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Shatanawi M., Duqqah M., Naber S.

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AGRICULTURE AND IRRIGATION WATER POLICIES TOWARD IMPROVED WATER CONSERVATION IN JORDAN

M. Shatanawi*, M. Duqqah and S. Naber*****
* Professor of Water Resources and Irrigation, University of Jordan Amman, Jordan
E-mail:shatanaw@ju.edu.jo
** Assistant Professor in Irrigation, University of Jordan, Amman, Jordan
E-mail: mmduqqah@ju.edu.jo
*** *Researcher in Irrigated Agriculture, University of Jordan, Amman, Jordan*
E-mail: al-naber@ju.edu.jo

SUMMARY - The paper addresses the water situation in Jordan in term of supply and demand management as well as policy formulation and implementation in irrigation and irrigated agriculture. Specific policies has been formulated to ensure sustainability of irrigated agriculture, optimal utilization of water resources, maximizing water efficiencies and optimization economic return of unit volume of water.
The policies of Ministry of Water and irrigation and the policy of the Ministry of Agriculture have been translated into action plans and projects. It seems that these projects are being harmonized by both entities to meet the objective goal aiming at water saving in the agricultural sector. The level of policy implementation in both sectors is satisfactory although additional efforts are needed in term of human resources development and training of farmers. The papers present some projects and success cases in promoting water saving and increasing efficiencies and water productivity.
Key words: Agricultural policy, Irrigation water policy, Policy formulation and implementation, Water policy analysis, Irrigation efficiency, Policy harmonization.

INTRODUCTION

Jordan is classified among few countries of the world with limited water resources where demands are far exceeding supplies. The scarcity of water has been a key part of the life of people where they have developed mechanism and norms to cope with the problem translated into rationing, limiting irrigated areas, water conservation and deficit irrigation. These conditions are aggravated as a result of reduced supplies, population growth, occurrence of drought, complexity of water resources management and water allocation policy. Under these conditions and due to water allocation policy, agriculture is the residual claimer of water. Priority in water allocation is first given for domestic use including tourism demand, then to the industrial sector and the remaining is allocated to agriculture. However, agriculture may receive additional water through reclaimed wastewater or recycled drainage water. By the year 2020, the volume of unconventional water used for agriculture is estimated to be about 40% (240 MCM) of allocated water to irrigation. On the other hand, agricultural areas irrigated with groundwater are being threaten due to control of pumping or plans to divert it to other sectors as the need is growing for additional supplies for domestic, industrial and tourist purposes. The hope in the future water supplies is limited and if available it will be expensive to use for agriculture because it would relay on desalinated water or imported water from neighboring countries.

The challenges facing irrigated agriculture in Jordan with respect to water availability are becoming chronic and complex due to a diversity of reasons; mainly:

1. Limited amounts of allocated water to the agricultural sector due to increasing uses by other sectors.
2. Low water efficiency and high water losses in the water system.
3. Shortage of available funds for water development and conservation
4. Lack of extension services and transfer of research results.
5. Unfavorable social habits and attitude toward water saving due to poor public awareness programs.
6. Lack of tools of public policy required to change attitude of stakeholder.

The above conditions leave no option expects to use water efficiency by improving water use efficiency and increasing its productivity. These options for a country, like Jordan, has bee given the highest priorities by the government through different policies and strategies that has been adopted by the Ministry of Water and irrigation and the Ministry of Agriculture.

This paper discusses various policies adopted by Jordan in the agricultural and water sectors that promote the efficient use of water is agriculture. Water saving is the main object of these polices, strategies and action plans. The paper discusses also policy formulation in achieving the above objective in forms of projects and action plans aiming at water saving, improving efficiency and increasing water productivity. This requires that a combination of technology, education and extension services be integrated in an effective policy and regulatory framework.

OVERVIEW

The total land area of Jordan is about 88,778 square kilometers (km^2) while the area of water bodies is approximated at 482 km^2 that includes the Jordanian part of the Dead Sea and the Gulf of Aqaba (DOS, 2004). About 91% of the land area is semi desert with rainfall amount of less than 200 mm. The range land area of annual rainfall between 200 to 300 represents about 5% of the country while the forest area that are found on the mountains and steep rocky areas comprise only 1%.

In general, only 4% of the total area of Jordan can be put into cultivation through rainfed agriculture in years of sufficient rainfall. The actual cropped area varies from year to year. It was 306,000 ha in 2000 compared to 380,000 ha in 1992. Areas developed for irrigated agriculture amounts to approximately 76,000 ha. Of this total, 33,000 ha are in the Jordan Valley and the southern Ghors which are primary developed by the Government. The rest of the irrigated area of about 43,000 ha has been developed by the private sector in the plateau and the Badia regions depending mainly on groundwater.

According to last census of 2004, the population of Jordan has reached 5.35 million people (DOS, 2004). Comparing this figure with that of the previous census of 4.18 million people in 1994 shows that the population growth during the last ten years has reached 2.5%. Before 1994, the population was growing at 3.4% rate due to three population influxes in 1948, 1967 and 1990. About 80% of the population is located in urban areas concentrated in the governorates of Amman, Zarqa and Irbid; all of which are water deficit areas and depend on water importation from other areas. Although the current population growth rate are relatively low and are expected to decline, due to education, birth spacing and the cost of decent living; the population will continue to place an enormous pressure on water resources.

