WATER DEMAND MANAGEMENT IN RELATION TO AGRICULTURAL SECTOR (CONCEPTUAL FRAMEWORK)

GESTION DE LA DEMANDE DE L'EAU PAR RAPPORT AU SECTEUR AGRICOLE (CADRE CONCEPTUEL)

Iyad Ahmad Jamal Hussein[1]

ABSTRACT

Most of the Arab Countries are facing a challenge of demand management for their limited water resources, mainly for the agricultural sector. This paper discusses the current practices of the agricultural demand management (ADM) at selected Arab countries, defining the strengths, weaknesses, constraints and potentialities. The anticipated impacts of implementing ADM program will have remarkable positive impacts on the agriculture sector level. That could be recognized in terms of improvement of water usage efficiency and raising the capabilities of the stakeholders who participate in improving the agriculture sector.

Implementing the ADM programs will ensure the coordination among the Government, financiers, farmers and other stakeholders. That will build the trust among all stakeholders for better performance at sectoral and national level. Savings in the agricultural inputs will affect in scaling down the cost of crop production, which will offer better competition positions for the farmers on national and regional levels.

Key Words: *Agricultural demand management, coordination, water resources in Arab regions, best management practices, desalination*

1 General Manager, Arab Center for Engineering Studies, Jordan ,P.O.Box 830368 Amman 11183, Cellular : 962-79-5206014,(dr.iyad@index.com.jo)

RESUME

La plupart des Pays arabes font face au défi posé par la demande de gestion des ressources en eau limitées, en particulier dans le secteur agricole. Ce rapport traite les pratiques actuelles de la gestion de demande agricole (ADM) dans les Pays arabes retenus pour étude, tout en définissant les forces, les faiblesses, les contraintes et les potentiels. Les résultats de la mise en oeuvre du programme ADM auront des effets positifs remarquables au niveau du secteur agricole. Ces résultats seront constatés par l'amélioration de l'efficience d'utilisation de l'eau et le renforcement des capacités des responsables qui participent au processus de l'amélioration du secteur agricole.

La mise en place des programmes ADM peut assurer la collaboration entre le Gouvernement, les agences financières, les fermiers et d'autres parties prenantes. Cela permet de créer une certaine confiance entre les parties prenantes et peut donner lieu à une meilleure performance au niveau national et du secteur. Les économies réalisées dans les contributions agricoles peuvent aider dans la réduction du coût agricole pour offrir aux fermiers une meilleure position de concurrence aux niveaux national et régional.

Mots clés: *Gestion de demande agricole, collaboration, ressources en eau dans les régions arabes, meilleures pratiques de gestion, desalination*

1. INTRODUCTION

Water Resources and Agriculture

With a fixed global fresh water supply and the growing world population, water shortages anticipated since the 1970s are now a reality. With the world's population now at six billion and another two billion expected by 2028, water use globally is unbalanced. Industrialized countries consume huge quantities of water; while half a billion people in 31 less-developed countries struggle to obtain enough water to sustain life. This number is expected to grow to 2.8 billion by 2025. Meanwhile, the earth's aquifers, lakes and rivers are running dry, and the world faces increased risks of violent conflicts over water.

Various solutions are often offered – water banks, population control, desalination, water reclamation and dual plumbing – but the most cost effective and practical solution continues to be conservation and the efficient use of water.

Irrigation methods have improved substantially in the 20th Century with advances such as computer-operated and satellite-assisted technologies. According to The Global Water Policy Project, the use of such technologies could improve water delivery efficiency up to 95%, increase agricultural productivity, reduce water needs by 10% worldwide and double the amount of water available for household use.

The Arab region is arid to semi arid and hence water resources are scarce. The per capita share of the conventional water resources is about 1060 cubic meters per year while the global average is about 7000 CM. In addition, there are several countries in the region where

the per capita share of fresh water is less than 500 CM per year that is considered below the water poverty line. These countries include Bahrain, Jordan, Kuwait, Libya, Oman, Palestine, Qatar, Saudi Arabia, Tunisia & Yemen. Furthermore the demand for water exceeds the available water resources and the gap between the the two is increasing because of two factors; one is the high rate of population growth which is about 2.5% compared to the global average 1.24%; and the second is the rising standard of living. Hence it is imperative that all efforts should be focused on increasing the efficiency of use of the available water resources and on increasing water supply through non-conventional sources, such as desalination of salty water and the collection, treatment and reuse of wastewater. In case of desalination the region is producing about 60% of the global production. The second source, i.e., the collection, treatment and reuse, is the subject of this paper.

