreign brands have been imported in many countries (especially cattle) but their adoption has been a little bit slow because they need large amounts of feed, the farmers cannot afford. So, farmers are still rearing local brand cattle, sheep and goats.

1.5. Status of Agriculture KST

1.5.1 Knowledge

Since the beginning of human settlement, major civilizations were started at the shores of rivers and lakes. Water is a very important factor in the initiation of human settlements. At the edge of the deserts and in the areas where the valleys run in winter and dry most of the year, water resources became a big challenge to the builder of settlements. How to collect and store the winter floodwater and use this water during the dry seasons became highly important knowledge. Simple tools and techniques were available to the ancient people to build water collecting systems adequate support their demands during the dry months. This knowledge and associated techniques were developed over time, and very efficient water harvesting systems were initiated in some parts of the desert. Indeed, the CWANA region boasts 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 rain water harvesting knowledge that helped the people to sustain the harsh environment of the dry lands. Over time the water harvesting techniques have been developed and modified in order to adapt to different geomorphologic and climatologically identities. Some of these are discussed here:

In areas where the catchments are significantly large, macro harvesting systems are implemented. They 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 occurs where a series of check dams and contour lines are built to concentrate runoff water for wild vegetation which results in effective rainfall many times the actual rainfall. In Jordan, most of these techniques have been adopted in various parts of the country and research is being conducted to see the efficiency and sustainability of various techniques mainly in rangelands enhancement. One popular technique is that of earth bonds (or Hafira) (from 10 000 m3 to 50 000 m3). Water collected in the earth bond is used for watering livestock and in some cases for domestic uses in remote areas (as in Sudan). Those earth bonds were dug and managed by local communities in the past, but now earth moving machines are used by the Government to dig them. Those earth bonds are maintained by the Governments and some NGOs.

For crop production and in the wet areas, the terraces are built to serve two purposes: to stabilize soil from erosion and to harvest run off. 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. During this period, major technical and institutional reforms have occurred, which have

shaped the pattern of technology development and dissemination. 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 eco-regional consortia.

Historically, research has been conducted on the role of organic matter in soils, the development of reduced tillage systems, and 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 are topics 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 this is not the case in CWANA. The NARS are short of financial support and personnel. In some countries, the available personal has emigrated. Some particular features of the international agenda are:

- 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 towards 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 the demands of clients. 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 through the generation of customized crop varieties. Whilst there has been a gradual decrease in national and international public funding available for agricultural research and extension systems, private sector biotechnology research has attracted considerable support. Most of this research is likely to focus on profit-generating inputs, export crops and agroprocessing.

Some examples of research conducted in CWANA are outlined here:

- One of the first research institutions in CWANA was in Sudan. It started in 1907 and it concentrated only on cotton research during the British administration. After independence, it focused on diversification and intensification and 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, 1960s a lot of research was conducted and published in

