

## AGRICULTURAL EXTENSION IN THE KINGDOM OF SAUDI ARABIA: DIFFICULT PRESENT AND DEMANDING FUTURE

M. Shayaa Al-Shayaa, Mirza B. Baig and Gary S. Straquadine\*

Department of Agricultural Extension and Rural Society, College of Food and Agricultural Sciences, King Saud University P.O. Box 2460, Riyadh 11451 Kingdom of Saudi Arabia

\*Dean and Executive Director, Utah State University- Tooele Regional Campus, Tooele, UT 84074 USA

Correspondence Author's e-mail: mbaig@ksu.edu.sa

### ABSTRACT

Agriculture is not environmentally ideal for the Kingdom of Saudi Arabia yet agricultural sector receives great importance. The state has been making concerted efforts through its five-year development plans to develop its agriculture to ensure food security. Due to the supportive and encouraging policies of the government, and able guidance from the extension service, farmers were able to enhance agricultural production and achieve self-sufficiency, at least to some extent. A voluminous literature indicates the state now exports its products such as wheat, dates, watermelon, poultry and fresh eggs and milk. The kingdom also produces some cereals like: wheat, sorghum, barley and millet in the regions rich in water resources. Tomatoes, watermelons, eggplants, potatoes, cucumbers and onions are also grown. Encouraging response on the production of Date-palm, citrus and grapes has been experienced. Agricultural endeavours aim at moving towards achieving food security. However, in order to produce more food for the increasing population, the country realized its agricultural potential but at the cost of over-exploitation of its natural resources. The government has launched a new plan on the cultivation of crops that require less quantities of water. The government, academia and the researchers are convinced that the use of over-exploitation of water is not a sustainable practice. A balance between agricultural production and the use of its resources, particularly water, without harming the environment needs to be maintained. In the situation, the role of Agricultural Extension has become more challenging and demanding. The extension work in the state is quite difficult and presents unique problems as the farms are being managed by the overseas workers who are unable to understand extension messages being delivered in Arabic or English languages. King Saud University (KSU) has developed an Extension Centre to promote sustainable agriculture in the kingdom.

**Key words:** Arid Environment, Agricultural Production, Self-sufficiency, Capacity Building, Natural Resources, Sustainable Agriculture.

### INTRODUCTION

Approximately spreading over an area of 2.25 million square kilometers (UNDP, 2010), the kingdom of Saudi Arabia is the home of 25.7 million masses (FAO, 2010). It comprises about 80 percent of the Arabian Peninsula (Al-Hamzi, 1997). It has borders with Jordan, Iraq and Kuwait in the north; Gulf, Bahrain, Qatar and the United Arab Emirates in the east; the Sultanate of Oman and Yemen in the south and the Red Sea with a coastline of 1750 km in the west (FAO, 2009). Its climate is quite harsh, dry desert with extreme temperatures (WHO, 2007) and climatically it is not very ideal for farming. In the past many agricultural programs were initiated to gain food security, ensure self-sufficiency and improve rural livelihoods in the kingdom. The kingdom has been successful in raising yields of several important crops, vegetables and fruits through the introduction of modern agricultural technologies, farmers friendly policies, provision of soft and interest free loans; distribution of free lands and efficient agricultural extension service. The kingdom not only gained self-

sufficiency, but a sufficient surplus was also produced to export (FAO, 2007; FAO, 2009). Soon after attaining the level of self-sufficiency, the kingdom realized that producing surplus at the cost of overexploitation of water is causing serious damage to its water resources and is not a sustainable practice (Al-Subaiee *et al.*, 2005).

In the situation, the kingdom immediately adopted the roll back policy and at present export of wheat has been disallowed. Crops with high water requirements are being discouraged. The scenario developed due to this particular situation completely changed the role of extension agents. At this juncture, extension agents are helping farmers to practice sustainable agriculture to realize reasonable production on their farms and the same time they are advocating for the adoption of conservation measures to protect the kingdom's natural resources. The responsibilities of the extension agents have been increased by manifolds, making their tasks quite challenging and difficult. In this article an efforts has been made to review the problems and challenges faced by the Extension Service of the Kingdom, furnish an account of the services offered to the farming community

and some suitable measures are suggested to improve the situation.

