

High Value Products for Smallholder Markets in West Asia and North Africa – trends, opportunities and research priorities.

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1. Introduction	3
2. Small-scale farmers in the West Asia and North Africa region:	4
The role of Horticulture in poverty alleviation:	9
3. Past market trends and development in WANA region:	10
4. Opportunities for small-scale farmers to participation in high-value markets:	14
Future agriculture export competition:	15
Markets in West Asia and North Africa.	15
Sustainability of production.	15
5. Current R&D activities in the regions:	17
On the National level:	17
On the international level:	17
6. Lessons learned	21
Horticulture and sustainable development:	21
7. Priorities for research:	23
Soilless culture:	24
8. Bibliography	25

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1. Introduction

The ultimate objective of agricultural activities in general sense is actually providing the community with enough food to sustain life and welfare. Agricultural activities are those human practices that utilize natural resources such as soil, water, energy, and human efforts to produce more and better food. The type of food production in a given region is determined by several factors including the historical crop pattern dominating the region, water availability, climatic conditions, and more important human preference that is affected by socioeconomic factors and historical and cultural background. The definition of high value crop may be based mainly on the highest cash return that could be obtained from the commodity when it is produced in a specific area to be sold in a specific market. It depends on several factors including the availability of resources and capacities required to produce the commodity, the human capacity to utilize such resources efficiently in successful production systems, and the availability of enough demand in the local and international markets to absorb the amount of commodity produced. Therefore, the highest value crops are different from one region to the other. While the cereals are considered to be the highest value crop in North America, it is livestock and animal production in south America, roots and tuber crops for central Africa, and milk production for Europe. The region of West Asia and North Africa (WANA) is unique in the sense that there is no commodity that dominates the region as the highest value crop.

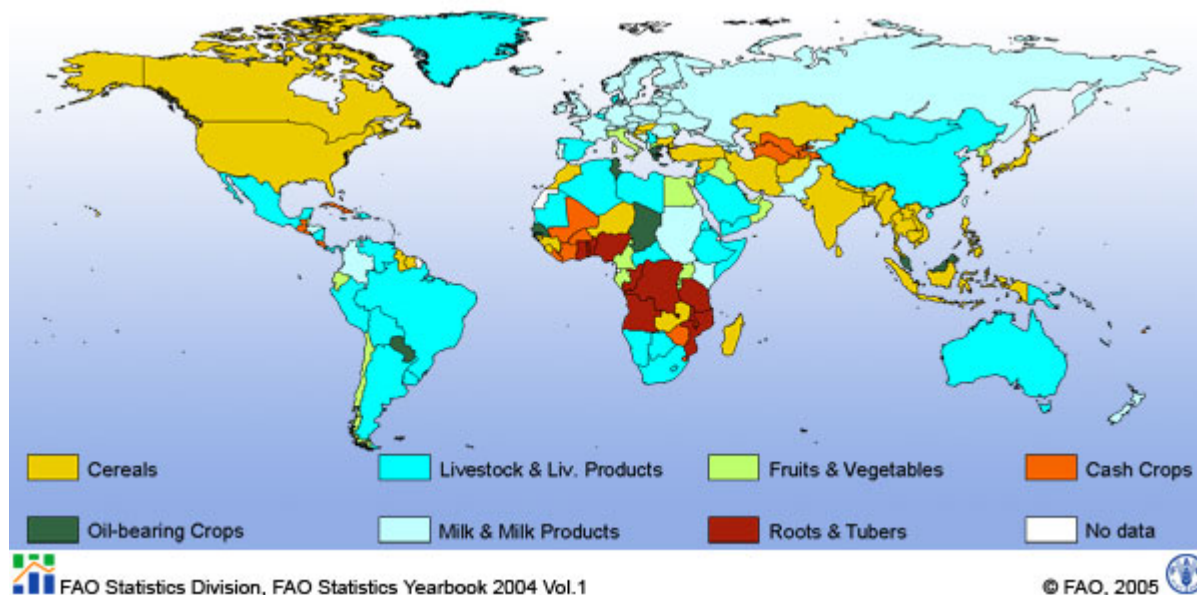


Figure (1): Highest value agricultural production by commodity groups

While we see the cereals as the high value crop in Morocco, Turkey, Syria, Iran, and Afghanistan, the animal production and Livestock production are the highest in Algeria, Libya, Saudi Arabia, and Yemen. Vegetables and fruits are the highest value crops in Egypt Iraq and Oman, it is the oil-bearing crops in Tunisia. Milk production has the highest value in Sudan and Pakistan. Smallholder growers usually produce what is known to be the highest value crop in their local conditions. Nevertheless, the income generated for this small scale type of production may not be enough to sustain a reasonable standard of living. The poverty count, therefore, is relatively high. The introduction of unconventional cropping pattern and/or production systems, together with diversifying crops and introducing high cash generating crops could be means to provide enough food for the increasing population of the WANA region. The paper will shed some light on the possible role of horticultural crops as a tool to alleviate poverty and improve human livelihood and welfare.

2. Small-scale farmers in the West Asia and North Africa region:

The region of West Asia and North Africa is one of the most vulnerable regions in the world. The population of the region on the year 2000-2002 is about 0.7 billion, and is expected to be 0.88 billions on the year 2015 with a sharper increase towards the year 2050 where it is expected to reach 1.34 billions as illustrated in table (1). It is expected that most of the countries in the region are characterized by the small agricultural land ownerships due to the fragmentation of the land with time and the limited land reclamation in comparison with the increase in population. It is difficult to find a satisfactory answer about where are the small-scale farmers in each country in the region, or to how many are there, due to the lack of reliable and trustworthy data.

Population in THOUSAND PERSONS				
Country Name	2000-2002	2015	2030	2050
Afghanistan	22135	35473	49987	69517
Algeria	30752	38142	44120	48667
Azerbaijan, Republic of	8227	9450	10486	10942
Egypt	69138	89996	109111	127407
Iran, Islamic Rep. of	67253	81422	94441	105485
Iraq	23865	34226	45338	57932
Israel	6173	7772	8970	9989
Jordan	5182	6982	8643	10154
Kazakhstan	15547	15328	15258	13941
Kuwait	2348	3352	4198	4926
Kyrgyzstan	4994	5949	6711	7235
Lebanon	3537	4207	4692	4946
Libyan Arab Jamahiriya	5341	6886	8123	9248
Mauritania	2725	3988	5482	7497
Morocco	29588	36496	42505	47064
Oman	2688	3908	5223	6812
Pakistan	146281	204465	271600	348700
Palestine, Occupied Tr.	3311	5260	7758	11114
Qatar	591	711	821	874
Saudi Arabia	22832	32728	43193	54738
Somalia	9096	15263	24407	39669
Sudan	32155	41430	50525	60133
Syrian Arab Republic	16970	23018	28750	34174
Tajikistan	6143	7252	8548	9552
Tunisia	9624	11116	12351	12887
Turkey	69301	82150	91920	97759
Turkmenistan	4719	5820	6825	7541
United Arab Emirates	2878	3588	4056	4112
Uzbekistan	25310	30718	35031	37818
Yemen	18661	30677	50584	84385
Total	667365	877773	1099657	1345218

Table (1) population of the West Asia North Africa Region adapted from the FAO statistics.

The FAO statistics indicates that the poverty headcount based on the percentage of the population is quite high in some countries. The data available from eleven countries (table 2) indicates that the poverty headcount ranging between 7.6 to 52 %. Unfortunately there is no complete data set to have a reliable comparison, but the available data indicates an alarming increase in poverty level in the region

Poverty headcount, (share of population) (%)									
Country Name	1994	1995	1996	1997	1998	1999	2000	2001	2002
Algeria		22.6			12.2				
Azerbaijan, Republic of								49	
Egypt			22.9				16.7		
Jordan				11.7					
Kazakhstan			34.6						
Kyrgyzstan							52	47.6	
Morocco						19			
Pakistan						32.6			
Tunisia		7.6							
Uzbekistan							27.5		
Yemen					41.8				

Table (2): Poverty headcount percent of the population in some countries in WANA region.

The rural population in WANA region ranges between 20 to 40 % in Morocco, Algeria, Egypt, and Syria, while it ranges between 20 to 40% in Iraq, Iran, Jordan, Turkey and Oman. The extremes are in Libya, and Saudi Arabia where it is below 20% and in Yemen, Afghanistan and Pakistan where the rural population is over 60% of the total country population.