international journals: now very little is published. Research concentrates only on irrigated crops, neglecting rain fed crops, although the rain fed area (mechanized and traditional) is ten times that of irrigated areas in Sudan. Research on livestock is meager, concentrating mainly on veterinary issues as opposed to increasing production. Nowadays, the agriculture research situation in Sudan is bleak because of the lack of funds, because of the brain drain and due to partisan issues. Agricultural research once formed part 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, there are some specialized research institutes in agriculture. One of the pioneers is the National Center for Agriculture Research and Technology Transfer (NCARTT) with its field stations that serve as research and demonstration farms. Research is mainly carried out on developing of drought resistant varieties of cereals and legumes as well as breeding livestock. Dissemination of findings is through the field stations. Improved varieties seeds are produced in large scale for farmer supply. The Ministry of Agriculture has an Extension Division where extension agents provide advice and consultation to the farmers (animal production engineers, plant production engineers, soil engineers….). The main constraint is financial; all the research depends on international funds. Government funds mainly concentrate on extension. Most of the agricultural research has been on developing and selecting adaptable varieties for rain-fed farming mainly barley and wheat for instance in Jordan, the National Center for Agricultural Research and Technology transfer bred cereal crops adapted to the arid lands.
- Due to the problem of water scarcity, irrigation systems have been developed to encourage efficient irrigation. Most developments have focused on adapting and transferring new irrigation techniques, such as drop and sprinkler irrigation which during the 1980s substituted the traditional practices using basin irrigation. These new techniques were first introduced by the Jordanian Ministry of Agriculture and its extension system with an institutional and regulation set up to discourage farmers from using more water. Another driver for using less water consuming irrigation techniques is the saving in pumping the water for irrigation where most farming activities are dependent on ground water pumped from deep aquifers. For the surface water users, the main driver or reason to use less water consuming irrigation systems is that they do not get the water for free. To encourage take up of new technologies, new irrigation techniques are introduced into research stations. Over time, people startseeing the benefits of saving water and the ease and practicality of operating these techniques versus the traditional basin and channeling system. Where there is a difference a difference in cost associated with using a different amount of water, there is a strong incentive to use water saving techniques and this is typical for water scarce countries and private farmers. However, when water is free, or the cost is not associated with the amount of water used, farmers prefer to go to easiest techniques which are 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 of irrigation systems are basin. In the farming areas using ground water there are two systems in operation: the first is that the government digs the 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. In the second system is that farmers have their own wells and pump water and almost all of them use the efficient irrigation systems which save pumping costs. These technologies are associated with added costs to the farming system. Most of the time, the saving in water pay for this cost, but sometimes the initial start up costs are not available for farmers. In such cases governments 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 to farmers to adopt the new technology (subsidized interest rate). In Tunisia, adoption of new irrigation technique is highly subsidized by Government.
- With increases in domestic water and sanitation requirements, more of the treated waste water is re used for agricultural production. Research is carried out on reuse of reclaimed water (or treated waste water) for restricted irrigation (forage, wood trees…). This re-use of treated waste water differs from country to country and is mostly carried out in countries where there are limited water resources and high agricultural demand. Some countries have good experience, and treated wasted water is used in farming o n a large scale such as Tunisia; others are in the demonstration and testing stage as Jordan while the majority of CWANA countries have very limited experience.
- With the evolution of structural engineering, mankind is able to build massive structures that can am tremendous amount of water. In the last century, a number of mega dams were built in major rivers allowing people to regulate water flow and farm all year round and have water for dry cycles. Some examples of these dams are: Assouan High dam in Egypt and Ataturk dams in Turkey. In addition to these huge dams, there are several medium size dams designed for agricultural and electricity purposes. There are small size dams (as in Tunisia) for agricultural purposes.

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. Prominent reason for that 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, performance of extension services has 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 in many CWANA countries, donor support for research and extension will continue to be important for some time to come.

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

In other cases, farmers never learn about new technologies developed in the research systems 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 of CWANA countries.

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

Finally, they must open the research and extension systems to more providers, strengthening links between universities, non-governmental organizations, private firms, and others.
There is a lack of research, extension and education lacks of coordination.
Research evaluation is not appropriate: applicability of research findings should be evaluated (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 it does not go back to farmers because extension is weak.

Some messages for technology transfer are sent through media, radio, TV but they are still very technical and as sent, they cannot meet a wide range of farmers' needs. Demonstration plots are rare and new techniques are seldom scaled up because feasibility conditions for scaling up are not available (cash or funding at farm level, labor, marketing chain for new products, integration of techniques).
Technology transfer occurs mostly through agricultural development projects as government agencies are lacking resources (financial and human) to carry out adequate extension programs. In some cases, there are some success stories in terms of adoption of new techniques but they are rare and the impact of such projects is still limited : a project implemented by FAO in Tunisia (Watershed Management Project in three Governorates, Kairouan, Siliana and Zaghouan) introduced a kind of water reservoirs in the project area (FAO, 2004) : farmers, settled in other regions, adopted the same way of building their water reservoirs. Unfortunately, this new technique could be scaled up at a large

scale because capital is usually lacking within the small scale farmer community. Sometimes there is a farmer to farmer technology transfer through visits of group of farmers to other groups of farmers in another regions but it usually occurs in the setting of an agricultural development project. Resources are then available and after the projects are closed, there is no way to up scale at a large scale the new techniques they have promoted.

There is a decreasing interest in agricultural education: it is becoming more knowledge based than skilled based: little critical thinking and multidisciplinary aspects lack in the curricula in the curricula developed. There is no holistic vision. Governments are not hiring people anymore.
The main problem in the region that made past extension initiatives fail is that there are too much people working in the Ministries of agriculture.

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