**An overview of agriculture in the kingdom:** Historically, small scale agriculture was practiced by the rural population with the help of nomads (Beduin) in the rural areas. With the limited arable lands having little vegetation and were Beduin were forced raising their livestock into a nomadic pattern. However, serious efforts on the development of agriculture with the objective of food security were initiated in 1970s. However, agriculture was able to receive attention first time in the first development plan of the kingdom (Royal Embassy of Saudi Arabia, USA, 2010). Further to move in this direction, emphasis was placed on the development of infrastructure. Major factors contributing to the development of agricultural sector are discussed as under:

**The initiatives to promote agriculture:** Among the numerous initiatives taken by the kingdom to promote modern agriculture, the prominent ones include establishment of rural roads, irrigation networks and storage, export facilities and agricultural research and training institutions (Royal Embassy of Saudi Arabia, USA, 2010). An appreciable progress made in the last 4 decades can be attributed to an array of programs, launched by the kingdom. They include: the provision of soft, long term interest-free loans; technical and support services; free seeds and fertilizers (Saudi Arabia Magazine, 2001); low cost water, fuel and electricity; duty free imports of raw materials and machinery; and drainage and irrigation network (Royal Embassy of Saudi Arabia, UK, 2010). In addition, through land and reclamation program, free of charge pieces of lands were given to farmers to increase area under cultivation and to encourage crop and livestock production. The farmers are also encouraged and assisted on the diversification of crops and adoption of the efficient farming systems (Royal Embassy of Saudi Arabia, UK, 2010). Due to the farmer friendly policies, easy availabilities of the farm inputs and other facilities a revolution in the agriculture sector was realized. An account of the agricultural production realized in the kingdom is presented in Table -1 and Fig-1.

**Kingdom became self-sufficient in some food items and an exporter:** The kingdom did achieve the self-sufficiency for some important food crops (Al-Subaiee *et al.*, 2005) by adopting new innovative and modern technologies (FAO, 2009). By 1984, Saudi Arabia became self-sufficient in wheat and shortly thereafter, kingdom started exporting wheat to several countries, including China (Royal Embassy of Saudi Arabia, London, UK. (2010). In addition, substantial amounts of other grains such as barley, sorghum and millets are also grown in the country (Royal Embassy of Saudi Arabia, USA, 2010). Intensive programs on dairy, meat and egg

farming were introduced and since 1985 the domestic requirements for these food items are met by the local farms (Royal Embassy of Saudi Arabia, UK 2010). An overview of agricultural trade of some of the commodities is presented in Fig. 2.

**Table 1- Agricultural production for the years 1999, 2003, 2004 and 2008 in the Kingdom of Saudi Arabia (KSA)**

Produce	Year	Year	Year	Year
	1999	2003	2004	2008
Production in tons				
Eggs	129,000	137,000	145,000	188,000
Fish	55,000	67,300	67,000	93,495
Fruits	1,190,000	1,333,000	1,450,000	1,616,000
Milk	1,039,000	1,200,000	1,230,000	1,370,000
Poultry	418,000	4,680,000	522,000	427,000
Red Meat	160,000	165,000	167,000	-
Vegetables	1,930,000	2,200,000	2,480,000	2,696,000
Wheat	1,804,000	2,552,000	2,952,000	1,986,000

Source: SAMIRAD (2005). Accessed on March 03, 2010; Data for the year 2008 are extracted from (1) Annual Agricultural Statistical Book 2000-2008 and (2) the website of the Ministry of Agriculture, KSA.