Arab world is divided in terms of rainfall into:

- Around 9.5 million Km^2 (67% of the land) receive less than 100 mm / year of rainfall which equals around 330 MCM annually.
- Around 2 million Km^2 (15% of the land) receive an average (100 – 300 mm / year) of rainfall which equals around 436 MCM annually.
- Around 2.5 million Km^2 (18% of the land) more than 300 mm / year of rainfall which equals around 750 MCM annually.

The long average rainfall intensity in the Arab countries is not consistent and fluctuates in quantities and intensities annually and seasonally. The maximum rainfall intensity is around 2000 mm annually like in Yemen and Sudan, where the minimum is zero at the desert areas.

Rainfall and surface water resources are the main conventional sources in the Arab countries. Main rivers and streams crossing the countries originate partially from the same region. Nile, Euphrates, Tigris and Yarmouk are the main rivers. The total surface water resources in the Arab region is estimated at 205 BCM annually distributed over four main regions (Table1):

Table 1: Distribution of surface water resources in the Arab Regions (Répartition des ressources en eau de surface dans les régions arabes)

Region	Quantity (BCM)	Percentage (%)
Eastern region (Mashrak)	67.2	32.8
Arabian Peninsula	9.85	4.8
Western region (Magrab)	40.37	19.7
Middle region	87.4	42.7
Total	204.82	100

Source: Arab Organization for Agricultural Development, Statistical Yearly Book, Year 2004.

Groundwater resources are available at three main aquifers; Eastern Arj to the south of Atlas mountains in Algeria with a total storage of 1400 BCM, Al Nubaa aquifer between Egypt, Libya and Sudan (7000 BCM), and the Disi aquifer between Saudi Arabia and Jordan. In addition to the other minor aquifers, the total groundwater storage all over the Arab regions is

estimated at 7734 BCM where the safe yield is only 42 BCM annually and the current use is 35 BCM annually. Table 2 shows the distribution of groundwater aquifers in the Arab regions:

Table 2: Groundwater resources distribution over the Arab regions (Ressources en eaux souterraines de distribution sur les régions arabes)

Region	Storage		Recharge		Safe yield	
	BCM	%	BCM	%	BCM	%
Al Mashrek Al Arabi	13.3	0.2	8.5	20.2	6.5	18.7
Arabian Peninsula	361.6	4.7	4..8	11.5	4.7	13.5
Al Magrab Al Arabi	920.0	11.9	17.4	41.5	15.0	42.8
Middle region	6439.0	83.2	11.2	26.8	8.75	25.0
Total	7733.9	100	41.9	100	35.04	100

Arab Organization for Agricultural Development, Statistical Yearly Book, Year 2004.

The non-conventional water resources in the Arab World comprises the following:

- Desalination of saline water.
- Reuse of drainage water.
- Reuse of treated wastewater.
- Reuse of treated industrial waste.
- Virtual water (not accounted in the water budget).

All the non-conventional resources sum up to around 7.5 BCM annually, excluding the virtual water which is outside the water budget. The total conventional and non conventional water resources can be summarised as shown in table 3:

Table 3: Total available resources in the Arab World) Total des ressources disponibles dans le monde arabe)

Resource	BCM annually	% Percentage
Surface water	205	82.5
Groundwater	35	14.1
Non conventional	7.5	3.1
Total	247.5	100

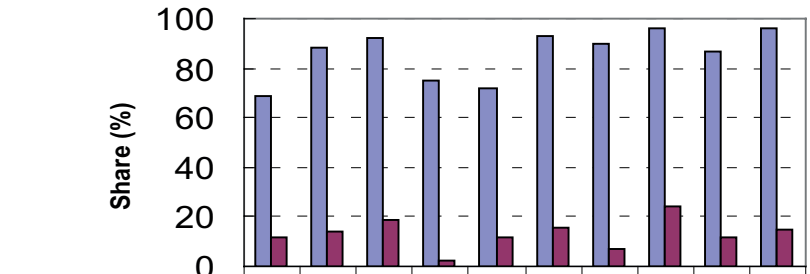
With the fact that the Arab countries import around 50% of its food requirements from outside the region, around 292 BCM of virtual water is imported which is more than the available water resources (247.15 BCM annually: Table 4). In order to compensate for this amount, it will be a big challenge to develop this quantity and utilise it for producing the necessary food and related commodities.

Usage of Water Resources in the Arab World

The percentage of available resources utilization in the Arab World is 76.8% compaired with worldwide percentage of 7.5%. Some of the Arab countries exceeded the safe yield abstractions by about 100% from the groundwater resources. The current water usage in the Arab World is around 190 BCM annually for different purposes, where agriculture is the dominant sector in the water usage.