WATER SUPPLY SITUATION

Jordan is classified among few countries of the world with limited water resources and it is one of the lowest on a per capita basis. The renewable water resources per capita are falling as a result of population growth and are projected to fall from less than 160 m^3 /capita/year at present to about 90 m^3/cap/year by 2025, putting Jordan in the category of an absolute water shortage. The scarcity of water in Jordan is the single most important constrain to the country growth and development because water is not only considered a factor for food production but a very crucial factor of health, survival and social and economical development. As a result of scarcity, the demands and uses of water are far exceeding renewable supply. The deficit is made up by the unsustainable use of groundwater through overdrawing of highland and desert aquifers, resulting in lowered water table in many basins and declining water quality in some. In addition to that, the deficit is overcome also by supply rationing to the domestic and the agricultural sectors.

Water resources consist of surface and ground water, with reclaimed wastewater being used at an increasing scale for irrigation. Water desalination has also become an optional source where 40 million cubic meters (MCM) are presently produced from over 10 desalination plants for domestic supply and about 9 MCM for irrigation. Renewable water resources vary from 785 to 840 MCM per annum, including 280 MCM of groundwater and 505 to 560 MCM of potentially exploitable surface water. An additional amount of 143 MCM is estimated to be available from the non renewable aquifers. The volume of effluent from the different wastewater treatment plants was estimated to range from 75 to 80 MCM in the year 2004.

WATER DEMAND ON JORDAN

Water uses vary from year to year depending on the available surface water supply which is decreasing due to upstream uses and climatic fluctuations. According to available water supplies, a

total of 520 MCM in 2003 were used in agriculture (representing about 63.5 % of the total water use); the domestic sector consumed 270 MCM (32.5 %); industry share was only 36 MCM (4 %).

The municipal water demand is growing rapidly faster than the population growth but due to system capacity and limited supply, the actual demand has never been met. The total amount that have been supplied to municipal uses in 2004 reached 270 MCM which indicated that the annual per capita share of water for domestic uses was only 50 m^3/capita/year. This low amount averages a daily supply of 137 liter/capita/day. To overcome the shortage and gap between supply and demand, water consumption is rationed by rotating supplies and providing intermittent services during most of the dry months.

Most of the industrial allocated water is consumed by two major industries, namely; phosphate and potash production. These industries and many others are located outside of cities limits and therefore they secure their water supplies either by using surface water like the Arab Potash company or by drilling their own private wells as the case of the phosphate company. The government is selling surface water to industry and imposing a resources tax of 0.15 JD/m^3 for groundwater. For industries that receive water from the domestic network distribution system, water price is 1.0 JD/m^3.

Irrigated agriculture in Jordan falls under two categories in term of management and source of water. In the highlands, privately managed individual farms are irrigated by groundwater from private wells. The publicly managed irrigation system in the Jordan Valley uses surface water of the Yarmouk River and side wadis as well as reclaimed wastewater.

Expansion of both systems has been rapid in the last 30 years. Highland irrigation expanded from 3,000 ha in 1976 to an estimated 43,000 ha in 2004 which uses mainly groundwater as a source of irrigation including 6,000 ha that are irrigated by the fossil non-renewable groundwater in Disi and Mudawwara areas for the production of cereals, vegetables and fruits.

Irrigation in the Jordan Valley and Southern Ghors have been developed by the Jordan Valley Authority (JVA) which covers 23,000 ha under full irrigation in the Jordan Valley plus 6,000 ha in southern part of the Valley that are restricted by water availability to winter use only. In addition, there are about 3,000 ha that are irrigated with groundwater using private wells.

In the Southern Ghors, south the Dead Sea, about 5,000 to 7,000 ha are irrigated using the base flow of southern wadis and release of the southern dams. As such the total irrigated area in the Jordan Valley and Southern Ghors is estimated at 33,000 ha and about 43,000 in the highland and the desert; totaling 72,000 ha as the irrigated area in Jordan.

WATER MANAGEMENT

In Jordan, there are three public agencies responsible for the management of water resources. The Ministry of Water and irrigation (MWI) is responsible of water resources policy and strategy development, water resources planning, research and development, information systems, procuring financial resources. The two agencies, namely; the Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA) are executing bodies; they are under the umbrella of MWI and the Minister of MWI heads their boards of Directors. WAJ is responsible for providing water and sewage services throughout Jordan and for water resources management while JVA responsibilities cover the development of Jordan Rift Valley, including water resources, primarily for agriculture in the Jordan Valley and southern Ghors. JVA is also in charge of managing the scheme in the Valley and all dams and reservoirs feeding JRV. The Ministry of Agriculture has a small role in irrigation management confined to on-farm irrigation extension services and research and technology transfer through its research arm (NCARTT). The Ministry of Environment monitors the quality of surface water in natural environment and the quality of industrial wastewater discharged to the ecosystems to meet its mandate in conserving the environmental elements from pollution.