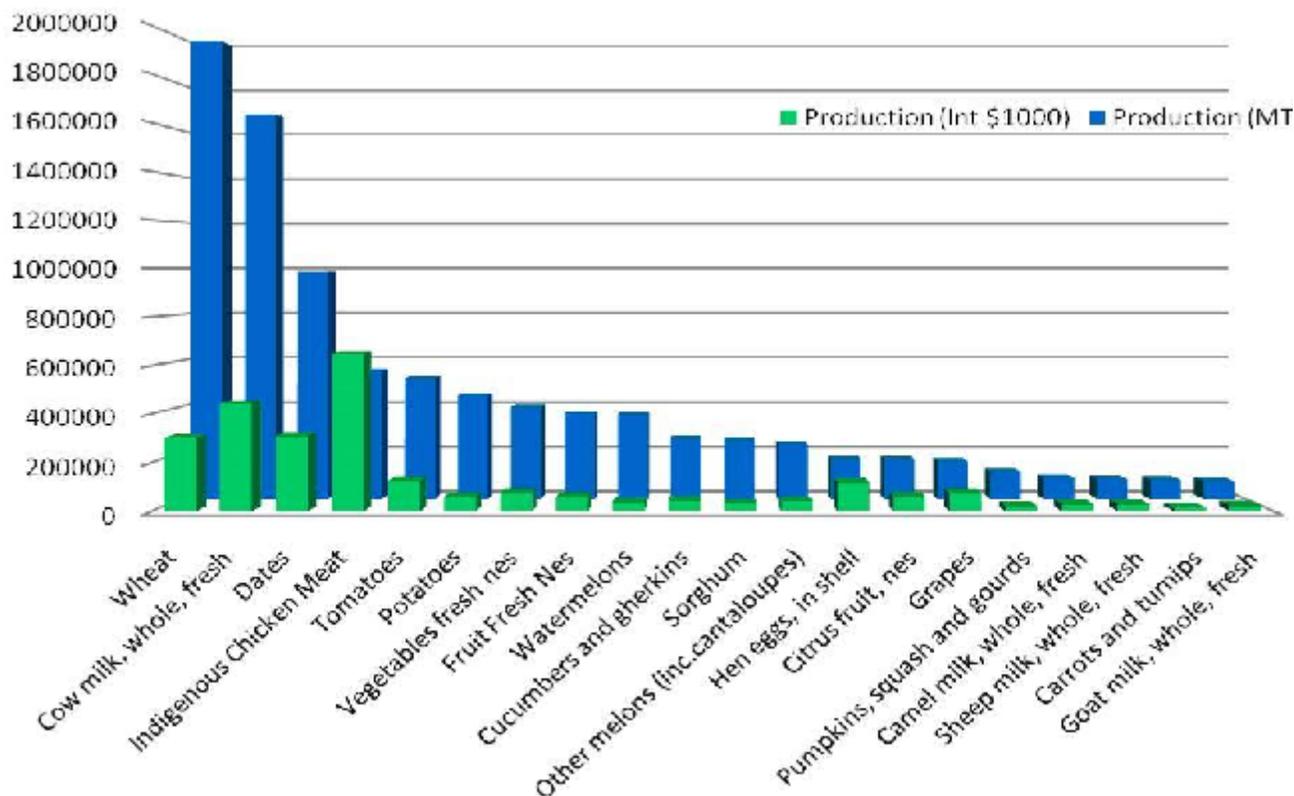
**Agricultural development achievement so far:** An appreciable growth in the production of all basic foods and the kingdom's self-sufficiency in a number of food items to feed its population have been reported by many sources (Al-Hazmi, 1997; FAO, 2009; Royal Embassy of Saudi Arabia, London, UK, 2010; Royal Embassy of Saudi Arabia, Ottawa, Canada, 2010; Oxford Business Press, 2010). Al-Hazmi, (1997) reports the successful farming sector in the kingdom as cereals like: wheat, barley, sorghum and millets have been grown on some areas. Similarly tomatoes, potato, watermelon, eggplant, cucumber and onions are some of the vegetables grown in the kingdom. The cultivation of fruits like date-palm, citrus and grapes remained successful in the kingdom. Alfalfa was grown as a forage crop, may be on small scale (Al-Hazmi, 1997). The most prominent agricultural accomplishment of the kingdom was its rapid transformation from importer to exporter of wheat (Royal Embassy of Saudi Arabia, Ottawa, Canada, 2010). A bird eye-view of imports and exports of agricultural commodities is shown in Figure -2.

As revealed in Fig. 2, exports remained below 10 percent and imports reached as high as 40% for livestock products of the total agricultural imports. Kingdom's also built its first silo to store extra grains in 1978 (Saudi Arabia Magazine, 2001). An account of production of certain prime food items, their consumption and the deficit met through imports is presented in Table -3. The kingdom's journey in agriculture was initiated to gain

food security, attained the level of self-sufficiency in few commodities, and some of the traders also started exporting a few agricultural commodities to other counties. However, to ensure long term sustainability and maintain its natural resources in good standing for its

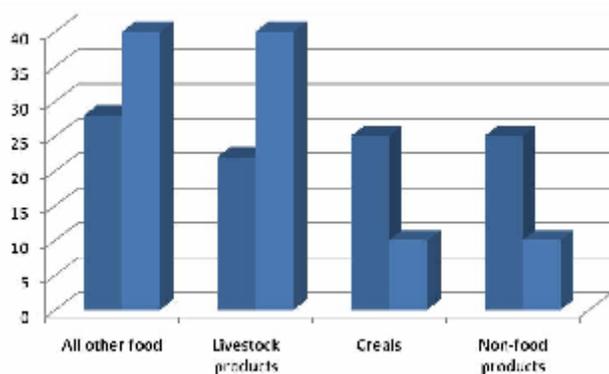
future generations, the kingdom very timely decided to roll back its policy on intensive agriculture to conserve its precious water resources and focused to grow only those crops with minimum water requirements.

