WATER MANAGEMENT DEVELOPMENT AND AGRICULTURE IN SYRIA

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ABSTRACT

Irrigated agriculture has increased steadily in Syria over the last decades, almost doubling since 1985. This mounting pace has responded to the nation's food security policy objectives to satisfy the food production needs of an increasing population that features one of the largest growth rates in the world, namely 3,50 percent in 1985 and still 3,39 percent in 2007. Total expenditures for irrigated agriculture accounted for almost 70 percent of all expenditures in agriculture. Sustainable irrigation water policies aimed at increasing the efficiency of water use in agriculture and at conserving water resources by reducing future consumption.
The Euphrates River is 2.800 km long and its middle traverses a wide floodplain in Syria, where it is used extensively for irrigation, and the Euphrates Dam is 230 ft (70 m) high. The total estimated water use volume is about 15 billion m^3. The Euphrates and Orontes basins account for about 50% and 20% of the water use respectively.
About 701.634 ha has been irrigated by ground water in the year 1997. This area represents 60% of the total irrigated land in Syria It has been gradually increased from 30% during 1970 to 44% in 1980 and 49% in 1990.
The Government projects extended on 349.820 hectare area, which includes large, medium and small scale farms. The small scale government project is under 2000 hectare, but large scale project over 20.000 hectare areas. The Syrian Government wants to ensure the food supply for sharply increasing population based on established governmental agricultural projects, as state-owned farms.
Water balance for Syria indicates that most of the basins are in deficit. This will be exacerbated further especially in basins encompassing large urban areas and if the country's population continues to grow at its current rate (about 3%) and water use efficiency is not increased effectively.

INTRODUCTION

Some 60% of the freshwater resources in the MENA countries come from outside the region. Within the MENA countries, most of the water resources have already been developed. Several MENA countries are suffering from water deficiency and others are heading that way with an annual population growth of about 3% and rising levels of consumption due to socio-economic development. While water per capita consumption rates are the lowest in the world, municipal and industrial water requirements are expected to double and triple over the next years, respectively. Meeting the long-term priorities of the region for the improvement of water resources management, especially the provision of drinking water and wastewater services, will require cooperation private sector with government in terms of partnership investment to reduce the financial burden on the government and assure improved levels of service.

In Syria as in many other countries of the Near East region, water is becoming progressively scarce as future demand is coming close or even surpassing available resources. Hence water use efficiency in all sectors is becoming a matter of economic, social and political concern, and water policies are at the core of the nation's economic policy discussions. This crucial issue is particularly relevant for the agricultural sector in Syria, which uses up to 85 percent of all the available water resources in the country (FAO-MAAR, 1999).

Irrigated agriculture has increased steadily in Syria over the last decades, almost doubling since 1985. This mounting pace has responded to the nation's food security policy objectives to satisfy the food production needs of an increasing population that features one of the largest growth rates in the world, namely 3,50 percent in 1985 and still 3,39 percent in 2007 (FAO-MAAR, 2007). Recently, the notion of food security, formerly assimilated to food self-sufficiency, has been redefined into a more flexible concept oriented to increase production of certain crops that profit from comparative advantage. Consequently, exports of these products can counterbalance the need to import other commodities.

As the economy in Syria has been primarily based on agriculture, agricultural policies have been shaped by the general state-led import substitution development policies that have prevailed for the last decades and are currently being liberalized. The major strategy for agricultural production has been self-sufficiency in the principal food staples, instrumented through the Government's annual agricultural production plan.

Despite significant liberalization in the last years, the introduction of incentives to stimulate private sector exports and to liberalize imports, the state still plays a major role in production and trade. At present, the state maintains a heavy intervention in the purchasing and marketing of the strategic agricultural products (cotton, tobacco, sugar beet, wheat, barley, lentils and chickpeas) as the private sector trades in fruit and vegetables and livestock products. The Government grants crop licenses to the farmers which entitles them to obtain subsidized loans and inputs and to sell the produce to the state agencies at the Government's support prices. Therefore the agricultural sector benefits from consid-

erable protection, which implies a large share of the public budget. Total expenditures for irrigated agriculture accounted for almost 70 percent of all expenditures in agriculture.