Agricultural Usage:

The total irrigated lands in the Arab world are around 24% of the total cultivated lands. While agriculture and the rural economy are important elements in the Arab countries, the relative contribution of agriculture to overall GDP in most countries in this region is low and has been declining. Figure 1 shows that agriculture, even in Syria, which has the highest share of contribution to GDP in the region, contributes only 24%, whereas agriculture in Jordan contributes to a mere 2% of GDP. However, agriculture is by far the dominant user of water, where in some countries like Morocco, Syria and Yemen, where agriculture consumes close to 100 percent of all available water resources.



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Water use	69	88	92	75	72	93	90	96	87	96
GDP contribution	12	14	19	2	12	16	7	24	12	15

Figure 1: Water use share and GDP contribution of agriculture (%) (Contribution part d'utilisation de l'eau et le PIB de l'agriculture (%))

The current water utilization for irrigation is around 169 BCM annually, or around 89% of the water used for all purposes, and around 70.4% of all the available water resources. The essentiality of using water for irrigation in the Arab world stems from the following:

1. Around 82% of the irrigable lands receive less than 300 mm of rainfall annually. That means that sustainable agriculture in not possible without using additional water for irrigation.
2. Water for irrigation is the main source for producing the field crops, fruits, sorghum and other valuable products.
3. From the socio-economic aspects, irrigation water is supporting most of the rural area human activities.

Most of the Arab countries witnessed an extension in the cultivated lands during the last two decades. In Syria the irrigated area increased from 670,134 ha in 1989 to 1,088,891 ha in 1995 and to 1,266,900 ha in 2001. The irrigated area for the 13 governorates was assessed during growing season 2001. The irrigated areas have been digitized from an irrigation map covering the western part of the country and from two land use maps. Additionally satellite imagery has been used to locate recently developed schemes and to adjust the outlines of the digitized polygons.

In Jordan, the area under irrigation increased from 64,300 ha in 1990 to 76,912 ha in 2000. Another inventory, however, reported a total irrigated area of 84,130 ha in 1993 and 95,005 ha in 2000. Irrigated areas were digitized by using an irrigation map of the Jordan valley and another map of irrigated areas outside of the Jordan valley. The 1997 information for Lebanon showed the irrigated area of 26 'mohafazas' as 117,113 ha, which was about 40% of the cultivated area. The irrigated areas have been digitized from a land use map published in the Tübinger Atlas of the Middle East and from satellite imagery.

In the Gulf area in Saudi Arabia, the cultivable land in 2000 was estimated at 4,987,000 ha, of which only 1,119,750 ha was actually under cultivation. Another inventory states that 1,620,983 ha was under cultivation during the cropping season of 1992. All agriculture is irrigated and the extent of cultivation depends mainly on the availability of irrigation water. The area under irrigation in the 13 regions, was estimated by using the maximum value of the cultivated areas for the cropping seasons 1992 and 2000. The so estimated irrigated area added up to 1,730,767 ha.

In UAE, The cultivated area for the five Emirates increased from 68,877 ha in 1992 to 111,356 ha in 1998 and to 280,341 ha in 2001 and all are irrigated. About 82% of the irrigated area is located in the Emirate of Abu Dhabi. In Kuwait, the cultivated area increased from 4,770 ha in 1994 to 6,968 ha in 2000. Because of the climatic conditions all the cultivated area is irrigated.

One of the few exceptions where the irrigated lands were scaled down is in Qatar where, the area under irrigation was estimated to be 12,520 ha in 1993 and the area actually irrigated during the year 2000 has been reported to be 9,762 ha.

Challenges that are facing the available water resources in the Arab world

The following issues represent the main challenges that are facing the availability of water resources in the Arab world:

- Shortage of water resources: All the indicators show that the region is facing water shortage in most of the Arab countries.
- Aridity and Climate conditions: Due to the aridity of most of the Arab countries, the balance between precipitation and evaporation is always negative due to the high evaporation rates which reach an average of 1500 mm annually, where the precipitation reaches around 155 mm annually.
- Deficiency of utilizing the available water resources: This deficiency arises due to adopting traditional irrigation systems in most of the countries. The long distances between the water source and the irrigated farms increase the losses of water due to

evaporation and seepage. Such losses are around 35 BCM or 38% of the allocated water resources and may increase in some of the countries to around 49% especially for the rain fed irrigation systems. Many of the countries, especially in the Gulf have adopted pressurized irrigation systems which reduced the losses down to 5% and raised the irrigation efficiency up to 95%.