**PRODUCTION OF AGRICULTURAL COMMODITIES IN METRIC TONS (MT) AND VALUE IN INTERNATIONAL DOLLARS.**



**Fig. 1 Production of Agricultural Commodities (metric tons) realized in the year 2008**

Source: FAOSTAT 2010 Available at: [http:// faostat. fao. org/ site/339/default.aspx](http://faostat.fao.org/site/339/default.aspx)



**Fig. 2 Composition of Agricultural Trade (Imports and exports expressed in percent of 100)**

Source: FAO, 2010. Available at Country Profiles – Saudi Arabia

**The problems and challenges faced by the kingdom**  
**Water shortage and the limited water resources:** The agriculture sector in the kingdom faces many constraints, the prominent are shortage of water; lack of experienced technical personnel; soil and water salinity, and the rising cost of desalination; marketing problems; low prices for products; pests and diseases etc. (Al-Zeir, 2009). However, among these water remains the most serious challenge in the kingdom (Ray, 2003), because the kingdom lacks perennial rivers or permanent bodies of water; this feature poses a continual challenge, as does the depletion of underground water resources (U.S. Department of Energy, 2002; Ray, 2003). A large gap exists between use and recharge rates. Waters from the underground aquifers are being drawn faster than the recharge rate (Ray, 2003). He also warns that the rapidly growing population could end up competing with agriculture for the scarce water resources (Ray, 2003).

Table -3 Food Balance (1000 tons) from 2000-2002

Food Groups	Production (+)	Exports (-)	Imports (+)	Seed, Feed, Other uses (-)	Consumption (=)
Cereals	2464	32	6290	5313	3409
Vegetable Oil	14	28	381	-10	377
Sugar & SW	-	15	556	-85	626
Roots & Tubers	349	44	173	72	407
Meat	643	23	426	0	1046

Source: FAO, 2010

**Arid climate and potential threats posed by the climate change:** The climate of the kingdom is harsh, hot and arid and any minor change in climate can have prominent impact on water resources and in turn on agriculture. Keeping in view the importance of this potential threat, an assessment study was conducted (Alkolibi, 2002). He analyzed the data for 4 decades and reported that an increase in temperature and decrease in precipitation (climate change) could have a major negative impact on agriculture and water supplies. However, preliminary assessment and analysis of the data showed no discernable signs of climate change. Nevertheless, the author urged the decision-makers of the kingdom to adopt a “no regret policy” keeping in view an increase in population and change in recent climatic conditions. Further, he suggested chalking out a policy including measures to avoid future environmental and socio-economic problems that might happen due to possible climate change.

**Environmental challenges:** In addition to the harsh climatic conditions, the kingdom faces numerous environmental challenges such as little as 5% arable land, desertification and creeping sands (U.S. Department of Energy, 2002). The need for agriculture, importance of natural resources and prevailing environmental issues warrant the scientists to evolve the sustainable farming practices; and genuinely they are advocating for the adoption of innovative environmental friendly technologies to sustain the agriculture sector.

#### **Future plans and initiatives to realize sustainable production**

**Ban on wheat export and cultivation of crops with low water requirements:** The kingdom witnessed remarkable progress in wheat production for many years. Saudi Arabia has been exporting rather than importing wheat for few years, and now its export has been completely disallowed to conserve water resources (Strategic Media, 2009). Gradually, less area was brought under wheat cultivation, consequently from 1994 to 2004, the production of grains also declined from 4.86 million tons to 2.95 million tons while the production of fruits and vegetables increased (SAMIRAD, 2005). The decline is the result of the policy of discouraging farmers

to grow less wheat and to popularize the idea of diversification of crops in order to save water resources and achieve their sustainability. Agriculture accounts for 85% the kingdom’s water consumption, i.e. about 17.5 billion cubic meters (BCM) and a significant part of it is drawn from groundwater sources and from the desalination plants. Waters from these plants are highly subsidized by the state (Agric water management, 2009). According to Strategic Media (2009), the kingdom now produces wheat for local consumption only, which is roughly 2.5-2.6 million tons per year. Now it does not allow exporting wheat and the government no longer buys barley as well from the farmers to save and conserve its water resources. Under the new plan, the entitlement for subsidies would be available for the crops with least water requirements (Agric water management, 2009).