Up to 1996, management of the water sector had been characterized by short term planning focusing on increasing water supply, fragmented short-term policy and overlapping responsibilities between the three agencies (MWI, WAJ and JVA). In addition, there was no coordination between MWI and other ministries like the Ministry of Agriculture (MoA). For example, the responsibilities on up-land irrigation and on-farm irrigation management are vague and lost between MWI and MoA. Also, there has not been any significant coordination between MWI and the Ministry of Environment as well as other entities in Jordan. However, according to ESCWA report (2004), Jordan is one of the few countries in the Middle East that applies the integrated water resources management.

FORMULATING OF WATER AND AGRICULTURAL POLICIES

Prior to 1990, management of water resources was based on crises management principles. Every summer, rural and urban populations are faced with fresh water shortage which results in rationing of water distribution. The situation with the agricultural sector is similar and even severs in drought year. As a result of that, there was an urgent need to formulate a national water policy taking into account all issues related to the water resources and their uses and management. This need was supported strongly by the World Bank, FAO and other donor agencies as well as by other donating governments.

Early work on water policy development programs started in Jordan in 1995 which was initiated by MWI with support from US-AID project (WQIP) and GTZ. The first phase of the program included establishing a water policy committee, chaired by the General Secretary of MWI composed of a team of experts who represent the full range of prospective and interest in the water sector in Jordan. The core of the water policy committee numbered roughly 25 was drawn from Jordanian and international experts representing the senior staff of MWI, private sector, the academic community and members from other government agencies. The committee members reviewed previous policies adopted earlier in the country such as those of the Ministry of Agriculture, Ministry of Planning and the Higher Council for Science and technology. Relevant literature, including water policy review papers adopted by the World Bank, FAO and other countries were identified, analyzed and synthesized. The committee identified 22 policy issues which were grouped under six categories; water resources and supply management, demand management, allocating priorities, water quality, investment in the water sector, and institutional and legal aspects. Each one of the 22 issues was developed into a brief policy profile. The profile was used to assist the policy team in ranking the issues and concluding a policy statement, strategies and action plans.

In 1997, a National Water Strategy was approved by the government. The strategy stresses the need for improved water resources management with particular emphasis on the sustainability of present and future uses. Special care was given to protect Jordan's water resources against pollution, quality degradation, and depletion. Furthermore, MWI was supposed to sustain the highest practical efficiency in the conveyance, distribution, and application and use of water resources. In addition, MWI was expected to adopt a dual approach of demand management and supply management, with tools of advanced technology being increasingly utilized to enhance the resource management capabilities.

The Water Strategy ensures that the rightful shares of the Kingdom's shared water resources shall be defended and protected through bilateral and multilateral contacts, negotiations, and agreements. Water and wastewater projects associated with regional peace processes, including the scheme for the development of the Jordan Rift Valley, shall be accorded special attention for construction, operation and maintenance. Due respect will be given to the provisions of international law as applicable to water sharing, protection and conservation, and those applicable to territorial waters. Bilateral and multi-lateral co-operation with neighboring states shall be pursued, and regional co-operation shall be advocated.

The strategy defines the long-term goals that the government of Jordan seeks to achieve in the water sector. The Ministry plans was to formulate certain policies that would help achieve these goals. Up to now, the Ministry has prepared and published the following four policies:

1. Groundwater management policy;
2. Irrigation policy;
3. Wastewater management policy and
4. Water utility policy.

Agricultural Policies

After the economic depression in the 1980s and the resulting 1988 economic crises, the government of Jordan took strong measures by implementing a long-term structural adjustment process. As a result, many substantial and far-reaching changes in the overall economic and sectorial policies have been made. Since the agricultural sector was the largest contributors to the government's subsidy expenditure, therefore, it was among the first sector for reform in the early 1990s. There was an urgent need to formulate a comprehensive agricultural policy which would be an integral part of the overall policies for the economical development especially in rural areas. The agricultural policy, which has taken the government approval in 1996, would be an integral part of the comprehensive social and economic policy of Jordan considering the following criteria:

Efficiency

- Development and optimal use of available natural and agricultural resources.
- The application of concepts of economic efficiency and comparative advantage in utilizing these resources.

Sustainability

- Effective management and conservation of natural resources used in agricultural production especially soil, water and natural vegetation to ensure long-term sustained agricultural production.
- Ensuring that measure aimed at the promotion of agricultural development must be sustainable in the long run and must not become a continuous burden on the government budget.
- Development of the necessary legal and institutional framework within the public and private sectors, to provide stability as well as a favorable investment environment, with the aim of strengthening agricultural development.
- Assuring a continuous supply of food that is adequate in terms of quality and quantity.

Equity

- Achieving social and economic equity between agriculture and other economic sectors, and also within the agricultural sector itself.
- Providing equal social and economic opportunities to all participants in agricultural activities, especially to those engaged in agricultural production, and in particular to small farmers who depend on agriculture as their main source of income.
- Increasing the income of framers and agricultural workers to equitable levels, and improving their standard of living accordingly.