- Shared water resources: Another challenge that is the shared water resource which represents around 73% of the available water resources. These resources are shared with countries outside Arab world. This is summed to around 150 BCM annually. In most of the cases, Arab countries are the down streamers which make it a big challenge for the water rights with the up streamers.
- Lack of available information and monitoring programs: The lack of hydrological and hydrogeological information make it a big challenge to the researchers and analysts in the area of water resources planning and management.
- Overexploitation of groundwater resources: The quantity of groundwater resources is around 7733 BCM where the annual recharge is around 42 BCM, and the available resources for usage is around 35 BCM per annum.
- Deficiency of integrated water resources management: Most of the countries are not adopting enough means towards implementing an integrated water resources management in their policies. Reasons are lack of solid organizational structures of the water agencies and lack of water legislations and regulations to maintain the sustainable use of available water resources.
- Concept of Virtual water: Virtual water refers to the water required in the production of a good or service. The concept of virtual water helps us realize how much water is needed to produce different goods and services. In semi-arid and arid areas, knowing the virtual water value of a good or service can be useful towards determining how best to use the scarce water available.
- Virtual water trade: It refers to the idea that when goods and services are exchanged, so is virtual water. When a country imports one tonne of wheat instead of producing it, it is saving about 1,200 cubic meters of indigenous water. If this country is water-scarce, the water that is 'saved' can be used towards other ends. If the exporting country is water-scarce, however, it has exported 1,200 cubic meters of virtual water since the real water used to grow the wheat will no longer be available for other purposes.

2. AGRICULTURAL DEMAND MANAGEMENT AND WATER CONSERVATION

Out of twenty countries in the Middle East and North Africa, eleven are already using more than half of their water resources. Libya and all of the Arabian Peninsula countries are using more than 100 percent. They are relying on expensive desalinization of seawater, or drawing on groundwater reserves that cannot be replenished (Harrison, 1992). Of the 88% of fresh water used for irrigation in the Arab states, 70% is lost because of the use of traditional irrigation systems, leakage in water pipelines and bad administration of irrigation waters (Arabic News, 2002). Food security, sustainable economy requires new technologies for improving the situation.

Compared to others, water conservation initiatives resulting in the efficient use of water provide the most immediate and promising option by using existing technology and low-cost changes in procedures. They are suitable for large and small-scale irrigation systems.

Improving agricultural and green industry irrigation efficiency through conservation could reduce water needs by 10% and double the amount of water available for general consumption. Benefits include increases in agricultural productivity, improved water efficiency of up to 95% and permanent reductions in water use.

Due to increasing demands for water and its continued depletion, water resources management has received considerable attention around the world for many years – and particularly in the Arab world. Prominent in policy and strategy thinking are three particular trends:

- Integrated water resources planning and management based on the river basin or catchments.
- A balance between policy and regulatory functions of central government and the decentralized management, operation and maintenance of water delivery through participation by the stakeholder and water user.
- A shift in the policy of water resource management, away from the development of new systems and infrastructures to provide more water, to the improved management of existing water resources and the improvement of water use efficiency and water conservation. These improvements are often implemented through Water Management Plans, with a focus on Best Management Practices.

Due to the dominant share of the allocated water for agricultural uses in the Arab world, it became essential to focus more on the best uses and practices in this sector and try to raise the efficiency of using the allocated water for irrigation through adopting water saving policies such as the demand management tools.

3. CONCEPTUAL FRAMEWORK OF AGRICULTURAL DEMAND MANAGEMENT (ADM)

Water Demand Management (ADM) aims to conserve water, to improve water supply services to irrigation farmers and to enable them to use irrigation water more efficiently.

There are many elements that need to be considered in determining ADM as follows:

- Incorporation of sufficient water resources in planning to ensure food security in the targeted country.
- Adjustment of cropping patterns to take account of water availability, both in respect of quantity and quality, land and climate
- Implementation of modern irrigation and farm management techniques
- Farmers and relevant institutions to plan for maximum of wastewater re-uses schemes in future including provision for the necessary storage, health precautions and crop pattern.
- Strengthen the legal and regulatory framework of determining water demand through

water meters, licensing system for legal and illegal wells and establishing an appropriate tariff system.

- Launch public awareness programs to educate on the economic value of water and future use of treated wastewater.
- Support capacity building and satisfy training needs in the water-related areas of the sector, technically, administratively and financially.
- Research Needs: Potential areas of research in water sector in a region should be compiled. The major research objective should be directed towards sustainable improvement of agricultural production.
- Agricultural Communities, Farmers Associations, and Water Users: The policy should encourage the participation of all stakeholders that lead eventually to improvement of crop production and water use efficiency.
- Enforce Pollution Control and Protection of Water Resources: The objective is to develop the appropriate and efficient legal, regulatory and institutional instruments to enforce pollution control and protection of water resources through efforts of the relevant institutions.
- In order to translate any ADM framework there should be a plan, which is called Water Demand Management Plan. A water demand management plan should therefore make all reasonable effort:
- To calculate the irrigation water requirement for each crop grown in the country, and to estimate, as closely as possible, the area of each crop grown, preferably averaged over more than one year, in the country, and using the above to calculate the monthly and annual irrigation requirements for the country.
- Applying the calculated requirements as a water management tool.