**Exploring technologies to produce more with less drops of water:** The kingdom has been continuously exploring ways and means to produce more with less drops of water, overcome water deficit and remain sustainable in water use. For example, treated urban wastewater is used exclusively for watering agricultural crops (Saudi Arabia Magazine, 2001). By the year 2002, almost 548 million m<sup>3</sup> treated waste water was available, of which 123 million m<sup>3</sup> were re-used. Some 70 sewage plants were operating in the kingdom in 2003. In year 2006, about 166 million m<sup>3</sup> treated waste water was re-used and potentially it is an important source of irrigation and for other uses as well. The kingdom is promoting and stressing upon the use of drip irrigation system to save water and enhance (WUE) water use efficiency (FAO, 2009). Basic focus of the sustainable agriculture strategy is reduce water consumption to 50 percent of the presently volume of water used for crop production.

**Sustainable agriculture in the kingdom:** The kingdom is self-sufficient in wheat, fresh milk, eggs and potatoes, meeting 100 percent of the kingdom’s needs. General vegetables and fruits may satisfy 85 and 65 percent nation’s requirement (Strategic Media, 2009). However, this level of production has put the water resources of the kingdom at stake and is the result of over-exploitation and over-utilization of resources and inputs. This kind of boom and boost in agriculture is viewed to be only short-

term, short lived and unsustainable and the country needs to focus on long term sustainability and must adopt productive but preventive farming practices and in the scenario the kingdom is left with the only choice- and that is sustainable agriculture.

In the kingdom, the natural resources are faced with various types of stresses and are considered at risk today, perhaps more than ever, therefore, the scientists are struggling to devise the ways to use the natural resources wisely and in a sustainable manner. Al-Subaiee *et al.*, (2005) are of the opinion that conflict between production agriculture and the environment partially results from the degradation of natural resources. Keeping in view the importance of agriculture, natural resources and environment, Al-Subaiee and co-authors (2005) examined the future and potential of sustainable agriculture in the kingdom of Saudi Arabia. They noted that the kingdom had experienced rapid and remarkable agricultural development since the mid-1980s. In this situation, the scientists felt the need for change in the farming systems in favour of sustainable agriculture, and the Saudi policy-makers very wisely endorsed and stressed to make agriculture more sustainable (Al-Subaiee *et al.*, 2005) to meet the feed and food needs of the kingdom. To address the issue of water shortage and to fit the plant life in the existing conditions El-Obeidy (2009) suggests adopting agriculture that consumes less water and use crops with an economic value and potential. According to him, several xerophytes have been introduced in the harsh and arid climates and their potential as horticultural crops lies in the production of fruits that can offer commercial opportunities. They crops can offer the means of earnings to the dwellers of arid and marginal lands.

#### Potential role of agricultural extension

##### **Extension support can make agriculture sustainable:**

The intensification of agricultural extension programs to raise awareness among farmers regarding the significance of water conservation and development of manpower in the agriculture sector has received due attention in the development plans of the kingdom (Ministry of Planning, 2000; Al-Subaiee *et al.*, 2005). The plans include the initiatives that focus on the practice and promotion of sustainable agriculture. Ministry of Agriculture (MOA) is the primary agency responsible for the execution and implementation of activities related to agriculture; it also provides extension and research-based information to the farmers in the kingdom (Royal Embassy of Saudi Arabia, Ottawa, Canada 2010).

There is no denying that a dire need exists to create awareness among both the farmers and extension agents about the concepts and farming practices of sustainable agriculture. However, launching successful sustainable agriculture programs without the required support of Extension Service and its workers would remain

impossible. Before initiating any extension program, it is extremely important to evaluate the current perceptions and knowledge of the extension agents toward the particular concept that needs to be promoted. Realizing the importance of this aspect, Al-Subaiee *et al.*, (2005) conducted a study to determine the attitude and perceptions of Saudi extension agents toward sustainable agriculture. Their study indicated that the sustainable agriculture and its associated practices are capable of addressing many problems faced by the Saudi agriculture such as (low soil fertility; conservation of natural resources including water, variety selection, environmental protection etc). Their study further revealed that extension agents in Saudi Arabia generally had a positive perception toward sustainable agriculture, and farming practices and concepts (Al-Subaiee *et al.*, 2005).

**Need for training and capacity building:** Sustainable agriculture and sustainable irrigation systems require the application of a set of technical actions that include the introduction of modern cultivation techniques, modification in the cropping patterns through the use of crops with lower water requirements, judicious use of farm inputs, introduction of modern irrigation technologies, irrigation scheduling techniques, and introduction of economic incentives etc. FAO (1998) suggests that modern irrigation techniques should be selected with care and they should be to adapt to the local physical, agronomic, and socio-economic environment. Further they should match with managerial and technical skills of farmers. These practices cannot be employed without strengthening capacity building of in the irrigation and agricultural sectors. For effective extension and efficient technology transfer, it is imperative to improve the efficiency of institutions involved; and upgrade the technical and scientific know-how of the field and extension staff. In the changing scenario, it is acknowledged that training needs at all levels in both the disciplines are immense. It is important to design and organize training courses, workshops, seminars to elevate the educational levels and technical skills of all the stakeholders involved in the business.

