# Agricultural Extension and Sustainable Water Resources Management in Agriculture

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**Abstract:** Agricultural extension is a public service for human resource development (HRD) in the agricultural sector. Multiple studies in Iran showed that, although extension services has played a positive role in agricultural development of Iran, but there are difficulties, barriers, misunderstandings, and weaknesses in the transfer of new technology and information to farmers**.** Lacking the suitable linkage between extension and research organizations has been a barrier for transfer of appropriate new technology to farmers. This problem exists in water sector of agriculture. The major consumer of water in Iran is the agriculture sector. Identifying suitable extension mechanisms have important role to developing extension system. Therefore, identifying extension mechanisms for supporting sustainable water resources management in agriculture of Iran is the one of the major approaches needs to be carefully thought and accurately implemented for the extension system development. [Ahmad Reza Ommani. **Agricultural Extension and Sustainable Water Resources Management in Agriculture**. Journal of American Science 2011;7(5):106-112]. (ISSN: 1545-1003). http://www.americanscience.org.

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## 1. Challenges for Sustainable Agriculture

During the past fifty years, agricultural development policies have been remarkably successful at emphasizing external inputs as the means to increase food production. This has led to growth in global consumption of pesticides, inorganic fertilizer, animal feedstuffs, and tractors and other machinery (Ommani and Chizari, 2002). These external inputs have, however, substituted for natural processes and resource, rendering them less powerful. Pesticides have replaced biological, cultural, and mechanical methods for controlling pests, weeds, and diseases; inorganic fertilizers have substituted for livestock manures, composts, and nitrogen-fixing crops; information for management decision comes from input suppliers, researchers and extensionists rather than from local sources and fossil fuels have substituted for locally generated energy sources (Roling and Pretty, 1997).

The basic challenge for sustainable agriculture is to make better use of these internal resources. This can be done by minimizing the external inputs used, by regenerating internal resource more effectively, or by combinations of both (Ommani and Chizari, 2007).

According to various studies, the agri-food sector in Iran has not yet shown any significant development during the last decades. Despite the advancement of infrastructural services made available to rural people over the past 20 years, they still, however unfortunately, live in unequal social and cultural environments. In the third decade of rural development in, Iran, this problem will reveal itself as societal demands which naturally bring about social challenges in future (Safaei, 1999). The most important challenges may fall in the following categories: Inadequate resource management for production and insisting degradation of soil or water resources and the associated ecological consequences and inadequate job opportunities (Safaei, 1999). Nevertheless, there is various evidence that agriculture is still far behind the real potential of the country considering its available resource. On the other hand, sustainable land and water use has not yet been reached in Iran (Darvishi, 2003).

Karshenas (1994) contended that the difficulties within Iranian agriculture have resulted from inefficient resources management by actors within the sector, rather than by a squeeze of natural resources in agriculture. Hence, more consideration to human resources in the agricultural sector is essential. Since farmers and land and water users are the primary active human resources in the agricultural sector, increasing their competence is of necessity to improve the efficiency and productivity of farming. Today more consideration to human resources in the agricultural sector becoming increasingly important because of the competitiveness within the sector. Based on the research of Karami and Rezaei-Moghaddam (1998), both socio-economic characteristics and environmental conditions of the farm have increased the poverty of Iranian farmers. They suggest that smallholder farmers with under-developed socio-economic and environmental conditions are relatively

poorer. They concluded that poverty is a major reason for unsustainable agriculture. Lack of sufficient farm management competencies effectuate higher soil erosion, over-fertilization, inadequate application of manure, lack of fallow, overgrazing, burning of crop residue, and over-use of pesticides.

In addition, Chizari, Lindner and Lashkarara (2001, p.65) reported that:

"Major barriers hampering adoption of sustainable agriculture practices included: limited financial returns for farmers, limited farmer knowledge of sustainable agriculture principles and methods, low levels of farmer education, government rules and regulations, problems with soil erosion and lack of water, and a low level of extension agent knowledge with respect to sustainable agriculture."