With the large population and the poverty prevailing in the region, astonishingly, this is not reflected clearly on the nourishment of the population as illustrated in Figure (2)

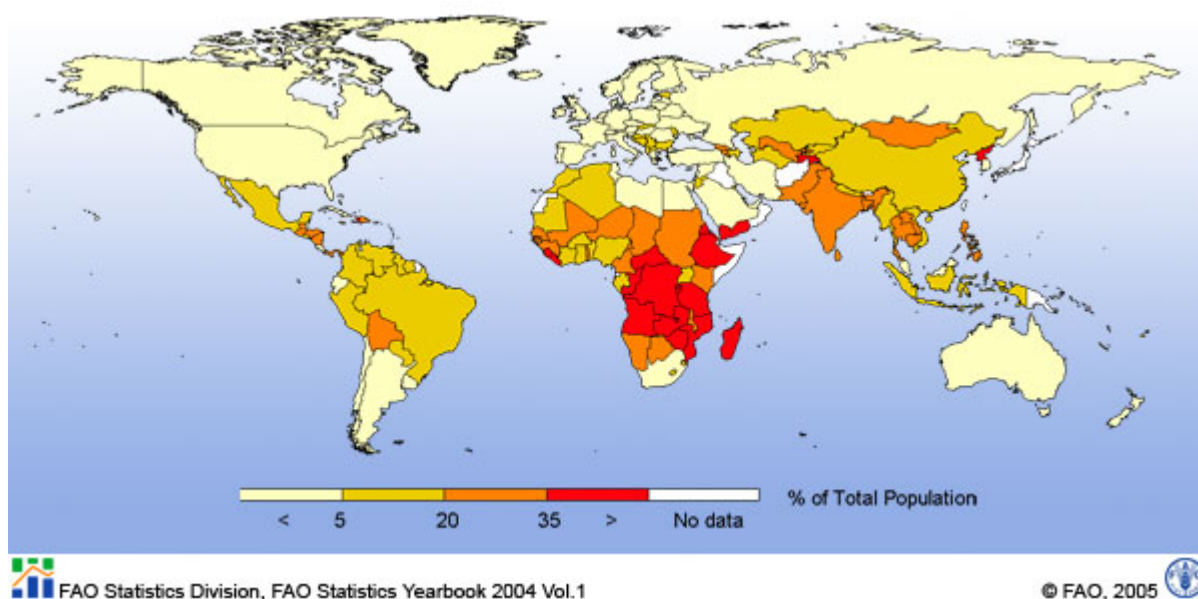


Figure (2) : Undernourished population (2000 – 2002)

Only Yemen (over 35%) and Pakistan (between 20 to 35%) shows high rate of undernourished population according to FAO. Morocco, Algeria, Jordan, and the newly independent states of the former Soviet Union has an undernourished rate that ranges between 5 to 20%. Libya, Egypt, Turkey, Iran , Syria and Saudi Arabia have a rate less than 5% of the population undernourished.

Some countries in the region receive a considerable amount of foreign aid especially cereals (table 3). As the FAO data shows, the food availability in such countries is not secured. A number of the countries in the region has so limited resources that self sufficiency is not practically achievable in the present time. The most affected by this situation is the poor population.

Food aid received					
(Cereal Total in Mt / year)					
Country name	1969 - 1971	1979- 1981	1990 - 1992	1995 - 1997	2000 - 2002
Algeria	139600	17708	19466	23684	32113
Azerbaijan				192790	18876
Cyprus	11033	5542			
Egypt	255567	1877098	1388378	159715	30797
Iran	145733		63435	11864	7155
Israel	817133	22809	676		
Jordan	96300	80970	301132	138114	212967
Libyan					
Morocco	375167	182922	206435	5219	99265
Pakistan	1042407	260695	292929	72048	114270
Sudan	31280	183100	467456	70255	127461
Syria	55200	51554	20311	19790	19098
Tajikistan				109850	149640
Tunisia	310467	129955	194390	12920	631
Turkey	575987	8987	4247	287	
Turkmenistan				47815	7004
Yemen	64133	29807	85309	37120	158306
Uzbekistan					47692

Table (3) available information about the foreign aid received in some years during the last decades. (Adapted from FAO STAT Data.

Agricultural GDP per economically active person in agriculture in most of the countries in WANA region (except some oil- rich countries, is in the range between 500 and 2500 US\$, which is substantially low compared to the developed countries where it is over 20,000 US\$.

Agriculture is consuming a large portion of the countries water resources in WANA region. Almost all the countries in the region consume more than 60 percent of its water resources for agricultural activities. The case is clearer in Morocco, Yemen, Oman, Syria, Iraq, Iran, Afghanistan and Pakistan where agriculture consume more than 90% of the national water resources (figure 3). This is largely due to the fact that the region in general is within the arid zone, and with a large part in the hyper arid lands. With the nature of the agricultural activity that is characterized by high water consumption, and the fact that most of the countries in the region still use the water inefficiently due to obsolete agricultural practices , it is assumed therefore that agriculture consumes water wastefully.

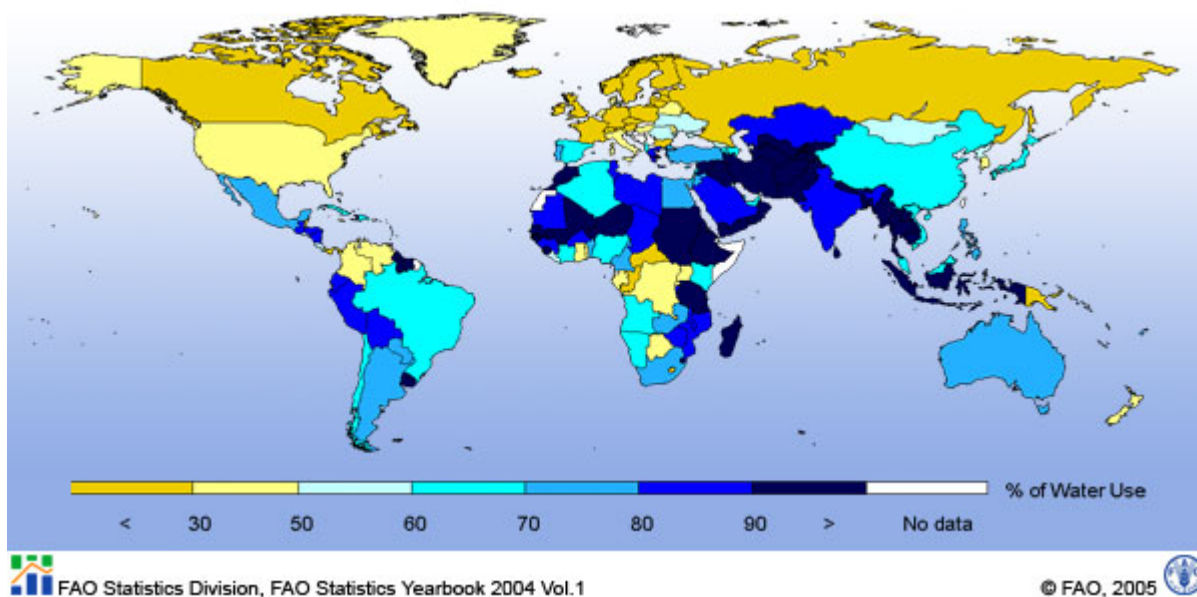


Figure (3): Share of agriculture in water use

In Egypt and Oman, more than 80% of the agricultural lands are irrigated, while in Iraq and Iran the irrigated agriculture ranges between 50 to 80 %. The other countries in the region have a considerable area that depends on rain fed agriculture. Such countries most of the cases suffer from the lack of water and stress conditions frequently prevails resulting in yield reduction, lower quality and seasonality of production.