These calculations need to be viewed as guidelines for irrigation water requirements and may need to be tempered by local experience.

In a Water Management Plan, there should be more description for the current irrigation water use and conservation measures and set out how it plans to implement Best Management Practices (BMPs) to improve the irrigation water supply services and to achieve water conservation and water demand management.

Developing a Water Management Plan and reviewing it regularly is a major stimulus to efficiency, promotes coordinated action and facilitates negotiations with stakeholders. The process does not require expensive data gathering, but uses existing data for its initial implementation and then aims to improve the data from year-to-year. Therefore the Water policy of the country should be able to develop its own Water Management Plan.

Water Management Plan should go through the following steps:

Step 1: Describe the plan, its location and facilities, history, operating rules, etc.

Step 2: Identify and adopt appropriate Benchmarks for irrigation water use and water management in the targeted areas

Step 3: Develop a Water Account of the plan that encounter water resources and uses for auditing purposes

Step 4: Review progress and show plans for the implementation of Primary and Secondary BMPs for the plan.

4. OBJECTIVES OF AGRICULTURAL DEMAND MANAGEMENT

The objectives can be stated as follows:

- Maximize the irrigation efficiency and scale down the physical and non physical losses.
- Minimize the operational cost of agricultural activities inside and outside the farm and assist in recovering the cost of agricultural activities.
- Assist in elevating the poverty and minimize the risks of droughts.
- Best utilization of the available water for the best crop yields and quality.
- Adaptation of low water consumption crops that will give good products and profits for the farmers.
- Minimize the cost of agriculture activities in order to minimize the cost of product production and enable the farmers to compete in regional and international markets.
- Saving more quantities of fresh water for use in other profitable ventures.
- Exchange experiences among the Arab countries with regard to demand management technologies and programs and dissemination of knowledge.
- Open the opportunities for the farmers through the water user associations to participate in the planning, implementing and operating the agriculture sector activities.
- Encourage the farmers to adopt the high technology in irrigation inside their farmers.
- Improved water and economic efficiency on national level.

To make the idea more applicable to the Arab world countries and the objectives more specific, measurable and applicable, it is necessary to develop the tools and potentials for implementing the ADM programs as will be elaborated in the following section.

5. TOOLS AND POTENTIALS TOWARDS IMPLEMENTING THE ADM

For the effective development of ADM in a developing country, the following key “tools” and practices are essential. They are:

- Benchmarks for Agricultural Water Use
- Disposal Reports, Water Accounting and Water Audits
- Best Management Practices

Benchmarks for Agricultural Water Use

These Benchmarks are used to define, predict and to monitor actual agricultural activities:

- Irrigation water requirement benchmarks per crop per homogenous area.
- Scheme/canal design capacity vs. allocation.
- Canal management losses.
- Irrigation efficiencies of different irrigation systems.
- Productivity of water use, measured as crop returns per unit volume of water used. These can be expressed as R/m3 or kg/m3.
- Assured yield changes over time.
- Marketing and socioeconomic aspects.

The main item that is related to the best use of irrigation water is the calculation of irrigation water requirements.

Calculation of irrigation water requirement

Research on crop water use and irrigation requirements for a wide range of commercial crops in different climatic regions and on different soil types has been ongoing in Arab world. The results of this research have been effectively applied in many irrigation areas for almost as long a period. The agricultural sector may therefore be well ahead of other sectors with regard to the establishment of benchmarks and operating guidelines for crop water use and irrigation requirements.

Despite this progress there remain many gaps in the information/data pool and the initiatives have been adversely affected by inconsistencies in approaches, duplication and uncoordinated efforts.

Irrigation Water Accounting

A water account or water balance summarises the annual volume of inflow, consumption and outflow from the geographical area served by the operator. The water account crystallises the beneficial and non-beneficial consumptive uses in the cultivated area as a basis for calculation of performance indicators. Performance indicators are particularly useful in identifying water savings opportunities.

Each water use component in the cultivated area should be categorized in the Water Account to reflect the consequences of human intervention in the hydrological cycle. Inflows, consumptive uses and outflows are classified into various categories as defined below:

Disposal Reports, Water Accounting and Water Audits

The disposal reports originated from the need to optimally manage on-demand water management systems. The purpose of water distribution systems is to make water available

at predetermined periods at a set flow rate at a specified point. To achieve this goal irrigation designers and managers have developed various water distribution systems, namely,

Downstream or User control

With this system the user abstracts water at any time through an automatic registering flow control valve. Most piped system and even automated canal systems can operate in this way. This is normally a very advanced and expensive system.