**2. Challenges for Water and Soil Resources**

Water pollution and destruction of natural resources is one of the serious problems faced by the people in Iran. Rapid population growth, industrialization and urbanization in the country are adversely affecting the environment. Though the relationship is complex, population size and growth tend to expand and accelerate these human impacts on the environment (Razavi, 2001)

Direct impacts of agricultural development on the environment arise from farming activities, which contribute to water pollution (Ommani and Noorivandi, 2003). Usage of chemical material in agricultural practices has main impacted on water resource pollution. Seepage of pollution waters that produce by agricultural practices. Karshenas (1994) claimed that the difficulties within Iranian agriculture were caused by the mismanagement of human resources and by actors within the agricultural sector, and not because of shortages of natural resources in agriculture. Main method that use for plow of lands in farms of Iran is traditional plowing. Traditional plowing cuts down and overturns up to 8" of soil. The coulter disks on traditional plows are straight disks. This way has vital affected on erosion of soil and water.

Direct impacts of agricultural development on the environment arise from farming activities, which contribute to soil erosion, land salinization and loss of nutrients (Abtahi, 2006). In Iran, like other developing countries, soil erosion is one of the most important factor that affect on agricultural productivity. The content of annual soil erosion in Iran is estimated 2.5 billion ton. This amount is equivalent with 8 percent of soil erosion at world scale (Najafi, 2005).

Nevertheless, there is a variety of evidence that agriculture in Iran still lags far behind what it could potentially achieve considering the available resource in the country. For instance, research reveals that more than 50% of the total available land, water, and natural resource have not yet been used in agriculture and only 37% of all cultivable land and 58% of all acquirable water, have been utilized (Tahmasebi, 1998). On the other hand, sustainable land use has not yet been achieved in Iran.

Another direct impact of agricultural development on the environment arises from farming activities, which contribute to water pollution (Ommani and Noorivandi, 2003). Usage of chemical material in agricultural practices has main impacted on water resource pollution. Seepage of pollution waters that produce by agricultural practices is main factor to pollution of suberranean water resource.

Agriculture, as the single largest user of freshwater on a global basis and as a major cause of degradation of surface and groundwater resource through erosion and chemical runoff, has cause to be concerned about the global implications of water quality. The associated agrofood-processing industry is also a significant source of organic pollution in most countries. Aquaculture is now recognized as a major problem in freshwater, estuarine and coastal environments, leading to eutrophication and ecosystem damage. The principal environmental and public health dimensions of the global freshwater quality problem are highlighted below (Ongley, 1996):

- Five million people die annually from water-borne diseases.
- Ecosystem dysfunction and loss of biodiversity.
- Contamination of marine ecosystems from land-based activities.
- Contamination of groundwater resource.
- Global contamination by persistent organic pollutants.

In addition to problems of waterlogging, desertification, salinization, erosion, etc., that affect irrigated areas; the problem of downstream degradation of water quality by salts, agrochemicals and toxic leachates is a serious environmental problem. "It is of relatively recent recognition that salinization of water resource is a major and widespread phenomenon of possibly even greater concern to the sustainability of irrigation than is that of the salinization of soils. Indeed, only in the past few years has it become apparent that trace toxic constituents, such as Se, Mo and As in agricultural drainage waters may cause pollution problems that threaten the continuation of irrigation in some projects" (Rhoades, 1993).

**3. Enhancing Water Conservation**

FAO (2003, p. 21) claimed that the regional water demand management strategy would be based on the following domains:

- Generalization of modern and improved irrigation methods in replacement of the currently prevailing conventional, low-efficiency methods;
- Promotion of water recycling and use of non conventional water resource such as treated wastewater and other low-quality waters;
- Mobilization of the water resource still available, through infrastructure and water harvesting techniques, with due consideration to the environment;
- Adoption of irrigation water pricing to recover at least operation and maintenance costs of irrigation schemes and to enhance water conservation and higher productivity;
- Review of water-related policies with a major focus on water scarcity and drought preparedness and mitigation;
- Establishment and adoption of water regulatory frameworks and review of existing ones to introduce measures and incentives for water savings and to grantee transferable water rights;
- Irrigated crop diversification, promoting high value and water-stress tolerant crops;
- Regional cooperation on the above aspects to create synergy from investments and promote exchange of experience between countries of the region.

The problems of water scarcity, groundwater depletion, pollution, water logging and salinity are symptoms of a much deeper problem embedded in policy, institutional and market failures for the development and management of water resource in the Iran. Policy failure is attributed to low cost recovery used in producing a commodity (FAO, 2003). The institutional failure is due to lack of well-defined property rights, improper regulatory frameworks and open access that encourage depletion of natural resource such as groundwater for which the user does not pay the cost. Finally, market failure refers to the existence of natural monopoly and other external cost placed on agriculture and water sector.