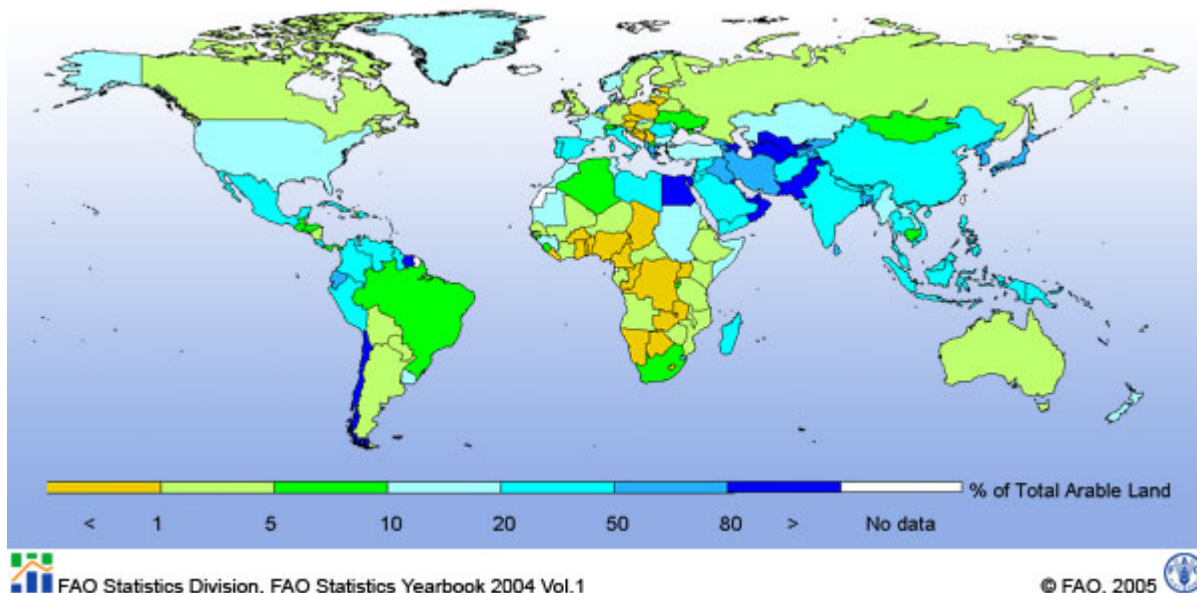


Figure (4): Share of irrigated land in arable areas.

High population, together with low productivity of the lands due to the lack of water and the seasonality of rains results in low production in food in general in the whole region of West Asia and North Africa. Therefore imported food is ranking very high (figure 5) almost all over the region. Food constitutes 10-20 % of the total imports in Morocco, Egypt, Saudi Arabia, Oman, Jordan, Syria, Iran, and Pakistan, while it is ranging between 20 to 30 % in Algeria, Libya and Yemen. Coupled with the low National income, food imports have a strong impact on the economy of the countries. Efforts to overcome this constant will definitely be positively reflected on the national and individual welfare.

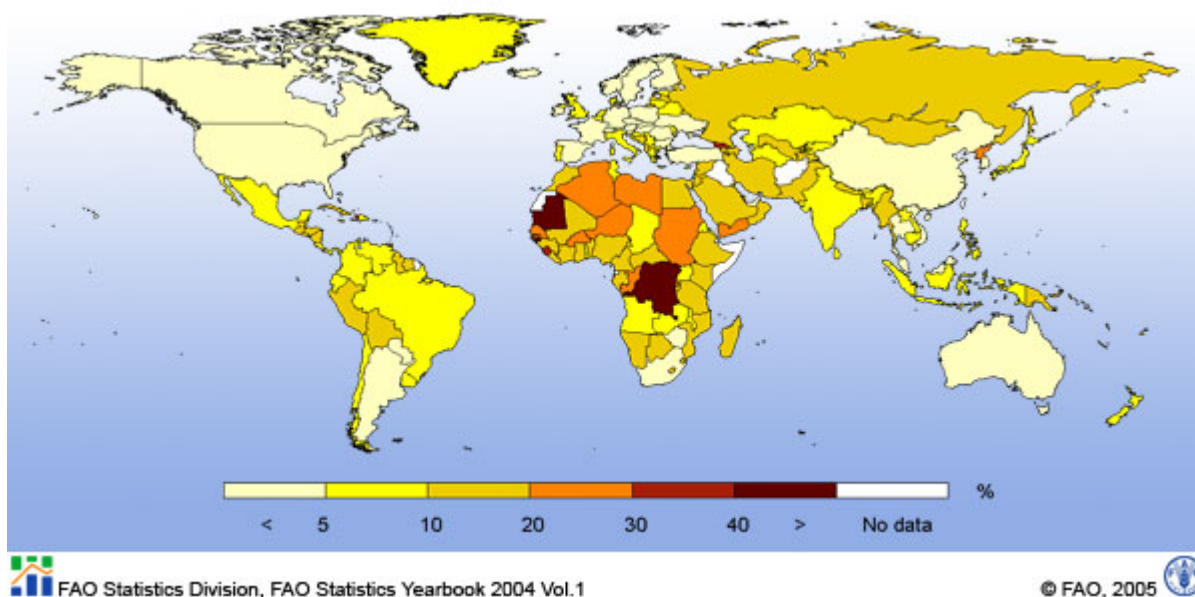


Figure (5): Share of food in total imports.

It is not likely to claim, therefore, that the value of a certain crop depends only on how suitable the climate is, but it may depend on several other factors including, and most important, the human capacity to produce and deal with the crop in the fields and after harvest. The production of high value crops by small farmer in the WANA region seems to be an option that could form the background and the potentials of increasing the income of small production units to help elevating poverty and improve human livelihood.

In all the efforts aiming at environmental development, poverty elevation, and establishing food security strategies especially in developing countries, small holders are key players. Agricultural activities utilize natural resources such as soil and water more than any other activity. Agricultural activities resulted in transforming the largest land mass of the world. It utilizes most of the world water resources. As agriculture is considered to be the main tool to supply food for humans, an increased pressure on the natural resources have been observed. With an increasing population in cultivated areas, the per capita land share tended to decrease. Small holders are becoming more numerous in developing countries, reaching thresholds under profitability levels.

The major management and developmental problems related to small holders are soil erosion, water use efficiency and water withdrawals that deplete the aquifers in a non reversible and unsustainable manner. Such situation affects not only the existing population, but also reduces the natural resources availability for future generations. The end result is a consistent trend that the poor are getting poorer. The extent of natural hazards are partly natural and partly man made. The yearly decrease in arable land due to desertification in the Sahara may be equivalent to the area of a whole nation. Man-made reduction is also phenomenal due to the destruction of rainforest or the rapid urbanization of the fertile old lands in the deltas of the major rivers. Such areas are mainly inhabited by the poorer in the developing countries, especially in the West Asia North Africa (WANA) region. This region is devastated but it also is the most suitable region for agricultural development due to a suitable climate, and less need to use energy to modify climate, the long experience in agriculture, and the cheap labor.

The developing countries in WANA have a majority of population either poor or relatively poor. Most of poverty is in rural areas. Serageldin, (2004) stated that “sadly, it is the smallholder farmers who subsidize the urban poor, the main buyers of their produce, by lowering prices. This translates immediately into money in the pockets of the urban poor - more effectively than any administrative program could ever achieve”. Some of the main points to correct this situation could be related to urban agriculture and urban food production which is a relatively new phenomenon that depends on horticulture. Thus, horticulture is unique in that it can directly address poverty and

food security issues in both urban and rural areas of the developing world . Gender represents another field for inequity and inequality since in much of the developing world it is women who carry the burden for both agriculture and nurturing the family. It is important to recognize the failures of policymakers and to promote greater investment in education and health, in rural infrastructure that benefits rural communities. The production systems in WANA region should be modified to achieve sustainability and to increase the income of the local farmers to sustain a decent standard of living. Achieving food security in the developing world will require the transformation of these economies and a doubling of the trade exports from the North to the South. This means reaching smallholder farmers in the developing world and transforming their agricultural production. In many cases this also means dealing with very difficult, low potential environments where it is not easy to see how such transformations can be accomplished . Beside the direct impact of the lack of food security that is expressed in the thousands of life losses every day, there is a less obvious and even worse effect of hunger, which is malnutrition and element deficiency such as iron, iodide, and vitamins) in food that result in reducing the production ability and mental power incapability.

The role of Horticulture in poverty alleviation:

Horticulture is a vehicle to intensify land productivity and hence obtain more crops. Due to the fact that the market price of horticultural commodities is relatively higher compared with other crops, the income generated from the unite area of lands is also higher. The land ownership and the share of agricultural lands per capita are lower in WANA as it is in most of the countries with transition economy compared to the developed countries. Such a situation results in limited source of income for families, and together with the high population intensity, poverty prevails. The dependence on low-cash generating commodities for agriculture cannot generate enough income for rural inhabitants. Horticultural crops can be a salvation for such a situation. Another point here is related to the dependence on cereals as the main, and probably the sole constituent of diet. Malnutrition is expected due to the lack of vitamins and other food supplements. Horticultural crops provide the necessary food supplements to assure a balanced diet for a healthy population. Horticulture also offers potentials for small value-adding activities that could help in generating income for rural areas and create job opportunities.