Best Management Practice

An important aid in improving efficiency is the concept of Best Management Practices (BMPs). A BMP is not some distant idealistic vision, but a generally accepted practice that has every chance of being attained. A BMP (also called an Effective Water Management Practice) is a policy, programme, practice, rule and/or regulation, or the use of devices, equipment or facilities which is:

- An established and generally accepted practice that results in more efficient use, conservation or management of water.
- A practice which makes progress towards insuring sufficient data is available from existing water management projects to indicate:
- That significant efficiency improvements or management related benefits could be achieved.
- That the practice is technically and economically reasonable and not socially or environmentally unacceptable.

Two lists of BMPs are being developed nationally:

- Primary BMPs, and
- Secondary BMPs.

Some BMPs are high priority and are generally applicable to all cultivated lands – "Primary" BMPs. However, since priorities and conditions differ from one area to another, we also need a list of "Secondary" BMPs, all of which may not be applicable to any specific cultivated land. BMPs, therefore, do not imply standardization and no BMP should be introduced unless it has been thoroughly evaluated to ensure that it would be beneficial to and sustainable.

Capacity Building and Training for Water Conservation and Demand Management in Agriculture

The focus of the Water Conservation and Demand Management Strategy is to establish an approach and a system in which there is a balance between centralized (top down) and decentralized (bottom up) water delivery management. For this bold "self-regulation" approach to succeed will require empowerment of all role-players in irrigation.

Empowerment, in turn, implies capacity building and training. Therefore an essential element of the strategy will have to be a systematic and long-term initiative of enabling irrigators and

the various levels of regulatory authorities to improve water use efficiency.

Capacity building programmes need to be focused on the different levels of professionalism; mainly the technical staff who are setting the programs and following the implementation, and so the management who will follow up the reports from the field and take necessary decisions. The Farmers who will be in the field and form the domain for implementing the ADM program need to be exposed to capacity building program in the areas of operation and maintenance of the irrigation infrastructure. The Farmers need to be aware of the expected benefits and advantages of adopting the ADM policy at the area where they are performing their activities. Exchange of success stories with other developed countries will assist in transmitting the messages to the technical and administrative staff who will follow up the implementation of the ADM policy. The same is applicable for the people at the site, either from the public sector of the private sector.

6. CONSTRAINTS AND WEAKNESS OF IMPLEMENTING THE ADM

There are a number of constraints that may challenge the implementation of the proposed ADM in the Arab countries. These may be summarized as the lack of:

1. Capitals and necessary resources.
2. Professional capacities and required human resources.
3. Information necessary to adopt the ADM.
4. Proper infrastructure at the country.
5. Political will of the decision makers.
6. Coordination with other countries.
7. Agricultural policies that will guide the sector towards improvement.

Each of these challenges will play a role in delaying the ADM policy at the targeted country. More details about these challenges can be described as follows:

Lack of capitals and necessary resources:

The lack of enough financial resources will play an essential adverse role in retarding/ canceling any plan for demand management. The financial resources are a shared responsibility between the Government and the private sector (Farmers). The first initiative should be through the Government in terms of pledging seed money for the preparation of the ADM policy. This will be followed by securing and mobilizing the necessary fund for implementing the policy. International donors and financiers may participate in implementing the ADM program if the Government shows a willingness to be part of the fund securing activities. The farmers should be part of securing the fund for adopting and implementing the ADM policies. Other parties may participate in encouraging the farmers such as the Farmers Union and farmers NGOs.

Lack of professional capacitates and required human resources:

One of the main challenges in adopting certain implementing policy or development program is the lack of professional capabilities and necessary human resources. Most of the time, the Governments may provide the technical support but lacks the managerial capacities. Most of the managerial capacities are founded at the private sector. There should be a capacity building program in order to maintain the necessary qualifications for implementing the ADM program. An initiative from the Government side should be offered to encourage the qualified capabilities to stay within the public sector.

Lack of information necessary to adopt the ADM

In order to set the ADM program, there should be enough information about the current status of the agricultural sector in terms of efficiency and deficiencies, strengths and weakness, potentials and constraints. Lack of information will lead to setting illogical objectives and expecting more than what is achievable or doable. There should be a mechanism of stemming the necessary data from the field, human resources and current circumstances. In general, specific data collection and monitoring programs are missing in the Arab world, unless there is some specific need to do so. Unreliable data as the input for the analysis leads to wrong decision.