Objectives

- To increase the degree of Jordan's self-reliance in food
- To manage and utilize the available agricultural production inputs, in particular; water, land, capital and labor, in an economically efficient manner, while preserving the environment and ensuring the sustainability of agricultural production in the long-term.
- To increase the profitability of the agricultural sectors as well as standards of living for farmers and agricultural workers.
- To orient the production of food and other agricultural commodities to meet demand of the domestic, regional and international markets and to ensure that such production is competitive in quality and price.
- To maximize the value added to the gross domestic product (GDP) of Jordan's agriculture sector, particularly that of agribusiness.
- To promote the export of agricultural and livestock products, and help improve the national balance of trade.
- To attain social and economic equity between the agricultural and other sectors of economy and also within the various parts of the agricultural sector itself.
- To achieve integration of agribusiness among Arab countries, and promote cooperation between countries of the region in the area of production and trade of food and agricultural commodities, ensuring balanced to all countries concerned.

Challenges and Approach

The Government is determined to achieve the above-mentioned objectives by putting in place adequate economic, legislative and institutional framework to support rural change and transformation

in the agricultural sector and to enable the sector to cope with the challenges and problems facing development. The following principles and general approaches are intended to provide the appropriate environment that will enable the sector to grow:

- Creating a favorable environment to ensure a freely functioning marketplace including the necessary regulatory and monitoring framework, while encouraging private agribusiness to play a major role in agricultural development.
- Strengthening the implementation of government policies supporting agricultural production and rural development, and making the necessary policy adjustments whenever needed.
- Providing the necessary institutional support and services in areas where the private sector is unable to provide them, including the infrastructure needed for sustained agricultural development, as well as information and other basic services.
- Encouraging the effective participation of individuals and target groups in agricultural policy formulation and in decision-making processes, and also ensuring their participation in the implementation of various programs and activities.
- Integrating agricultural policy into, and ensuring that it is in line with other general and specific government polices.
- Defining agricultural development as the core of the integrated development of Jordan's rural areas.

Irrigation Water Policy

The Irrigation Water Policy (MWI, 1998) was also approved by the Council of Ministers in 1998. The policy addresses irrigation water including agricultural use, resource management, technology transfer, water quality, and efficiency, but does not address or extend to irrigated agriculture. Many provisions of this policy already are in practice. Specific policy statements address**:**

- *Sustainability of Irrigated Agriculture* (e.g., existing areas shall be accorded the chances for sustainability; protection of ground water resources takes priority over sustainability of agriculture; coordination with Ministry of Agriculture)
- *Resource Development and Use* (e.g., use of wastewater; use of rainfall for crop production)
- *Technology Transfer* (e.g., higher agricultural yields; modern advanced irrigation technologies; pressurized pipelines; genetically engineered plant varieties)
- *Farm Water Management* (e.g., night application of irrigation water; automation of farm irrigation networks; monitoring of soil moisture; crop water requirements for micro-climatic zones)
- *Irrigation Water Quality* (e.g., monitoring at sources, conveyances, and distribution network; improving wastewater quality to allow unrestricted irrigation; testing of soil salinity).
- *Management and Administration* (e.g., JVA responsible for operation and maintenance of irrigation facilities from source (e.g., reservoir, river, spring) to farm gate; use of piped irrigation networks; metering of water at the farm turn-out; participatory irrigation management)
- *Water Pricing* (e.g., irrigation water managed as an economic commodity; water price to cover at least operation and maintenance costs and as possible capital costs; differential prices for different water quality)
- *Regulation and Controls* (e.g., discourage crops with high water uses through economic and market forces)

Irrigated Agricultural Policy

In order to exploit the growth potential of irrigated agriculture, Jordan will continue an outward-oriented market strategy based on economic opportunities and incentives, and on strengthening its institutional capacity to increase and diversify horticultural exports to reach beyond, emerging Middle Eastern markets. Thus, Jordan will re-establish a clear comparative advantage for its horticultural products for domestic and regional markets. Production for export will be part of a long-term strategy, taking advantage of the new export opportunities related by the recent economic and political developments at regional and international levels. Effective research and extension will play a significant role supporting dynamic and sustainable irrigated agricultural production.

The limited availability of irrigation water is the most severe constraints to the growth of the sector. It is thus imperative that policies geared towards improving the efficiency of water utilization receive the highest priority. Government policies and strategies in this area will aim at achieving the following:

Optimal Utilization of Water Resources: In order to achieve the objective of efficient and sustainable utilization of Jordan's available resources, the Government will adopt the following specific policy: *Maximizing the efficiency of water storage, conveyance, distribution and on-farm application*.

Government policies in this area are intended to produce substantial saving and to reduce the current shortages of irrigation water. This will require the joint effort and investment of both the Government and the farmers involved, particularly in the following areas:

- Developing suitable water storage structure both on and off-farm in order to minimize evaporation and seepage losses.
- Converting the open-canal conveyance and distribution systems to closed-pipe systems in the Jordan Rift Valley and the highlands.
- Replacing existing surface basin or furrow irrigation by drip systems.
- Designing and implementing irrigation projects jointly between the public and private sectors.
- Pricing publicly developed and managed water to reflect the importance and scarcity of water in Jordan.