3. Past market trends and development in WANA region:

Least-developed countries are most vulnerable to price declines. Long-term trends, short-term shocks and price spikes in agricultural commodity markets are not just economic phenomena; they have very real impacts on the day to day lives of people everywhere. Not only do they affect the price people pay for food and clothing, they can have a larger impact on the overall economic well-being of families, communities and even entire countries that are dependent on commodity exports for cash earnings.

Food trade deficit of developing countries have tremendously increased over the last couple of decades, from a surplus of around \$1 billion in the 1970s to over \$11 billion in deficit by 2001, according to FAO's report, *The State of Agricultural Commodity Markets (SOCO)*. Gross imports of food by developing countries grew by 115 percent over the last 30 years period. Imports by developed countries, which already import a higher proportion of their food, grew by 45 percent. Measured in constant 1997-99 dollars, FAO projections show that the net food trade deficit of developing countries, the difference between the food they import and the commodities they export, could swell to more than \$50 billion by 2030. Technological advances and changes in domestic and trade policies influence international commodities markets, but the diets and preferences of consumers also have a major impact on shifts in commodity trading. With the effects of globalization, the spread of fast food in developing countries, and urbanization added to the mix. It is clear that trade in agricultural commodities is undergoing a period of dramatic change. Both the volume and the composition of world trade in agricultural commodities, which differ considerably between the developed and developing worlds, testify to these changes. In developed countries, most consumers can already afford the food they prefer. When their incomes rise, changes in diets and food purchases are relatively small. But in developing countries rising incomes have an immediate and pronounced impact on diets, and consequently on trade in both commodities and processed foods, as people adjust their budgets to include higher-value food items.

In addition to rising incomes, rapid urbanization is contributing to changes in lifestyles, food preferences and even the structure of commodity trade. For example, as their purchasing power grows, people in cities buy more diverse food items and more products that require less preparation time. Imports of high-value and processed food products have risen to meet this urban demand. In recent years, the volume of gross food imports for developing countries grew at an annual rate of 5.6 percent -- far higher than the 1.9 percent annual growth in developed countries. This can lead to a heavy load on the world's least developed countries (LDCs). Paying for food imports can strain the resources of countries where economic growth lags and foreign exchange earnings are limited. Indeed, LDCs spend 54 percent of their export earnings on commercial food imports while other developing countries spend 24 percent. Because many developing countries are dependent on commodities for their export earnings, increasing their income through trade is one way they can increase their cash earnings. But the high level of agricultural protection in both developed and developing countries, as well as the enormous support given to agriculture in most developed countries, stifles growth of agriculture export from developing countries.

According to FAO report, (SOCO), the impact of commodity price fluctuations is greatest in the poorest countries of the developing world. "An estimated 2.5 billion people in the developing world depend on agriculture for their livelihoods. According to the report, in the second half of the 1990s prices of several commodities exported by developing countries fell to their lowest levels since the Great Depression. Overall, real prices for all agricultural commodities have declined over the past 40 years, but the rate of decline has varied from commodity to commodity. Raw materials, tropical beverages, oil crops and cereals have experienced the steepest declines. The real price decline for horticultural products, meat and dairy goods has not been so dramatic. SOCO also notes that global commodity supplies have grown more rapidly than demand, fuelled by increased productivity and the emergence of major new producers. According to the report, advances in agricultural productivity through improved technology potentially benefit both producers and consumers. Producers see lower costs and improve their competitiveness, while consumers benefit from lower prices. However, SOCO adds that it has been the more advanced and prosperous developing countries that have managed to take advantage of the downward price trend in commodities by shifting production and trade into higher-value sectors. Developing countries other than least developed countries (LDCs) have more

than doubled the share of horticultural, meat and dairy products in their agricultural exports, while reducing their reliance on tropical beverages and raw materials. In the 1960s tropical beverages and raw materials made up 55 percent of their agricultural exports. By 1999-2001 they accounted for just around 30 percent. In LDCs the story is very different. Their dependence on tropical beverages and raw materials for export earnings actually rose from 59 percent to 72 percent between the 1960s and 2001. At the same time, SOCO says, LDCs saw their share in world agricultural trade shrink even as their dependency on it remained far higher than that of other developing countries. Lower food prices mainly benefit consumers in developed countries or consumers living in urban areas of developing countries. Net food importing countries benefit from savings in foreign exchange. However, in so far as lower world prices are transmitted to local markets, the vast majority of the world's poor and hungry, who live in rural areas of developing countries and depend on agriculture, suffer losses in income and employment caused by declining commodity prices which generally outweigh the benefits of lower food prices. Government policies in both developed and developing countries have seriously distorted the over-supply problem in agricultural markets. Tariffs on agricultural imports in both developed and developing countries have impeded growth in agricultural exports from developing countries. In addition, farmers in many developing countries that do not have, or use, possibilities to apply tariffs on food imports face competition from highly subsidized and mechanized producers in industrialized countries.

Though agricultural commodity prices have shown signs of recovery sometimes, this trend does not appear to be secure. Warnings from long-term prospects for commodity-dependent farmers and countries in the developing world are heard frequently. Agricultural commodity prices remain highly volatile, and the tendency for growth in supplies of agricultural commodities to outpace growth in demand at given prices will continue according to FAO. To reduce the impacts of commodity price shocks and spikes, FAO has recommended helping farmers and consumers protect themselves through schemes such as market-based price insurance or forward pricing systems. It is realized that efforts to address the long-term problem of excess production of traditional export crops must focus both on increasing demand and controlling supplies of some commodities and on reducing the vulnerability of farmers and countries that depend on these commodities. It is recommended to implementing diversification strategies that would allow farmers to move into the production of higher-value crops, or value-added processed goods, which could contribute to reducing both supplies and dependency.

Tariffs on agricultural imports in both developed and developing countries hinder efforts by developing countries to export their commodities. Tariff escalation, where processed goods face much stiffer import duty than unprocessed raw products, reduces opportunities for developing countries to export higher-value processed goods. In addition to tariffs, farmers in developing countries face competition from highly subsidized and highly mechanized producers in industrialized countries. Producer support to farmers in developed countries is currently running at \$230 billion annually. Tariffs and other barriers have also slowed the growth of trade among developing countries, where South-South trade otherwise could expand rapidly. Some commodities, such as sugar and horticultural products, face tariff peaks that are as high as 350 percent, in the case of tobacco, and 277 percent for chocolate.

At the retail level, supermarkets have grown rapidly in both developed and developing countries. The 30 largest supermarket chains dominate almost one-third of grocery sales around the world. The five biggest retailers control between 30 and 96 percent of food retailing in the EU and the United States. Supermarkets' domination of the market gives them significant leverage over production, distribution and trade, including through direct involvement with developing country suppliers. To simplify operations, most supermarkets prefer to work with a limited number of suppliers who have the resources to meet requirements and delivery schedules. The price that growers receive typically represents a small fraction of the retail price for finished products, ranging from as low as 4 percent for raw cotton to 28 percent for cocoa. In the case of bananas, which require almost no processing, international trading companies, distributors and retailers claim 88 percent of the retail price; less than 12 percent goes to the producing countries and barely 2 percent to the plantation workers.

The Global Horticulture Assessment (GHA) made by the USAID (2005) has analyzed the market systems in different regions of the world. The report has demonstrated that successful

production and trade of horticultural crops requires an understanding of the fundamentals of market structure and function. Knowledge of buyer demands, producer supplies, consumer preferences, and international and domestic standards are critical to success in highly competitive markets. The need for market information and effective market linkage is essential for profitability of growers, both large and small. The challenge for small producers is particularly acute because they have neither the resources nor the skills to access and interpret this market information, nor adequate financial, human or social capital to develop the linkages needed to succeed in the market. Due to the rapid and dynamic nature of the modern market for horticultural goods, smaller farmers will need new and innovative technologies for accessing market information. Success, for growers large and small, will depend on their ability to access diverse markets and to respond promptly to changes in market conditions. Much of the world's poor live in the developing regions of Africa, Asia and Latin America, areas that are experiencing rapid transformations in their agri-food systems. Primary causes for these changes are: (1) increasing urbanization, (2) growth of supermarkets, and (3) increase in export market opportunities. One well-documented shift in market function is the rapid expansion of supermarket chains (Reardon et al. 2003). The growth of the supermarket has had repercussions throughout the agri-food system, both directly through its effect on traditional markets and all aspects of the food production system, and indirectly by altering consumer expectations for quality, safety and presentation. Analysis of the supermarket phenomenon provides useful insights into changes throughout the food supply chain and their impact on the rural poor.