##### **Extension services offered by King Saud University**

**(KSU):** King Saud University (KSU), established in 1957, is the oldest and the biggest university in the kingdom. It has been recently recognized as the top university in the Arab World, and one of the best 300 in the world, according to the Times Higher Education - QS World University Rankings (The World University Ranking, 2009).

##### **Agricultural Extension and Community Development**

**Centre at KSU:** KSU has established an Agricultural Extension Centre at the Department of Agricultural Extension and Rural Society, College of Food and

Agriculture Sciences, Riyadh. This is the only department in the entire Gulf Region delivering an academic degree program in the subject of Agricultural Extension and Rural Development. The department is delivering quality education, offering modern agricultural knowledge and upgrading the skills of the extensionists to be able to communicate with the farming communities. The mandate and activities of the department revolve around the transfer of better technologies, promotion of sustainable agriculture practices and development of skilled human resources and are in line with the mission and objectives of both the college and the university.

**Agricultural extension will have a demanding future in the kingdom:** In the kingdom, Extension and Education is viewed vital and essential in the developmental process that provides numerous services and undertakes multiple activities. The working sphere of Extension professionals has expanded beyond basic agriculture. In this modern and scientific era, extensionists are expected to offer professional advice on the management of natural resources particularly on soil and water; and marketing of agricultural commodities, in addition to their primary role as an expert on agriculture. Today, the role of an extensionist in the kingdom has become very demanding because he will have to promote modern farming practices while ensuring the sustainability of natural resources and providing appropriate up-to-date information on the marketing of agricultural commodities. Along with the education of farmers, he will to advocate the kingdom's policies and facilitate farmers in seeking interest free and soft-loans; farm inputs - supplies and machinery; and free lands etc.

Protection of the environment and conservation of the natural resources are enlisted as the major features and objectives of Saudi Arabia's national development strategy. The kingdom also attaches a great importance to its relatively limited fresh water and arable land resources. Estimated by UNDP about 89.2 percent of fresh water is consumed in agriculture, while 57.4 percent comes from non-renewable fresh aquifers (UNDP, 2010). Water is a non-renewable commodity – that means once it is gone – it is gone forever. Therefore, a stronger and forceful campaign to create awareness in its population for protecting and conserving non-renewable natural resources is very badly needed. At this point in time, intervening of Extension Service has an active and productive role to play. With the involvement and assistance of all the stake holders, using extension professionals and messages would be suitable and an appropriate choice to consider.

**Extension can help reviving rural economy and keeping rural communities intact:** By the end of the 3<sup>rd</sup> Development Plan (1985), almost 50 percent population was living in the rural areas (SAMIRAD, 2010). According to the most recent estimate only 15 percent

reside in the rural locations (WHO, 2007). It is very important to keep a reasonable and maintain a healthy ratio and balance between rural and urban population. It is highly desirable to make measures to reduce the population pressure from the big cities to make them more manageable. Big cities face social problems and experience difficulties in delivering needed essential services to the public and in cases seem under great stress in sustaining big populations. It is only possible if reasonable facilities are created for the rural masses and they are provided with equal or more attractive opportunities and facilities making rural areas worth-living. Above all, rural areas are viewed universally the cradle for classical cultures and civilizations and vanishing of rural areas will make national heritage disappear. Extension education can identify various small scale rural industries like rural arts and crafts, herbal medicines, bee keeping, rearing of small ruminants and others for rural people. Usually in the villages and rural areas, older people produce certain medicines from herbs and make home-made products of significant value and high quality. Such products can be identified and the valuable heritage can be preserved and handed over to generations to come. Extension can help making the villages more attractive by reviving rural economies and creating more economic activities to realize productive and healthy rural communities.

**Future roles for extension:** Today, environmental protection and conservation of the natural resources are subjects of prime importance in the kingdom. Extension and education can help creating awareness on their wise use.