Lack of proper infrastructure in the country:

The ADM program could not be implemented due to the lack of necessary infrastructure at the targeted sites. That could be in terms of pressurized system, canals, tunnels, gauging stations, farms turnouts and other monitoring equipment. This may arise due to a lack of financial resources but due to its significance, it is, nevertheless, one of the main challenges. Usually the main infrastructure is the mandate of the Governments and not of the farmers. Building the main canals, rising mains, pumps, laterals and monitoring systems are components of the infrastructure. The responsibility of the farmers usually start at the farm gate such as establishing pressurized system, drip irrigation and other secondary infrastructure.

Lack of political will of the decision makers:

It could be the case that the capitals, human resources, infrastructure are available, but the political will is not formed yet to take relevant decisions. In this case the challenge will be to convince the key Governmental decision makers of the essentiality of such program. Providing success stories from other countries will assist this effort. It is preferable that each country should have a higher steering committee responsible for the agricultural strategy. This committee entails representatives from all concerned parties who will form a homogenous body that will make decisions based on the general interest of the country.

Lack of coordination with other countries:

The exchange of experiences and experts among countries within the Arab world and outside the region, as a means of coordination, will enhance the adaptation of ADM policies. Coordination could be in the form of exchanging the experts at the same field, exchanging

information and technologies and technical assistance. The Arab league does coordinate among the Arab countries but it may need more implementing agenda towards the exchange of real cases.

Lack of agricultural policies that will guide the sector towards improvement:

Without an agricultural strategy and policy at the national level at each country, there will be a gap in adopting an ADM program. With the existence of agricultural policy it will be much easier to justify the allocation of the necessary capitals and resources for implementing the program. With the absence of agricultural policy, the Government will not be in a strong position to secure and raise the necessary funds from the donors to start implementing an ADM program. Most of the countries worked on producing their agricultural policies, but these policies need to be updated in accordance with the current circumstances.

7. OPPORTUNITIES AND STRENGTHS

After discussing the challenges in adopting an agricultural water demand management program, one may look into the opportunities and strengths. Each of the Arab countries may have a number of strengths that will assist in creating the necessary demand management program. These strengths and opportunities are presented in the different sectors at different levels. In the following sections there will be more focus on the available opportunities on a regional level which can be summarized as follows:

1. Globalization and impacts of the developed world experiences in the areas of agricultural development on the region.
2. Good intentions and will to change from the public sector.
3. Need for saving water for better irrigation efficiencies and managing the demands.
4. More policies towards food security and better water management in the agriculture sector.
5. Tendency of adopting non conventional water resources in agricultural sector.
6. Interrelations among the different sectors on national and regional levels.
7. The existence of donors on a regional and national levels and the understanding of those donors for financing any efforts that will lead to saving the natural resources and fulfill the sustainable development on national basis.
8. High competitions for marketing the products on the regional and international basis which urge the farmers to adopt more saving and rational policies for ensuring more savings in performing the agricultural activities.

Globalization and impacts of the developed world experiences in the areas of agricultural development on the region:

Due to the opening of the world through technologies and communication, it became much easier to transmit the experiences, researches and development programs from one region to another.

- Good intentions and willingness to change by the public sector and the farmers:

  There are good intentions and willingness of the public sector and farmers towards changing for a better agricultural management practices and raising the irrigation efficiency. Such intentions may be translated into actions and programs if the Governments take the necessary initiatives for water demand management policies in the agricultural sector.

- Need for saving water for better irrigation efficiencies and managing the demands:

  The water allocated to agriculture is a substantial portion (70%) of all the available fresh water. . A 1% saving means 1800 MCM annually, which exceeds the total water budget of the Arab countries. The saved water could be utilized for expanding the cultivated lands or use it for other useful purposes.

- Realistic policies towards food security and better management of water and agriculture sector in the Arab world:

- Most of the Arab countries did formulate their water and irrigation policies. Some of them are revising them based on the current changes and future predictions. These policies will be translated through an implementable action programs. Water demand management in the field of agriculture is one of the programs that may be adopted through these policies.

- Tendency of adopting non conventional water resources in agriculture sector:

- Due to the shortage of conventional water resources in the Arab world, most of the countries are looking for more shares of the non conventional water resources. This will entail the reuse of treated wastewater, desalination, import, and water harvesting and water demand management.Most of the countries are planning to adopt a comprehensive program of water demand management and specifically for the agriculture sector.

- Interrelations among the different sectors on national and regional levels:

- The interrelations among sectors at the national level is an asset towards considering the best practices in agricultural sector where it will have positive impacts on the water and irrigation sector and hence, to the energy sector. Raising the efficiency in agricultural sector will generate higher share in the GNP of the country. The same concept is applied at regional level where sectors from different countries may have interrelations such as the agriculture and water sectors.