The GHA report (2005) reached the conclusion that the proliferation of supermarkets in developing countries creates both challenges and opportunities for rural producers. Supermarkets may contribute to higher demand for horticultural products, while simultaneously excluding small producers from participating in supermarket procurements and contracts. Examples were given to other regions such as Latin America, which has led the way among developing regions in the growth of the supermarket sector (Reardon 2003), rising from 10 to 20 percent of national retail food sales in the 1980s to 50 to 60 percent in 2000 and in some urban areas are approaching the 70 to 80 percent share common to the United States and France. In Southeast Asian countries, including Indonesia, Malaysia, and Thailand, supermarkets account for 33 percent of the market, while the figure is closer to 63 percent in the East Asian countries of Republic of Korea, Taiwan, and Philippines. In South Africa, supermarket sales account for roughly 55 percent of overall food sales (Reardon 2003). Whereas it took fifty years for supermarkets to achieve dominance in the US market, the changes observed in the developing world have occurred in just the past two decades. The procurement practices of supermarkets significantly affect rural agricultural development and pose new challenges, particularly for small, undercapitalized growers. Supermarket procurement system change are used as competitive tools in the retail sector and as a means to coordinate quality and consistency, and reduce costs in the supply chain through reform leading to centralization and regionalization of procurement, specialized/ dedicated wholesalers as agents of procurement for the supermarket, the use of preferred supplier systems, and the establishment of private standards of quality and food safety. These buying practices and procurement systems have significant consequences for farmers and suppliers. First, the centralization and regionalization of procurement puts local producers in direct competition with other producers across their own country and region. To stay in the system, the producer must be competitive at the national and regional level, rather than just at the local level. Second, the shift to specialized, dedicated wholesalers may result in the development of a relationship with the buyer that is formalized and potentially more secure. These buyers may also provide technical assistance, sometimes credit, and often transport. Buyers, however, will demand compliance with product quality and phytosanitary standards, will monitor volume and consistency standards, and may cancel purchase contracts if these conditions are not met. Third, the shift to preferred supplier systems means that producers are either represented on the supermarkets' procurement lists, or they are not—in which case they are excluded from the market. As supermarkets supersede urban markets, access becomes increasingly determined by a producer's ability to meet transactional and technological requirements specified by the large retailers' requirements. The predominant procurement practices of the supermarket sector, and the even more tightly constrained practices in the export sector, represent a profound challenge to the small grower who is unlikely to have adequate knowledge, technical skills or capital to understand or meet these terms of trade. In the absence of a pool of qualified and responsive small growers, supermarkets, export companies and wholesalers often deal exclusively with wealthier large-landowners who have the capacity to meet quality standards and contractual

infrastructure requirements demanded by the market. While these changes in the marketing chain due to the rise of supermarkets present an enormous challenge, the strong growth in horticultural demand, both regionally and worldwide also provides great opportunity for producers.

It is most likely according to the above mentioned analysis that the world is going to the direction of large and organized international market systems. The place for the traditional poor markets is no longer promising. Small and even medium holders in developing countries should be reorganized in a way to be able to face the new global marketing systems that is largely dominated by the supermarket chains and controlled by a network of certification and safety regulations. The shift of the marketing systems to line up with the global markets will most probably require heavy investments that might not be readily available in developing countries and that may need large contribution from the international donor agencies. Such contributions are required to support research programs, facilities and infrastructure modifications, and also socioeconomic reform to allow the new global systems to be established in developing countries. It is a fact that though supermarkets control large segments of the entire food chain, more than 75 percent of fresh fruits and vegetables are still sold in traditional open-air markets and small, independent stores (Reardon and Berdegue 2002). These markets are much more than physical locations to sell horticultural products; in many locations they are integral parts of the community and the society. Those markets are indeed the main support for the international export markets in the developing countries. The development and upgrading of the local markets is a prerequisite for the building of an export oriented production and marketing systems.

4. Opportunities for small-scale farmers to participation in high-value markets:

The net trade in food (Figure 7) as provided by FAO statistics indicates that the majority of the countries in WANA region are net importer of food, with the exception of few countries, namely Pakistan and Turkey.

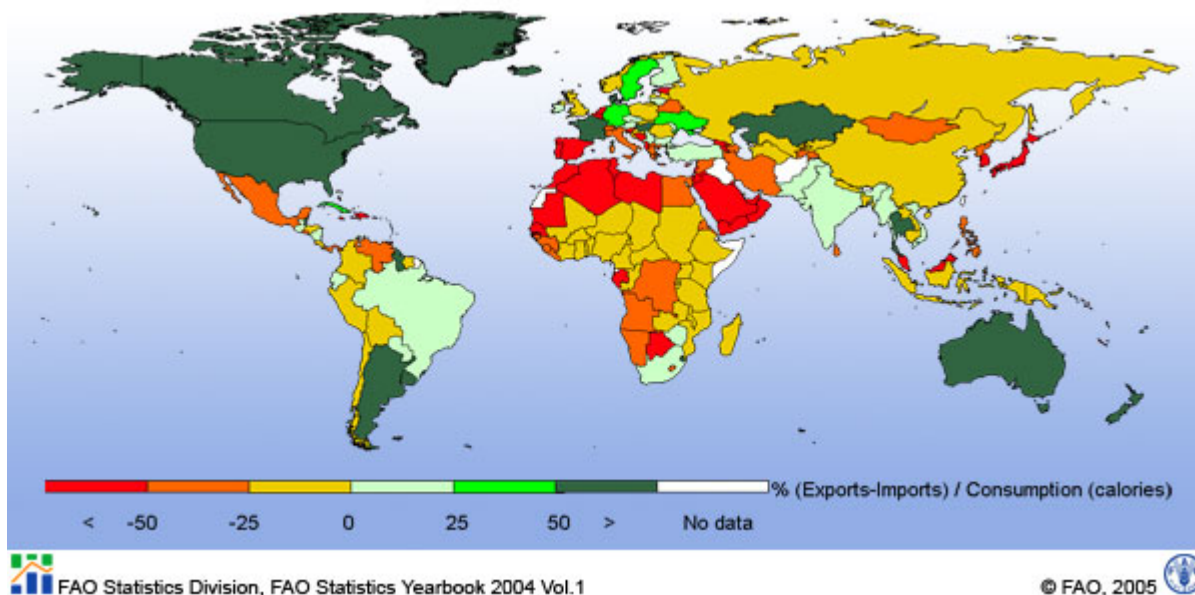


Figure (7): Net trade in food

The share of Agricultural exports (Figure 8) to total exports is generally low all over the region. It ranges between 10 to 30% in Pakistan, Turkey, Syria, Jordan, and Morocco, and from 5 to 10 percent Egypt, Tunisia and Oman. The agricultural exports form the rest of the countries in the region are below 5%.

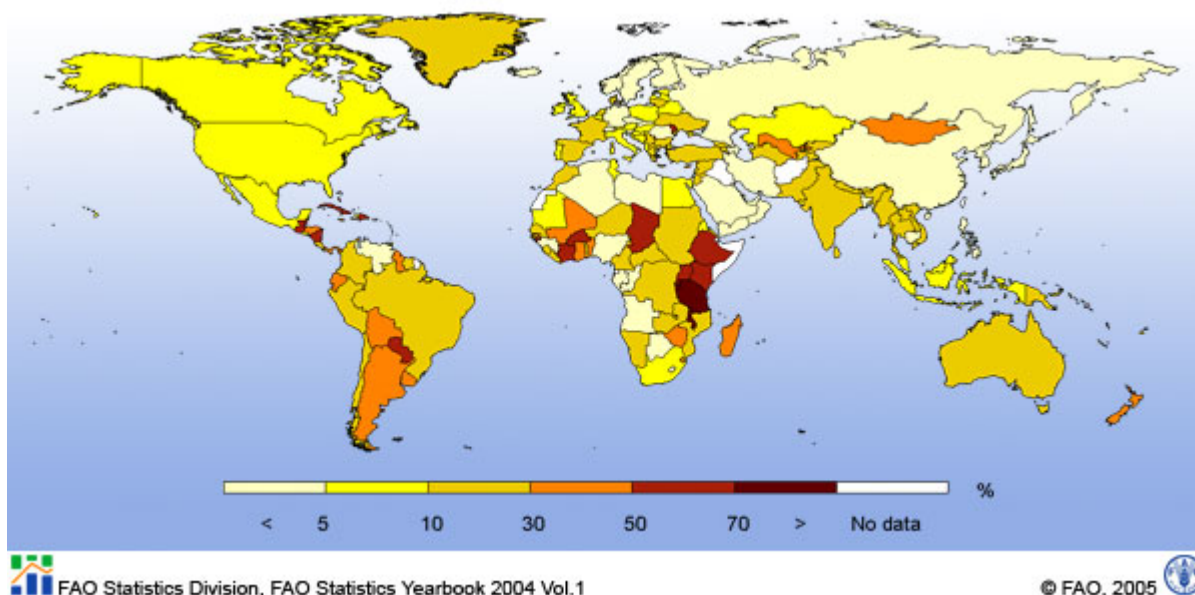


Figure (8): Share of agricultural exports to total export.