To implement the above-mentioned policies, the Government will adopt the following strategies:

- Strengthening all overlapping issues and responsibilities shared between ministries and other public-sector institutions concerned, regarding the management of the country's water resources to ensure compliance in their work.
- Strengthening the national capacity for the generation and dissemination of technical information on water-saving technologies.
- Defining crop-water requirements in the various agro-climatic zones to ration the use of irrigation water.
- Upgrading the management capacity of manpower involved in water distribution.
- Furthering public awareness regarding the efficient use of water, water quality, and the conservation of watersheds.
- Exempting materials required for the local manufacturing of water-saving technologies from import duties.

Maximal Efficiency of Water Use in Irrigation: The maximization of net economic returns on each cubic meter of water used in irrigation will mean that the production of crops with high water-consumption will be limited, in particular if their gross margins per cubic meter are comparatively small. This assumes that protective policy measures for such crops are removed. Appropriate pricing and market mechanisms will ensure that crops with high net returns per cubic meter of water, and which are in demand in both domestic and export market, will be given priority by farmers. The following measures will be implemented in pursuing this policy:

- Adopting water –management plan for the Jordan Valley on the basis of water requirements of crops in order to assure the availability of irrigation water to crops with high economic returns. Such a plan would reflect the economic value and the relative scarcity of irrigation water in the different seasons.
- Developing water crop regimes that maximize the net value of output per cubic meter of water.
- Promoting the use of technologies that maintain soil fertility and acceptable water quality.
- Safeguarding soil and water from contamination due to drainage water carrying undesirable chemical residues, and from misuse of fertilizers and pesticides.
- Steering applied research to define water requirement and performance various crops in the different agro-climatic zones, their economic returns on water input, quality requirements for main crops and the effect of varying water quality on crop yields.

Quality and Quantity of Recycled Water and Groundwater: The policies to be actively undertaken in this regard relate particularly to proper treatment when recycling water and to special measures for the preservation of the quality of groundwater. The Government will implement the following measures in pursuing these policies:

- Enforcing regulation for monitoring recharge of groundwater aquifers and groundwater extraction

- Enforcing regulations for the licensing of deep groundwater wells in cropped areas.
- Protecting the watersheds of major aquifers to ensure the sustainability of water recharge in terms of quantity and quality.
- Monitoring the quality of surface and groundwater resources as well as irrigated soils to prevent any deterioration, and to remove the source of pollutants.
- Monitoring salinity and pollution levels, in particular in the effluent of wastewater treatment plants, and minimizing salinity through improvement of treatment methods, or by mixing such effluent with fresh water to meet Jordanian standards for treated wastewater.
- Enforcing environmental impact assessment of all development projects and programs affecting the nation's water resources, in particular dams and wastewater treatment plants.

Securing Investment in Irrigated Agriculture: In order to maximize net returns on producer investment in irrigated agriculture, to reduce the various risks faced by producers, and to minimize production and marketing costs, the Government will implement the following measures:

- Render market information available to producers and exports.
- Facilitate the organization of a balanced supply and demand for commodities produced and marketed in Jordan and for export, to minimize potential losses to farmers arising from market price fluctuations
- Encourage farmers' and exporters' organization to assume responsibility for improving the marketing of Jordanian produce, including the development of new markets and new crops in demand in these markets.
- Enforce legislation concerning technical standards for agricultural products, and grading and packing regulations.
- Strengthen the generation and dissemination of technical information on pest and pesticide risks, and the potential misuse of agricultural inputs.
- Enhance post-harvest technical services for fruit, vegetables and other crops, including pesticides monitoring and residue analysis, and provide information on quality control standards, packing specifications, and the pre-cooling and handling of fresh horticultural produce.
- Orient research and technology transfer towards production and market oriented priority programs, with farmers participating in the decision making process for resources allocation and program priorities. The outlay of financial resources for this research will be at levels ensuring adequate efficiency, and should reach a target of not less than two percent of the total value added to irrigated crops. Such measures are equally applicable to other market oriented production systems (in particular, export oriented production systems).

POLICY ANALYSIS

Under the current water policy directive, agriculture is the residual claimer of water. Priority in water allocation is first given for domestic uses, then to the industrial sector, including tourism, and remaining is allocated to agriculture. Agriculture may receive additional water through reclaimed wastewater or recycled drainage water. Long term plans to increase the capacity of use of reclaimed wastewater are in place and it is expected by 2020, that the volume of treated wastewater to agriculture will reach about 240 MCM. This will represent about 40% of allocated water to irrigation.

By 2020, the per capita share of water can reach 90 m^3/capita/year including wastewater. The maximum amounts of 890 MCM that may be allocated for agriculture may contribute to about 15% of the country's self-sufficiency on food. Additional 15-20% comes from rainfed areas, will put Jordan food self-sufficiency at 30-35% level. The irrigation water policy of MWI and the irrigated agriculture policy of MoA are in agreement in terms of sustainable use of water resources, irrigation water management and irrigation water quality. Price and cost recovery policy of irrigation water is set only by JVA because it is responsible for delivery and tariffs collections. As a matter of fact, the role of MoA is irrigation water policy is limited to extension and public awareness and research as well as regulation and it has no power in policy implementation. Protection the interest of the farmers and the agricultural community are among the mandates of the Ministry of Agriculture. Therefore, it is not expected that MoA take a part in the pricing and water allocation policies as it would be set by MWI. Unless the Ministry of Agriculture is given a legislative role in irrigated agriculture in water delivery and scheduling since its role in improving on-farm irrigation efficiency role will be limited to extension and research.