- Extension can educate farmers in employing the judicious and moderate rates of farm inputs to operate in the safe limits without damaging the environment whereas they have been practicing high input agriculture in the past.
- Extension can help devising suitable solutions to address the farming issues like: lower yields and profit margins; crop diseases; insect-pest attacks; poor marketing facilities; low water availability and poor soil conditions. Extension can certainly come up with workable solutions and help farmers to practice sustainable agriculture.
- Agricultural Extension and Education can certainly help farmers adopting modern scientific farming practices that could elevate their crop yields, minimize losses, protect natural resources, address environmental issues and increase incomes.
- With the involvement and the possible cooperation of all the stakeholders of development, extension can help embarking rural development projects that could make rural areas more attractive for the rural people. These projects can result more income

opportunities, better facilities and improved livelihood and infrastructure.

- The rural masses are abandoning farming and are very rapidly coming out of their native areas to settle down in the big neighboring cities. Better agriculture and incoming generating rural industries and enterprises can restrict them to their native areas due to the revival of rural economies.
- Extension professionals can help the kingdom achieving its objectives set in development plans towards improving the living standards and realizing sustainable rural communities.

**Conclusions and recommendations:** By using enough irrigation water, the kingdom was able to produce surplus wheat and attained the level of exporter. Not only it caused a serious drain on the kingdom's water resources, drawing mainly from non-renewable aquifers, but it also required the use of huge quantities of chemical fertilizers to boost yields (Country Studies, 2010). This sort of agricultural production does not fall under the definition and limits of sustainable. Scientists believe that this sort of production would cause serious and irreversible damage to the water resources of the country. The kingdom should only focus on the farming systems, capable of resulting sustainable crop yields and improving rural livelihood of the farming communities. They include: poultry, greenhouse agriculture, dairy production and farming production technologies to produce more diversified crops with less water. The following extension education initiatives may help realizing sustainability:

**1. The initiatives taken by the kingdom** for improving the livelihood and elevating the living standards of the farmers are quite appreciable. However, agriculture and its diversification will further lead to prosperity.

**2. The role of agricultural extension** needs to be fully exploited and explored. It is proclaimed that awareness campaigns, technology transfer initiatives and agricultural extension can produce encouraging and tangible results in educating the farming communities on the wise, appropriate and judicious use of agricultural inputs including water. Extension can educate the farmers to the extent where they would start appreciating kingdom's natural resources (at least land and water) as the non-renewable resources. Extension can help farmers to consume water and use their lands considering them as the most precious and valuable resources.

**3. Rural people should not rely** only on agricultural sector alone; rather they need to broaden and diversify their income base by looking for value addition on the farms, new rural enterprises and cottage industries. All the three disciplines, sustainable agriculture, rural development and agricultural extension go hand-in-hand, as they all depend on each other.

**4. In-service training programs** for the extension agents are available to upgrade their skills and they should avail all opportunities made available to them. They should also be encouraged and provided with opportunities to attain higher education with an emphasis in extension education and/or technical agricultural fields as well as environmental concepts. Extension educators should develop and launch awareness programs to educate farmers in sustainable agriculture and farming technologies to achieve sustainable development and food security.

In extension and education "one size fits all" sort of business does not work at all. There is no single strategy, method or model that would address all issues and work on all of its clientele. However, any extension model that focuses on: gap-filling initiatives, address prime issues faced by the farming; capacity building, regular in-service training of extension staff; the development of skilled human resources capable of working on the judicious and sustainable use of land and water resources towards better farming; and finally establishing a strong professional links among research, teaching and extension may hold great potential in the kingdom.

**Acknowledgement:** The authors are grateful to the Saudi Society of Agricultural Sciences, Kingdom of Saudi Arabia for extending all possible assistance and cooperation in the completion of this study.

## REFERENCES

- Al-Hamzi, A.S. (1997). Country Report on Nematodes – Saudi Arabia. Proceedings of the Expert consultation on plant nematode problems and their control in the near east region, held at Karachi, Pakistan, 22-26 Nov. 1992. (Eds.) Maqbool, M.A. and Brian Kerry. Published by FAO, Rome, Italy.
- Alkolibi, Fahad A. (2002). Possible effect of global warming on agriculture and water resources in Saudi Arabia: Impacts and Responses. *Climate Change*. 54, 225-245.
- Al-Subaiee, F. S., E. P. Yoder, and J. S. Thomson. (2005). Extension agents' perceptions of sustainable agriculture in the Riyadh Region of Saudi Arabia. *Journal of International Agricultural Extension Education*, 12, 5-14.
- Al Zeir, Khaled. (2009). Protected agriculture in the Kingdom of Saudi Arabia. Accessed on May 14, 2010  
[www.icarda.org/aprp/PDF/PAinAP\\_KSA.pdf](http://www.icarda.org/aprp/PDF/PAinAP_KSA.pdf).
- El-Obeidy, Ahmed A. (2009). Introducing new crops with high water use efficiency in the Middle East and North Africa. The future of the drylands. Pp 659-667. DOI: 10.1007/978-14020-6970-3\_56