Future agriculture export competition:

Discussing rising share of trade by developing countries, FAO realized that global competition among exporters of wheat, rice, oilseeds, sugar and livestock is expected to intensify over the next ten years among both developed and developing countries, according to the Organization for Economic Cooperation and Development's latest Agricultural Outlook - produced for first time in collaboration with the UN Food and Agriculture Organization (FAO). Stiffer competition, combined with higher productivity, will result in a further drop in real prices for most basic food commodities. Farmers will thus have to make continued efforts to improve efficiency. Policy reforms could help improve agricultural markets. With increasing export supplies by low cost non-OECD countries and a continued high degree of protection in many of the rich OECD markets, rising demand growth in developing countries will result in an increase in their share of the global trade in farm products. The report estimates that total world cereal output will increase by over one percent annually with most of the growth occurring in the non-OECD area. Although increasing imports by China and other Asian countries could drive nominal prices higher in the near term, international wheat prices are expected to fall in real terms by around 11% over the next 10 years. However, in rebound from recently low levels, real world rice prices are expected to increase over the projection period, reversing the downward trend of the past 30 years. With the growing importance of China and India in global markets, small shocks to either demand or supply in these large countries could lead to substantial external adjustments. Similarly, conditions in the key emerging suppliers, particularly in South America, will be increasingly critical to the evolution of world markets. With rapidly increasing production and trade of livestock products, animal disease outbreaks also provide for an important source of uncertainty. Increasing concentration and globalization in the food industry, and their implication for the growing role of product standards, are likely to increase their influence on the evolution of global production and trade patterns. It is worthwhile to note here that in the 30 member countries of the OECD, the average level of support to farmers remained unchanged last year at 30 percent of overall farm receipts, most of which continues to be given through trade distorting measures such as the propping up of market prices. The report nevertheless welcomes the move to payments that are less linked to specific commodities in many countries.

Markets in West Asia and North Africa.

According to the Global Horticultural Assessment (2005), WANA has the capacity to serve as both the source and the sink for many of the horticultural products grown in the region. Demand is growing because increasing incomes allow the population to indulge in the historically high dietary intake of fruit, nuts, and vegetables. China dominates the regional horticultural industry with 20 percent of its arable land dedicated to horticultural crop production, supporting 47 percent of the world's vegetable production. East and Southeast Asia increased their net trade of horticultural commodities by 1.2 billion US dollars in 2002, while South Asia has become a net importer of fruits and vegetable (Weinberger and Lumpkin 2005). While acknowledging that the primary obstacles to ANE (Asia and Near East) market linkages are inadequacies in organization of producers, market intelligence, and value-added processing, it must be noted that the lack of market standards in the region impedes trade due to widely varying product quality. ANE suffers for lack of universally recognized marketing standards to gauge and judge product grades. Because standards differentiate commodities and reward producers of high-quality products, they provide incentives for improvements in quality and help to ensure marketable produce.

Sustainability of production.

Increased food production is certainly a necessary requirement for food security. It keeps prices in an affordable level for more people. We need to focus on the smallholder farmers in developing countries as key players in achieving the goals of environmental protection and stewardship, poverty reduction, and food security . The demand for food in the developing countries is enormous. The global demand for cereal grains over a 25-year period shows that the industrialized countries account for roughly 15% of this demand while 85% is in developing countries, (Sirageldin, 2004). The same is true for meat products. However, as the world population and wealth increase so does the demand for meat proteins . When it comes to roots and tubers, the demand in the most

industrialized countries will account for less than 3% of production while 85 to 97% will be used in the developing countries. While this points to the ongoing importance of international trade in food, there must be a transformation of the agriculture in developing countries if these food requirements are to be met. It is argued that increasing yields, and not the cultivated areas, is the only viable option to meet the increased demand for food at less expense while reserving the nature and protecting the biodiversity and endangered ecosystems that can be valuable resources for possible future economical activities. Sirageldin (2004) reported that three options are available today to increase yields, namely, high input agriculture, organic/peasant farming, and sustainable precision farming that combines the best science with best management practices. High input agriculture is what we know in industrialized countries. Largely a phenomenon of the past 50 years or so, it relies heavily on chemical and energy inputs. It is often associated with large, highly capitalized production units. It is not a model easily applied to the smallholder farms of developing countries. The increasing reliance on chemical inputs has led many in the industrialized world to promote organic farming as a substitute. Organic farming serves a small proportion of consumers and it is environmentally friendly where yield is dependent on manure applications. If this manure was to be obtained by having the cattle graze on open farmland, the amount of land required for organic farming would be enormous and the general land productivity will be too low. The economics of organic farming relies on low wages and high labor availability - an extreme poverty subsistence model that must not be perpetuated. The long-term solution will be precision farming marrying the best of science for the needs of the poor. Sustainable precision farming is the promise; adapting and applying the best of science to small holder farms will be required if we are to meet present and future food needs of the least developed countries. The question of whether it is possible to combine the best science and the best management for crop production by the smallholder farmer is gaining stronger support with time.

One more alternative is the urban and peri-urban agriculture that is now taking increasing interests in many developing countries. With the world's cities growing rapidly and the expansion of the cities and towns on the account of rural areas, farming in and around urban areas needs to play a bigger role in feeding city populations. Urban and peri-urban farms already supply food to about 700 million city dwellers, one-quarter of the world's urban population -- and nearly all of the world's population growth between now and 2030 will be concentrated in urban areas in developing countries, so that by then almost 60% of people in developing countries will live in cities. Urban agriculture involves using small plots such as vacant lots, gardens or roof tops in the city for growing crops and even for raising small livestock or milk cows. It can take many forms, from small "micro-gardens" to larger operations. Poverty rates in many cities are rising, and ever-larger numbers of city residents face difficulties accessing the food they need. In some developing countries, the urban poor spend 60% or more of their income on food.

Problems are compounded by poor infrastructure for transporting food to urban centers. Long distances, bad roads, and urban crowding cause spoilage of 10 to 30 percent of produce in transit. And as new, urban lifestyles lead greater numbers of people to consume more fats and less fiber, more fast food and fewer home-cooked meals, developing countries face a double challenge - widespread hunger on the one hand and rapid increases in obesity, diabetes, cardiovascular diseases and other diet-related diseases on the other.

5. Current R&D activities in the regions:

There is a wealth of institutional structure targeting at horticultural research and development in WANA region. The institutions concerned are both belonging to National Research Systems as well as International Institutes.

On the National level:

Many countries in the region has a well developed infrastructure related to research and development activities. Egypt for example has a research and development community related to horticulture, food processing, and export oriented food industries. The sector is financed mainly by the government. A little support from the industry is available for research and development activities. As far as the region is concerned, there is a need to:

- 1- Survey and estimate the funds available for agriculture and food production research and development within the growers, exporters and manufacturers of horticultural crop in particular. Data in this field is not available.
- 2- Survey the laboratories and facilities available that can offer technical support for high value products both in the private sector or governmental organizations.
- 3- Information related to the production technologies, legislation, marketing opportunities, and possible value added options within the research organizations are not enough to support their role in serving the industry.
- 4- The role of the civil society organizations and / or non-governmental organizations should be enhanced and supported.