## 4. Role of Extension Education in Sustainable Water resources management (SWRM) in Agriculture:

### Environmental Education

More than half of the world's population, and more than 70 percent of the world's poor are to be found in rural areas where hunger, literacy and low school achievement are common. Education for a large number of people in rural areas is crucial for achieving sustainable development. Poverty education strategies are now placing emphasis on rural development that encompasses all those who live in rural areas. Such strategies need to address the provision of education for the many target groups: children, youth, and adults, giving priority to gender imbalances. This complex and urgent challenge should be addressed systematically, through an intricate set of policy measures, at all levels of education systems (UNESCO, 2002).

There are five key interrelated dimensions of the relationship between access to good agricultural water, socioeconomic uplifting in rural communities, and poverty reduction. The dimensions are production, income/consumption, employment, vulnerability/food security, and overall welfare (Hussain et al, 2004). In general, access to good irrigation allows poor people to increase their production and income, and enhances opportunities to diversify their income base, reducing vulnerability caused by the seasonality of agricultural production as well as external shocks. Thus, access to good irrigation has the potential to contribute to poverty reduction and the movement of people from ill-being to well-being. While there is an enormous literature on the impact of irrigation on poverty reducing intermediate variables, particularly from South Asia, no review is made here. Rather, recent case studies are presented to identify the conditions under which access to agricultural water can have significant poverty-reducing impacts. Before reviewing the case studies, it is useful to have a conceptual framework for considering the potential impacts agricultural water can have on various segments of the rural population (Hussain et al, 2004).

The world as we know it has a number of immense, human related problems and all the predictions are that these problems will get worse unless we act globally (Inman and Rogers, 2007). Education is one powerful way in which we can affect change for a different kind of world (Benn, 1999).

### Extension Education and Sustainable Water Resources Management (SWRM)

The great challenge for the coming decades will be to increase food production with less water, particularly in countries with limited water and land resource. The effective and sustainable use of water for agriculture has become a global priority of vital importance, requiring urgent and immediate solutions in view of intensifying competition (Ommani and Chizari, 2006). Based of multiple researches training and education are a key input, and requirement, of sustainable development (Loucks, 2000; UNESCO, 2002; FAO, 2003).

The problem is not new and much research and investments have been made to develop more refined techniques and practices to apply water accurately to the crop according their requirements. There still exists a large gap between the availability of technologies for effective water use and the adoption of these technologies. One of the reasons is that relatively little attention is paid to establish an effective support system to assist farmers in the adoption and properly operation of new techniques and technologies.

Extension services can play an importantly role in assisting users to adopt new techniques and technologies for more efficient water use and increased production. Such services can be provided by private, public or co-operative agencies. Increasingly commercial agencies can take over the traditional role of the public agencies, although often restricted to the more lucrative parts of irrigation sector. Critical in the promotion of irrigation advisory services is the financial sustainability of such institutes, as in particular in many developing countries inadequate funding is available to finance public services (Smith and Munoz, 2002).

Sivayoganathan and Mowjood (2003) at their research with title "role of extension in irrigation water management in Sri Lanka" highlights the dynamic role of extension in effective irrigation water management by farmers engaged in both surface as well as groundwater irrigation. Irrigation water management to be effective should meet the perceived needs of the three major stakeholders namely the farmers, the system operators and the policy makers. The recent trend is the transfer of irrigation system management from the government agencies to the farmer organizations. The farmer organizations should, therefore, be strengthened by training and by the provision of necessary legal, economic and social supports so that they could play an effective role in motivating farmers to become partners rather than mere participants in irrigation water management. On-farm water management technologies for effective water use should be demonstrated to farmers and they should be encouraged to adopt the same. The village level officers from both government and non-government agencies engaged in advising farmers in irrigated agriculture should be trained periodically so that they could perform their role effectively leading to greater agricultural productivity.

Powell (1977) claimed that the contributions, which an agricultural extension service can make to improve water management at the farm level, are very essential. To be able to influence farmers in developing countries it is essential to devise systems in which relatively unskilled extension staff can communicate to the large numbers of small-scale farmers. Patterns of crop-rotation must be simple and will frequently be constrained by subsistence requirements. To establish the type of technical advice needed and communications systems to support this advice it is necessary to identify the stage of development, the aptitude and innovativeness of the farmers involved in the project.