In the upland, there is a direct link between groundwater management and irrigated agriculture policies. Reducing the abstraction level of renewable aquifer to the sustainable rate (safe yield) will have a direct impact on irrigated agriculture in the upland. The action plan to implement groundwater policy requires reduction of 122 MCM by 2020 and transferring 100 MCM (65 MCM of them already are used in Agriculture) from the non- renewable Disi basin to Amman for drinking purposes. This action will reduce irrigated area in the upland by about 20,000-25,000 ha leaving areas irrigated by groundwater to only 15,000 ha. It is anticipated that this reduction will be replaced by the reclaimed wastewater either for direct use or artificial recharge. These conditions will require adjusting the cropping pattern to those suitable for this kind of water such as fodder, industrial crops or wood trees. The policy of gradual reduction of ground water abstraction to its safe yield will be of course being on the expense of agriculture.

In the Jordan valley, the situation will be similar where there will be a transfer of about 135 MCM of fresh water to the upland cities in trade of wastewater. This action requires special soil and water management and the introduction of restricted agriculture. Such changes in water allocation and uses in the upland and the Jordan Valley will have a direct impact on the kinds of crops and thus on food security. Shifting to fodder or maize cultivation as animal feed might change the trade balance in milk and red meat.

Historically, food security and self reliance were the main two items put on the top agenda in the formulation and implementation of the successive development plans. Increasing wheat and livestock production was the two priority item in achieving the above goal. In doing so, the government in 1994, leased land in the southern desert of Jordan, and issued groundwater abstraction licenses to private companies in order to grow wheat and fodder crops. The area that was leased exceeded 60,000 ha. Wheat and fodder production under sprinkler irrigation continued for few years during which the government was the main buyer of grain at subsidized prices. Even with input subsidized (Water, land, seeds…), these companies shifted to the cultivation of fruit trees and vegetables, the objective of food security were not achieved.

Self-reliance on food has been fluctuating since then and as usual reflecting the climatic conditions or rainfall amounts and distribution. The severe decline in the agricultural sector which has begun in 1994 has not been corrected through government interaction. On the country, agriculture has been always under criticism due to its low contribution to the national GDP and high demand for water. The problem was further aggravated by the three year successive drought (1998-2001). The issues of food security were almost ignored after imposing the trade liberalization policy, eliminating the protection of agricultural products and abolishing the direct support to farmers and animals growers.

The issue of self-reliance on food has been considered on the agricultural agenda and is being addresses by the water policy and the agricultural policy charter. The first objective of the agricultural policy is to increase the degree of Jordan's self-reliance in food while the water policy calls for stability for irrigated agriculture. These objectives have not been translated into a specific policy statement or strategic measures and work plan until recently in the development of a national agricultural strategy. A set of programs including development was proposed to increase the degree of self-reliance on food.

POLICY IMPLEMENTATION

In this section, discussion concerning the stages of the implementation process is presented. Discussion will also consider adjustment measures and interactions that could overcome problems associated with implementation.

The Irrigation Water Policy Implementation: The irrigation policy addresses irrigation water including agricultural use, resource management, technology transfer, water quality, and efficiency, but does not address or extend to irrigated agriculture. Many provisions of this policy already are in practice. Specific policy statements address: sustainability of irrigated agriculture, resource development and use, technology transfer, farm water management, irrigation water quality, management and administration, water pricing and regulation and controls.

In implementing the irrigation water policy, Both MoA and JVA address the irrigation water policy as mean to improve irrigation water management, in term of improving irrigation efficiencies and water use efficiency as measurable indicators.

On the sustainability of irrigated agriculture provision, the policy ensures that protection of groundwater resources takes priority of sustainability of agriculture. Progress in these issues is still very slow. The policy encourages coordination between MoA and MAI, but such coordination has not been materialized. On resource development and use, the progress is very slow and is confined to

treated wastewater reuse. On technology transfer, farmers, private sectors and universities are ahead of government is using modern tools and technology transfer in irrigated agriculture. The process of adopting technology transfer is slow. An indicator for success requires baseline survey every five years. Two baseline survey conducted by Shatanawi et al (1986 and 1994) indicating a slow progress in this regards. However, a significant progress has been achieved since then with the implementation of many USAID supported projects such as IAS and Kafa'a. The number of farm that has converted from surface irrigation to high tech micro irrigation has jumped from 32% in 1985 to 68% in 2003. On management and administration, almost all irrigation distribution systems have been converted to pressurized pipe network. Water delivery to farm is under control through metering of water at the farm turn-out.