Horticulture is a major contributor to the agricultural income. Its importance for the national economy is unquestionable. The importance of horticultural activities in is increasing recently due to the large areas cultivated with horticultural crops and the fact that the horticultural crops generate more yields and better prices. Horticultural crops also are more usable for food processing and value adding developments. Most of the known horticultural crops are grown in the WANA region due to the mild climate.

National Agricultural Research Institutions:

Faculties of agriculture that contain departments for horticulture, post harvest and handling, food technology and food processing are available in several countries of the region. Besides, most of the countries have several research departments or institutes related to the production and, processing, handling and management of high value products.

On the international level:

Several international organizations are working in the fields of research in the CWANA region. The Food and Agriculture Organization (FAO) of the United Nations has a representative office in almost all the capitals of the region, and a regional office located in Cairo, Egypt. The FAO activities are very well known. Besides, there is three more international centers working in CWANA region. The following is brief description for the organizations.

The International Center for Agricultural Research in Dry Areas (ICARDA):

The International Center for Agricultural Research in Dry Areas (ICARDA), and institute of the CGIAR located in Aleppo, Syria. ICARDA, is an autonomous non-profit international research center established in 1977 with headquarters in Aleppo, Syria, is one of the fifteen international

research centers supported by the Consultative Group on International Agricultural Research (CGIAR). ICARDA's mission is to improve the welfare of people through research and training in dry areas of the developing world, by increasing the production, productivity and nutritional quality of food, while preserving and enhancing the natural resource base. ICARDA's eco-regional mandate covers the countries of Central and West Asia and North Africa (CWANA). It has global responsibility for the improvement of lentil, barley and faba bean, and responsibility in dry areas for the on-farm management of water, the improvement of small ruminant nutrition and productivity, and the rehabilitation and management of rangelands. In the CWANA region ICARDA has responsibility for the enhancement of the productivity of bread and durum wheat, chickpea, forage legumes and their associated farming systems, and for ensuring the conservation and management of the natural resource base of water, land, and biodiversity. ICARDA works through a network of partnerships with national, regional and international institutions, universities, non-governmental organizations and ministries in the developing world and is committed to the advancement of agricultural research; free exchange of germplasm and information for research; protection of intellectual property rights, including indigenous knowledge of farmers; and poverty alleviation, particularly among women and children. Recently, ICARDA has showed a remarkable interest in promoting research and development activities in the fields related to horticulture and protected agriculture as a tool to maximize the water use efficiency and water productivity. ICARDA has several sub-regional research programs that covers almost all the area of the Central and West Asia and North Africa.

The International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM)

The International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) is an intergovernmental organization with a Mediterranean regional vocation. CIHEAM was founded in 1962 under the auspices of the OECD and the Council of Europe. The Centre currently has the following member countries: Albania, Algeria, Egypt, France, Greece, Italy, Lebanon, Malta, Morocco, Portugal, Spain, Tunisia and Turkey. The objective of the Centre is to provide complementary learning, both economic and technical, and develop a spirit of international co-operation among senior agricultural staff in the Mediterranean countries (CIHEAM founding agreement, Article 1). In order to fulfill this mission, CIHEAM organizes post-graduate specialization courses and promotes and co-ordinates research networks on topics of importance for the Mediterranean region concerning agriculture and natural resources. The Centre is directed by a Governing Board, which includes one representative from each member country. The OECD and the Council of Europe are members by right with consultative status. The European Commission, the FAO and the AOAD participate in the meetings of the Governing Board as observers. In order to define their scientific policy, the Governing Board is assisted by a Scientific Advisory Committee, made up of independent scientific personalities. The tasks of co-ordination and execution are ensured by a General Secretariat, which includes the Secretary General, the directors of the Institutes and the appointed personnel. The Headquarters of the General Secretariat are in Paris.

At present the Centre has four Mediterranean Agronomic Institutes (MAIB, MAICH, MAIM, MAIZ), situated in Bari (Italy), Chania (Greece), Montpellier (France) and Zaragoza (Spain) respectively. These centers aim at training, research, and other cooperative activities. Many activities of the Centre are jointly organized with national institutions of the member countries, thus favoring evolution towards a Mediterranean network of agronomic institutions of research and training.

The Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA)

The Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA) was established in 1985 to strengthen cooperation among national, regional and international research institutions and centers through the dissemination and exchange of information, experiences and research results. Its mission is to contribute to the enhancement of agricultural and rural development in the WANA Region. By fostering agricultural research and technology development and by strengthening collaboration within and outside the region, AARINENA aims to achieve greater degree of self-reliance in food and agriculture, and to improve the nutritional well-being and overall welfare of the people of the WANA Region while sustaining and further improving the productive capacity of the natural resources base. The Western Asia and North Africa (WANA) region is economically diverse, including both the oil rich countries of the Gulf and resource-scarce countries in relation to their population. The region is composed of five sub-regions (i.e., Maghreb, Nile Valley and Red Sea, Mashreq, Arabian Peninsula, and Western Asia) which cover roughly 21.6 million sq. km with some 610 million people. Population grows at an estimated annual rate of 2.1%, with a life expectancy of about 67 years. Gross National Product (GNP) in the region is around US\$ 2200 per capita (Middle East and North Africa region). The Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA) was established in 1985 to strengthen cooperation among national, regional and international research institutions and centers through the dissemination and exchange of information, experiences and research results. The mission of AARINENA is to contribute to the enhancement of agricultural and rural development in the Region through fostering agricultural research and technology development and by strengthening collaboration in this regard within and outside the Region in order to achieve greater degree of self-reliance in food and agriculture, and to improve the nutritional well-being and overall welfare of the people of the Region, while at the same time sustaining and further improving the productive capacity of the natural resources base.

AARINENA's objectives includes efforts to foster the development of agricultural research in the Near East and North Africa Region; promote the exchange of agricultural scientific and technical experience and information; strengthen national agricultural research capacities for providing timely and necessary data and information to policy-makers; encourage the establishment of appropriate cooperative research and training program in accordance with identified regional, bilateral or national needs and priorities; advise members on issues pertinent to research organization and management; strengthen cross-linkages between national, regional and international research centers and organizations, including universities, through involvement in jointly planned research and training program; and to assist in the mobilization of financial and other forms of support to all efforts aiming at strengthening agricultural research and technology development in the Region.

The Near East and North Africa Region, as far as AARINENA is concerned, is divided into five sub-regions: Maghreb Sub-Region including Algeria, Libya, Malta, Mauritania, Morocco, Tunisia; Nile Valley and Red Sea Sub-Region including Djibouti, Egypt, Sudan, Somalia, Yemen; Mashreq Sub-Region including Cyprus, Jordan, Iraq, Lebanon, Palestine, Syria; Arabian Peninsula Sub-Region including Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates; and finally West and Central Asian Sub-Region including Afghanistan, Iran, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkey, Turkmenistan, Uzbekistan.

AARINENA is co-sponsored by: the Food and Agriculture Organization of the United Nations (FAO), the International Centre for Agricultural Research in the Dry Areas (ICARDA) and the International Service for National Agricultural Research (ISNAR). As of May 1998, AARINENA has 22 member Institutions belonging to the following countries: Cyprus, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Oman, Pakistan, Palestine, the Sudan, Syria, Tunisia, United Arab Emirates and Yemen. Four international and regional organizations - the

Arab Centre for the Study of Arid zones and Dry lands (ACSAD), the Arab Organization for Agricultural Development (AOAD), the FAO Regional Near East Office (FAO/RNE) and the International Centre for Agricultural Research in the Dry Areas (ICARDA) - have also joined the Association. In addition to its full member institutions, AARINENA also welcome associate members from national, regional and international organizations.