Extension activities based on the survey information were effective in creating awareness, but did not result in widespread change (Armstrong, 2000). Also, development options that have the potential to increase whole farm profit will invariably consider the potential to increase water use efficiency (WUE). At this regard, extension approaches are very important (Armstrong, 2000).

Smith (2005) pointed out, that through a participatory approach in extension, technical staff and other stakeholders put farmers in charge of water management at field and scheme level, promote the adoption of appropriate technologies and establish the necessary local capacity to put farmers in charge of water development and management. Participatory Training and Extension (PT&E) has proved to be an effective tool for this and to establish the appropriate support structure to assist and advise farmers in irrigation development and management. PT&E is in particular useful for small holder irrigation and in the case of irrigation management transfer programs.

Bruening and Martin (1992) at their research with title "farmer perceptions of soil and water conservation issues: implications to agricultural and extension education" claimed that the following conclusions were drawn from the findings of the study;

- Groundwater and water quality issues seem to be of greater concern to farmers than soil conservation issues.
- Field demonstrations and county meetings are useful techniques to use when presenting information about soil and water conservation issues.
- Farmers explain governmental agencies such as Soil Conservation Service, County Extension Service and state university specialists as the most useful sources of information regarding soil and water conservation issues.
- Farmers believe improved communications and education are needed to ensure proper management of chemicals used in agriculture (p. 53).

Andrzej (2006) presented direct relation between water management and farmer's education. Also, Molden (2007) stated, that investments are required to build knowledge and to reform and develop institutions. Education, research, capacity building,

and awareness raising are stepping stones toward better sustainable water management in agriculture. A new cadre of policymakers, managers, and extension providers is needed, with staff trained to understand and support producers in water management investments in farms and communities. But investments are not enough.

Molden (2007) claimed that, improving sustainable water management in agriculture requires learning by doing and a flexible, adaptive approach. Adaptive management is appropriate for variable resource in a context of continually fluctuating parameters. Adaptive management incorporates an understanding of the variability within systems, as well as long-term and slow-onset changes. It allows for management practices to be responsive to these variations, some of which can be rapid (Molden, 2007).

Loucks (2000) pointed out , that a "key to sustainable water resources management is the existence of sufficiently well trained personnel in all of the disciplines needed in the planning, development, and management processes"(p. 7). In regions where such a capacity is needed but does not exist, it should be developed. Training and education are a very important input of sustainable development. Capacity building is one of the most essential and important long-term conditions required for sustainable development. Sustainable systems development and evolution cannot be achieved without local expertise, an expertise that needs to be developed and to be transferred to each succeeding generation of professionals (Loucks, 2000).

Another important factor in sustainable water resources management is that the local people must not only be capable, but must also be willing to assume the responsibility for their water resource systems (Loucks, 2000). One of the drawbacks of a centralized dominating government that takes the responsibility for local system design and operation is that the local people become accustomed to looking to government for help, rather than to looking to themselves. The ideal local water resource managers are well-trained persons who know the behavior of that system, have experience with its floods and its droughts, and know the concerns and customs of the people of the region, a group to which they belong (Loucks, 2000).

In the late 1980s, it was realized that most technologies developed by researches alone were inappropriate for smallholder farmers (FAO, 2001). Farmer participatory research became the approach to adapt technologies to farmers' conditions and by the 1990s, to develop technologies together with farmers. Farmers were now seen as partners in research and extension, and the key players in the innovation process (Anyaegbunam, Mefalopulos and Moetsabi, 2004). The understanding that the main key to agricultural development is to enhance the farmers' management and problem solving capacity and the farmers' capacities to develop, modify and diffuse new technologies and techniques themselves from farmer to farmer led to the development of Participatory Extension (FAO, 2001).

FAO (2001) also claimed that for successful and sustainable introduction, use and improvement of water control techniques and technologies farmers should be encouraged to analyze their problems, search for solutions, monitor and evaluate the selected and implemented techniques and technologies, and adjust them according to their constraints and opportunities. Participatory Training and Extension in Farmers' Water Management (PT&E-FWM) aims to ensure a sustained support to farmers in this process (Kay, 2002).

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