- FAO. (1998). An overview on AOAD's strategies in relation to water policy reform in the Arab region. Proc. Of the 2<sup>nd</sup> expert consultation on national water policy reform in the Near East. Food and Agriculture Organization of the United Nations (FAO). Regional Office for the Near East. 24-25 Nov., 1997: Cairo, Egypt.
- FAO (2009a). Irrigation in the Middle East Region in Figures AQUASTAT Survey 2008. FAO Water Report 34, Country Report Saudi Arabia. Edited by Karen Frenken, FAO Land and Water Division, Food and Agriculture Organization of the United Nations, Rome 2009, pp 325-337.
- FAO (2009b). Country Profile. Food and Agriculture Organization of the United Nations, Rome 2009.
- Glennon, Robert. (2009). Saudi Arabia's water woes. The Huffington Post. December 8, 2009 by Robert Glennon Posted January 14, 2009. Accessed on March 2, 2010. [http://www.huffingtonpost.com/robert-glennon/saudi-arabias-water-woes\\_b\\_157817.html](http://www.huffingtonpost.com/robert-glennon/saudi-arabias-water-woes_b_157817.html)
- Ministry of Planning. (2000). The Seventh Saudi Development Plan. Riyadh. The Kingdom of Saudi Arabia.
- Oxford Business Group. (2010). Great Transition – Saudi Arabia Planting New Seeds. Accessed on May 25, 2010. <http://halalfocus.net/2010/04/27/great-transition-saudi-arabia-planting-new-seeds/>
- RPWRC. (2010). Red Palm Weevil Research Chair. Accessed on May 27, 2010. [http://www.rpwrc-ksu.org/index.php?page\\_id=93](http://www.rpwrc-ksu.org/index.php?page_id=93)
- Royal Embassy of Saudi Arabia, USA (2009). The Kingdom of Saudi Arabia - Report on Political, Economic and Development Initiatives, November, 2009. Information Office, Washington, DC. USA. Accessed March 30, 2010 from <http://www.saudiembassy.net/affairs/reports/>
- Royal Embassy of Saudi Arabia, USA (2010). Agriculture and Water. Royal Embassy of Saudi Arabia, Washington, DC USA. (Accessed on May 12, 2010). [http://www.saudiembassy.net/print/about/country-information/agriculture\\_water/default.aspx](http://www.saudiembassy.net/print/about/country-information/agriculture_water/default.aspx).
- Royal Embassy of Saudi Arabia, London, UK. (2010). Ministry of Foreign Affairs. Agriculture and Water Resources. Accessed March 30, 2009 from <http://www.mofa.gov.sa/Detail.asp?InSectionID=1545&InNewsItemID=24550>
- Royal Embassy of Saudi Arabia, Ottawa, Canada (2010). Agriculture and Water. Accessed on January 01, 2010 from <http://www.mofa.gov.sa/detail.asp?InNewsItemID=103852&InTemplateKey=print>
- SAMIRAD. (2005). The Saudi Arabian market information resource. Agricultural developments in Saudi Arabia. 21 September, 2005. Accessed March 30, 2009 from <http://www.saudinf.com/main/f41.htm>.
- Saudi Arabia Magazine (2001). Making the desert come alive. Petroleum and Minerals. Accessed on May 24, 2010. [www.saudiembassy.net/files/PDF/Publications/.../Agriculture.htm](http://www.saudiembassy.net/files/PDF/Publications/.../Agriculture.htm)
- Strategic Media. (2009). Cultivating Sustainable Agriculture. The Kingdom of Saudi Arabia. Strategic Powerhouse, Global Strength, Part II, Special Report prepared by Media Report. [www.foreignaffairs.com/files/attachments/saudi\\_arabia\\_7.pdf](http://www.foreignaffairs.com/files/attachments/saudi_arabia_7.pdf)
- The World University Ranking. (2009). <http://ksu.edu.sa/AboutKSU/Pages/qs.aspx>. Accessed on May 24, 2010.
- United Nations Development Program (UNDP). (2010). MDGs -Arab Kingdoms -Saudi Arabia progress towards environmental sustainability. Accessed March 30, 2009 from <http://www.undp.org/energyandenvironment/sustainabledifference/PDFs/ArabKingdomKingdoms/SaudiArabia.pdf>
- World Health Organization (WHO). (2007). Country cooperation strategy - At a glance. Accessed March 30, 2009 from <http://www.who.int/countryfocus>.