6. Lessons learned

Horticulture and sustainable development:

Using greenhouses, 10,000 ha of environmentally controlled glasshouses produce more for the Netherlands than 2 million ha of agricultural land - agricultural land that is amongst the most productive in the world. These greenhouses have environments that are totally controlled in a closed system that best utilize the resources for the highest income. Production efficiency could be enough to compete in the international markets and get the best price. While we may not yet be ready according to Sirageldin (2004), to transfer this precise model of glasshouse technology and business management to the developing world, we must not under-estimate what can be achieved by small scale farmers working in concert. There are many cases of emerging horticultural enterprise in developing countries. In Colombia, for example, total flower exports were valued at \$580 million in 2000. Roses were the leading crop (valued at \$177 million) but more than 50 types of flowers were exported. With 30,000 boxes of flowers shipped daily, achieved only 8 years after the industry was established, Colombia is now second only to the Netherlands in the export flower business. Across Colombia, according to Sirageldin (2005), but mainly in the region of Sabana de Bogota, there are now 4500 ha of flower plantations and 130,000 people are directly or indirectly employed within this industry and an additional 7,000 workers are employed in the USA to handle these flowers. These days, two out of every three flowers sold in the USA come from Colombia. The Florverde strategy describes the integrated Colombian strategy for optimizing the use of national resources and improving long-term profitability within the concept of sustainable development. It has a human component of optimizing the use of Colombian human resources and an environmental component that aims to reduce and improve the use of pesticides, rationalize the administration and use of energy, water and other resources, and prevent any negative impacts on the landscape. Ecuador, despite a general economic downturn, is also maintaining success with its emerging flower industry. Here is a country that is home to 16,000 species of vascular plants, including 3,300 orchid species. Ecuador now follows Colombia as the world's third flower producer. Another example is the production of green beans in Kenya for export to Europe. In all of these cases horticulture is contributing to a turn-around in a developing country. These achievements have not received the attention they deserve because the international community has been so focused on the production and trade in cereals.

Egypt has recognized the important role of growers associations since 1997 which was a major step to activate the role of horticultural exports in the national economy. HEIA was established as a NGO to assure the members access to modern production technology, state of the art post harvest practices, and to support industry to reach its production, quality and marketing goals. The organization is an industry driven association aiming at increasing productivity and quality through continuous improvement of production, marketing, policy advocacy, training and management aspects. The association started by a small group of highly motivated and well oriented growers, exporters and academic workers. The small group is now much larger in number and much more efficient in work. The association participated in human capacity building programs locally and internationally. It also created, participated and supported major projects such as the establishment of the first perishable terminal in Cairo Airport. Such an organization is now looking towards the ways to invite small growers to participate in export oriented crop production especially for horticultural crops after being certified through EUREPGAP. As has been reported in the Global Horticultural Assessment (2005), the Egyptian producers' income has increased by organizing for market integration in Egypt. Lack of current market information and poor logistical coordination can limit smallholders' access to markets. USAID's Agricultural Exports and Rural Income (AERI) – El Shams program in Egypt is overcoming these hurdles by organizing producers into farmer associations (FAs) that link them with markets. In nine governorates in Upper Egypt, El Shams has effectively aggregated growers to enhance market power and facilitate capacity building. An FA serves as a center for training, as well as providing a mechanism to market products as a community. Producers receive market information, and technical training in sustainable production and postharvest quality methodologies. As a group, Egyptian FAs link with domestic and export contracts for their produce. Products include fresh cut green beans, melons, tomatoes, onions, and garlic. As of March 2005, 79 FAs have been formed in Egypt, affording 2,400 growers direct training during cross-visits, and impacting an additional 1,200 farmers through

diffusion of methodologies. El- Shams has also facilitated linkages with 31 exporters and/or buyers handling commodities produced by smallholders. To date, more than 100 high-value contracts have been signed. Horticultural sales have increased by 16.575 million Egyptian pounds and production has increased by 13,142 metric tons. The average FA member's income has improved by 226 percent to 7,251 Egyptian pounds per year. The horticultural sector has created 2,972 new jobs on farm and 5,994 jobs off farm.

7. Priorities for research:

It is worthwhile here to copy the priority research and development activities that were mentioned in the most recent publication of the Global Horticultural Assessment as reported by USAID (2005), as it was a regional event attended by several institutes, the major research priorities that were recommended in the publication on the global scale were related to Market systems, postharvest systems and food safety, genetic resources conservation and development, sustainable production systems and natural resources management, capacity building enabling environment, gender equity, and nutrition and human health.

Horticultural as a tool to maximize land and water resource use efficiency:

The following is some examples for the potential role of horticultural crop production systems to improve productivity and water use efficiency in WANA region. Once water is collected or harvested, there is no point in using it for supplementary irrigation for a lower value crops. It is advised to utilize the water in the most intensive cultivation systems using high value crops to produce enough cash to sustain good living. In the case of arid environments, the best utilization of soil and water resources is a must. Information related to on farm water use is available in a wide range of publications. It is quite difficult to sum it in few lines. Nevertheless, it is important to stress upon the different patterns of agricultural activities and their relative differences in water use efficiency

Integrated production systems

The integrated production systems include different packages of production such as organic Agriculture to produce chemical free fruits and vegetables. Also bio-fertilization and biological control of pests and diseases is a combination of efforts between specialists from microbiology, soil sciences, chemistry, bio- technology and horticulturists. The final outcome of these programs is a set of results aiming at improving the quality of horticultural crops.

Post harvest (storage, packing,) – processing:

The losses of horticultural crops used to be as high as 40% of the yields during handling and marketing processes. The Horticultural Research Institute in collaboration with other research organizations and universities conducts an elaborate and multi-disciplinary program for research and development.

Irrigated agriculture:

Irrigation systems vary in their water use efficiency. The amount of water required for an irrigation may be approximated by sampling the soil at several places in the field and estimating the moisture deficit. The water application is then calculated on this basis allowing for the possible losses. The irrigation efficiency for sprinkler irrigation could vary from 60 to 70%, improving to about 80% for localized irrigation, ranging between 45 and 75% in basin irrigation, and between 40 to 65 in furrow irrigation. The fact is that most of the horticultural crops in Egypt are now either grown in new lands where modern irrigation systems are used, or that the growers are turning to such systems to control salinity and waterlogging problems in old lands.

Protected cultivations:

The use of greenhouse and plastic house techniques had contributed substantially for the improvement of water use efficiency. The plastic or glass cover creates a special microclimate (Abou Hadid and El Beltagy, 1991) in which radiation and wind movement are lower than its value in the open field, while air relative humidity is higher than the open field air humidity. These factors favor a reduction in evapotranspiration (Eissa et al 1991). On the other hand, the higher temperature results in increased plant growth rate and results in more yield per unit area of the cultivated lands. The increase in yield and reduction in water consumption under protected cultivation was reported by Abou Hadid et al

(1992). The end result of this situation is larger yields under protected cultivation using less amounts of water which improve the water use efficiency as reported by Abou Hadid and El Beltagy (1992). The efficient use of water in greenhouses is also reflected on the efficient use of fertilizers. Many reports on this subject (Ismail et al, 1996; El Behairy et al, 1996; Abd Elmoniem et al, 1996) indicated that protected cultivation and soilless culture techniques help in improving nutritional conditions in plastic housed and to solve nutritional problems that could not easily be solved under open field conditions.

Soilless culture:

A remarkable example on the efficient use of water resources is the use of substrates in soilless culture for better vegetable quality and as a means for improving the water use efficiency.

To clarify the relation between substrate culture and water use efficiency, it may be noticed that the field grown tomato produce 3 kg of tomato fruits per cubic meter of water, plastic houses soil grown tomato produces 17 kg per cubic meter of water. Tomato grown in substrate under plastic house conditions in Egypt was reported to produce 45 kg of tomato fruits per cubic meter of water.

Soilless culture techniques were developed under glass houses in order to overcome major agricultural problems such as nutrition, plant diseases and environmental pollution. It was found later on to be one of the most efficient tools for water saving. The development of simple low cost system for hydroponic was the main challenge to make soilless culture possible. Several attempts to design and implement the different techniques of soilless culture were followed and were proved to be economically viable and environmentally safe. The utilization of such techniques resulted in improving water use efficiency to a great extent and helped to reduce the amount of chemicals used for both nutrition and pest and disease control to a considerable low level. The cost of production is relatively high but future research may be promising to reduce the cost and hence improve the applicability of these systems on a large scale in arid lands.

The limited water resources and rapid increase in population were the major factors that drew the attention towards the use of intensive agriculture in Egypt. Protected cultivation was the first step, which started initially at late seventies and intensified at mid eighties. Maximizing crop yield per square meter of soil as well as per cubic meter of water could be achieved through the use of hydroponic systems. (Zayed *et, al.* 1989).

Several possibilities and options of soilless culture are available to be used in Egypt. Nutrient film technique (NFT) and rockwool are the most expanded systems compared to the other systems. Even though it was found that rockwool should be replaced every other years, which means another additional cost compared to the nutrient film technique (NFT).

Several efforts have been made to introduce the nutrient film technique (NFT) in Egypt started initially in the tourist villages where the soil could not cultivated successfully. Never the less, there still be a good opportunity, to increase the water use efficiency by using other systems like the aeroponic systems (El Shinawy et al, 1996) .

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