- The existence of donors on a regional and national levels and the tendancy of those donors for financing any efforts that will lead for saving the natural resources and fulfill the sustainable development on national basis.

- The national and international donors are encouraging the countries to take further steps in raising the efficiency of irrigation and saving water for more profitable uses. Most of the time, studies that are related to water demand management program at the country will get be a grant or technical assistance from the donor or from one of the developed countries. That will encourage the developing countries that are still without ADM policy, to start thinking of considering more efforts towards raising the efficiency and saving the resources.

- High competitions for marketing the products on the regional and international basis urge the farmers to adopt more saving and adopt rational policies for ensuring more cost effectiveness in performing the agricultural activities.

8. ANTICIPATED OUTPUTS AND BENEFITS

Through the previous chapters of this paper, the objectives of the ADM programs were mentioned and so the main channels of performing these programs. In order to fulfill the objectives, these programs should adopt the necessary actions that will lead to the targeted outputs and benefits. The following components present the anticipated outputs of the SDM programs in case that the implementation process matches the planned activities.

- Savings in fresh water resources and using more water for possible agricultural expansion to ensure food security. In case of no expansions, the saved water can be utilized in more profitable purposes such as agro-industrial or industrial activities.
- Adjustment of cropping patterns vis-à-vis, the water availability, both in respect of quantity and quality, land and climate. This adjustment will fulfill the demand management objectives in the agriculture sector.
- By the completion of the ADM program, there will be implementation of modern irrigation and farm management techniques at the field. That will contribute substantially in raising the irrigation efficiency to the required standards.
- Strengthen the legal and regulatory framework of determining water demand through water meters, licensing system for legal and illegal wells and establishing an appropriate tariff system.
- Launch public awareness programs to educate on the economic value of water and future use of treated wastewater.
- Ensure capacity building programs to satisfy training needs in the water-related areas of the sector, technically, administratively and financially.
- Potential areas of research in water sector for the targeted country would be compiled. The major research objective should be directed towards sustainable improvement of agricultural production.
- Agricultural Communities, Farmers Associations, and Water Users will be encouraged to participate in the decision making process and implementation of the set programs and that lead eventually to improvement of crop production and water use efficiency.

9. CONCLUSIONS AND RECOMMENDATIONS

Impacts on the Sectoral level

The anticipated impacts of implementing ADM program will have remarkable positive impacts on the agriculture sector level. That could be recognized through the following outputs:

- Improvement of water usage efficiency which will open the space for more cultivated areas and / or more production of crops.
- Improvement through raising the capabilities of the stakeholders who participate in improving the agriculture sector. That will maintain the confidence of all the parties in their mandates and responsibilities.

- Implementing the ADM programs will ensure the coordination among the Government, financiers, farmers and other stakeholders. That will build the trust among all stakeholders for better performance at sectoral level.
- New job opportunities will be secured after and during the implementation of ADM program. Professionals in agriculture sector will find high demand and potentials along the adaptation of ADM programs.
- Savings in the agricultural inputs will affect in scaling down the cost of crop production, which will offer better competition positions for the farmers on national and regional levels.
- Enhancing the socioeconomic conditions of the farmers through scaling down the costs of the agricultural activities and raising the profit margin.

Impacts on the National level

The positive impacts on the national level will be shown through the following indicators:

- Positive impacts on the economy of the country through reserving more water quantities that may be used for profitable out products in the agriculture sector or other development sector such as industry and trade. In addition to the added values to water uses so as to raise its productivity.
- Improvement of the agriculture sector will ensure better position of the country in terms of adopting new technologies in front of the donors, financiers and international community. That will assist in building the confidence between the country and the international donors.
- There will be more encouragement for the investors in the agriculture sector from the national market or from outside the country. Mobilizing more investments in the country will have positive impacts on the socioeconomic aspects.
- Assist in recovering the cost of the agricultural activities which will lead to adding values to the profits of the farmers. That will assist in elevating the poverty and enhance the life standards of the farmers.

Impacts on Regional level

The positive impacts will be extended from national to regional levels. The successful adaptation of ADM program in one country is a success story that could be duplicated in the other countries. Exchange of experts and ideas could be done among the different Arab countries in the field of water demand management in the agriculture sectors. In case of implementation ADM programs by more than one country that will build windows of mutual benefits and opportunities for coordination and collaboration among the different countries in the region. More opportunities would be available for researchers and professionals working in this sector to meet and discuss their experiences and elevate their capacities in agriculture technologies and ways of improvement and supporting Agricultural Technology Transfer.

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