On water pricing, the objectives of the provision of water pricing policy are based on the assumption that irrigation water prices should cover operation and maintenance cost and as possible capital cost and should be used as an incentive to improve on-farm irrigation efficiency. The price of irrigation water in the Jordan valley was dramatically restructured so that it is ranging from 8 to 35 fils (1 fils = 0.001 JD) per cubic meter. The average operation and maintenance cost (O&M), which are estimated to range from 25 to 28 fils per cubic meter, is covered. Subsidies to producers on irrigation water have been virtually eliminated by 1998 compared to about 670,000 JD in 1993 (JVA, 2001).

Prices of Irrigation Water in the Jordan Valley according to Block Tariff.

User class (Block)	Water Consumed Per month in m^3	Water costing Fils/m^3
1	0-1000	8
2	1001-2000	12
3	2001-3000	20
4	>3000	35

It is believed that the new water pricing structure has helped to improve irrigation efficiency in the Jordan Valley. Irrigation efficiency in the valley is rising reaching 70% in 2000 compared to 57 in 1994 (Shatanawi, 1995).

A study (FORWARD, 1999) was submitted to JVA recommending a differential pricing structure according to water quality. This study is based on crop response to water quality model. JVA is in the process of putting this recommendation into the implementation stage in the area of the central Jordan Valley where the quality of water poses an issue.

As for irrigation in the upland, MWI has concluded an agreement with the farmers to put charges on groundwater withdrawal exceeding 150,000 m^3/year. This limit is applied to all groundwater users regardless the area and the productivity of the wells. Such policy however, could not be fair for large ownership with high productive wells. On the contrary, it will encourage small farmers with wells of less than 100 m^3/hr yield to increase their pumping rate. Price restructuring is required to take farm holding and well productivity into consideration. Such arrangement has been materialized by issuing the ground water protection by-law of 2002 (Law 88 of 2002).

Wastewater Management Policy Implementation: The Wastewater Management Policy (MWI, 1998) addresses the management of wastewaters as a water resource including development, management, collection and treatment, reuse, and standards and regulations. Specific policy statements address: resource development, resource management, wastewater collection and treatment, reuse of treated effluent and sludge and pricing.

Wastewater is undertaking massive efforts in the development of master plan for the construction of wastewater treatment plants with provision of reuse to cover about 85% of the population by 2020. Planned activities should be able to treat about 280 MCM compared to about 80 MCM that are being treated as of 2003. The number of treatment plant that are completed and in operation has reached 19 treatment plants. Improving the plant efficiency and the quality of the effluent to meet the Jordanian standard for reuse is an objective to be achieved during the implementation of the master plan. Along with that, legislation and standards has been drafted to cover the legal and administrative aspect of treatment and reuse. A new standards and guidelines for reuse of treated effluent was completed and approved by the Department of Standards and Specification. Finally it was published as standard No 201 of 2003.

Treated wastewater is considered an integral plant of renewable water resources and is counted in the water budget. New treatment plants and the expansion of old plants will be operated by the

private sector on BOO or BOT basis. There will be a price of effluent to cover the operation and maintenance cost.

Groundwater Management Policy Implementation: The main provision of groundwater management policy included development, protection, management and reduction of abstraction rate to the safe yield. Efforts in assessment of sustainable yield and further exploitation process are going one. New well field were developed (Corridor well fields for example) to augment domestic water supply. In this regards, MWI has established a unit for protection of recharges where the By-law in this regards has been completed. It appears that integrated watershed management approach has not been considered a priority area by MWI or MoA.

The policy calls for gradual reduction of abstraction rate to the renewable safe yield by 2010. No. progress in this regards, has been made.

The Water Sector Review Report (World bank, 1997) recommended reduction in groundwater abstractions and improved water quality monitoring of groundwater. Irrigation use of Disi fossil groundwater was to be reduced. The possibility of a resource tax on resources mined in excess of licenses was to be studied. Some of these recommendations have been achieved responding to the policy where about 90% of wells were metered , charges for excess abstraction have been agreed upon by the farmers and MWI, WAJ took the monitoring responsibility, and a groundwater management program has been launched.

Government policy calls for a massive reduction in abstraction by highlands pumpers. The bulk of the projected reduction in abstraction of renewable groundwater, by 86 MCM/year until 2010 and by a further 36 MCM/year until 2020, will have to come from reduced abstraction for Highland agriculture. If this reduction does not materialize, there is a risk completely losing some aquifers due to almost irreversible Salinization of the groundwater stocks. Continued effort at metering, ensuring operational performance of meters, and enforcement of licensed quantities, volumetric tariffs, together with stakeholder participation should be the thrust forward. Lessons from the Zarqa basin project on socio-economic strategies with respect to agricultural users should be incorporated into a medium term program of action.

Efforts in low enforcement against illegal wells and enforcement of licensed rate of abstraction are not encouraging. Desalinization of brackish water are at early stages where few farmers are using reverse osmosis techniques to desalinize saline marginal groundwater and use it for irrigation.

ACTION PLANS AND PROJECTS

Implementing the water and agricultural policies in Jordan was coordinated by respected authorities putting them in modules and priority order. The implementation measures were translated into project and action plans that are put in the pipeline of implementation. The level of implementation depends on allocation from the general budget and the support of donors such as the World Bank, UNDP, FAO, USAID, GTZ and other bilateral donors. There are several projects that have addressed water management and conservation issue in the irrigated areas of Jordan. These projects, action plans and measures range from research and development, improving extension services, training, public awareness to direct support to farmers in term of financial assistant, loans or revolving funds. This section provides brief description of some projects including duration and implementing agency.

Description of Projects

1. Water Quality and Conservation Project (WQCP): In this project a base line diagnostic study was conducted in the Jordan valley to determine the on-farm irrigation efficiency.
2. Irrigation Advisory Services (IAS): This project provides services to farmers by evaluation the performance of their micro irrigation systems and advising on measures to improve their efficiencies.
3. Water Efficiency and Public Information for Action (WEPIA): The project aim at improving water use efficiency at all level including the irrigation sector by launching public awareness campaigns and training programs. It has also encouraged the use of water saving devices at the household and farm levels. It addressed wide range of stakeholder from school pupils to teachers, educators, housewives, decision makers and farmers.
4. Skill Enhancement Project: In job training course was provided to official of the Ministries of Water and irrigation, Agriculture and Environment by the University of Jordan to improve their skill in water management and irrigation extension services.
5. Research Projects by Universities; There are several research projects carried our by different universities. The University of Jordan is carrying out several project funded by European

Commission. Three of these projects are oriented to irrigation; WASAMED is a thematic network aiming at compiling information and technologies for promoting water saving in Agriculture. IRRIMED is aimed at designing and improved management tools for water-limited irrigation; while DIMAS deals with applying reduced amount of irrigation water without comprising yield significantly.

6. Sustainable use of Reclaimed Wastewater: There are several projects experimenting on the use of reclaimed water for sustainable and marketable agriculture carried out by GTZ, USAID, JICA, and the Arab Fund.

7. Improving System Delivery Performance: This project is carried out by the Agricultural Mission of the French Embassy aiming at creating best condition to improve the hydraulic and performance of the pressurized distribution network. The mission is also working on introducing precision irrigation by the use of soil moisture sensors and automated water scheduling.

8. Educational and Informational Program to Improve Irrigation Water Use Efficiency (KAFA'A): This project is funded by USAID and is designed to increase water productivity of the precious and limited water resources used in the agricultural sector. The project team is working with partnership with different stakeholder to tackle the problem from multiple directions in order to increase the economic yield of used water. This is achieved by different means such as changing cropping pattern and implementing new technology to control water use. The project achievement so far can be summarized in the following points (i) production of extension leaflets, (ii) improving on-farm irrigation management through community revolving grants, (iii) establishing high quality extension services, (iv) Promoting policies to improve irrigation water use efficiency, and (v) introducing modern and high irrigation technology in the field demonstration farms.

CONCLUSIONS

The Government of Jordan has realized that reform, economic adjustment, planning and development have to be streamlined into general framework and translated into different sectorial policies including agriculture, food security and water. The water and the agriculture sectors were the main candidates for reform because they are the basic elements for economical development and food security. In this regards, water and agriculture policies were formulated in the mid 1990s to avoid the fragmented approach of crises management. The irrigation water policy of the MWI and the irrigated agriculture policy of the MoA have put general framework for managing the limited irrigation water more efficiency and in a sustainable manner that ensure highest economical return per cubic meter of water. It has been noticed that coordination between MWI and MoA is still lacking in the irrigation sector although their respective policies call for full coordination. The lack of cooperation in implementing these policies is clear when it come to channel or provides support to research and development. It appears that the private sector and the Universities are far head in implementation of these policies. Both ministries depends in implementing their polices on external support provided by different agencies and bi lateral donors. Most of the action plans and projects are carried out for short term while lacking sustainability.

However, there are several success cases in the implementation of the irrigation water policy toward water saving can be summarized as:

1. The implementation of the water pricing policy as an incentive for improving on farm irrigation efficiency and water productivity was very successful.

2. The involvement of the private sector in water distribution in form of management contract has improved system performance and reduce unaccounted for losses at an annual rate of 5-7%.

3. Appropriate pricing and market mechanisms policy has encouraged farmers to grow crops with high net returns per cubic meter of water and which are in demand for domestic and export market.

4. Formulation of the National Strategy for Agricultural Development as a tool for agricultural policy implementation is a successful case and is considered as a first step toward implementation. The main reason of success is the involvement of the target groups, individual, farmers and decision makers in the process of strategy formulation.

5. The policy of enhancing resources development is a challenging issue for MWI, so that treated wastewater development project has taken priority in the Ministry investment plans.

6. The policy of reuse of wastewater for agriculture is taking priority to guarantee that effluent meets WHO and FAO guideline. In this regards new standard and guideline on reclaimed wastewater reuse has been drafted and approved.

7. The policy of encouraging private sector participation has resulted into fruitful results. Agribusiness farming are introducing the most advanced technology in water management and saving.
8. The policy of skill enhancement and human resources development has made sustainable changes in people attitude toward water saving.
9. The provision of international cooperation has attracted many international and bilateral donors to concentrate on stakeholder involvement and partnership to increase the economic yield of water.
10. Satisfactory public awareness attitude has been created as a result of intensive public awareness campaigns.

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