In this context, the main purpose of this study is to analyze water management policies in Syria in the framework of the recent developments towards more market-oriented agricultural policies. A growing preoccupation in Syria is the design and implementation of sustainable irrigation water policies aimed at increasing the efficiency of water use in agriculture and at conserving water resources by reducing future consumption. Of major importance in this context is the adoption of modern irrigation technologies at the farm level, which is already profiting from considerable support by the government agencies implicated. However, its wider adoption may require additional incentives and other supporting measures. On-farm improvements must be accompanied by similar policies at the network level to increase their efficiency. Such measures need to be evaluated in technical and economic terms at national and at system's level.

The study consists of the analysis of the irrigation water sector in Syria and its related water policies, for which an explicit methodology has been developed. The investigation includes two major parts at different levels of aggregation. One is devoted to analyzing the irrigation water sector in Syria at national aggregated level and at regional basin's level. The other part is a disaggregated farm level analysis. In both cases, simulations of different scenarios have been carried out to permit short- and long-term assessments of different policy alternatives for conserving water resources in Syria and their effects at national, regional and farm levels.

MATERIALS AND METHODS

The utilization of water resources and role of the Euphrates River for agriculture in Syria

One of the main drivers in the Middle East and North Africa (MENA) region is water, which has always been the central concern of the countries of the region. Early civilizations emerged along the Nile, Tigris and Euphrates and the struggle for water shaped life in desert communities. However, at present, the MENA region is facing one of the severest water scarcities in the world: most of the countries of the region are in the arid to semi-arid zone, and rainfall is low, variable and unpredictable in most of the area.

The largest river in Southwest Asia, it rises in Turkey and flows southeast across Syria and through Iraq. Formed by the confluence of the Karasu and the Murat rivers in the high Armenian plateau, the Euphrates descends between major ranges of the Taurus Mountains to the Syrian plateau. It then flows through western and central Iraq to unite with the Tigris and continues, as Shatt al-Arab, to the Persian Gulf. In all, it is 1.740 mi (2.800 km) long. Its valley was heavily irrigated in ancient times, and many great cities, some of whose ruins remain, lined its banks. With the Tigris, it defines an area known historically as Mesopotamia.

The middle Euphrates traverses a wide floodplain in Syria, where it is used extensively for irrigation. Euphrates Dam, 230 ft (70 m) high, constructed with Soviet aid at Tabqa, N Syria, is the main unit of the Tabqa Barrage Scheme. The huge reservoir impounded by the dam provides electrical power but has failed to transform the region into a productive agricultural area. Below the dam the Euphrates receives the Belikh and Khabur rivers, its only major tributaries.

In Syria the Tabaqah Dam (completed in 1973 and sometimes known simply as the Euphrates Dam) forms a reservoir, Lake Assad that is used for irrigating cotton. Syria has dammed its two tributaries and is in the process of constructing another dam.

Issues related to the development and management of the Euphrates-Tigris basin is discussed. Historical perspectives on water conflict, geography, hydrology, water and land resources development in riparian countries, namely Turkey, Syria and Iraq, are examined. Problems and misconceptions related to water utilization are analysed with regard to water availability, water loss, water rights, the role of dams and reservoirs, and environmental problems of the Mesopotamian marshlands. Advantages and areas of co-operation between riparian reviewed. Water conflict in the Euphrates-Tigris basin requires a hydro-political approach that covers legal, political, technical and economic aspects of its multi-dimensional characteristics.

Syria, which is located along the Mediterranean shores of the Middle East, becomes progressively scarce of water as future demand is coming close or even surpassing available resources (Varela-Ortega and Sagardoy, 2002). Syria had a population of 18 million in the year 2002, and its Total Renewable Water Resources (TRWR) is estimated around 16 BCM per year. In other words, the per capita TRWR is less than the water scarcity index (1000 m3/person/year). Although, this would still rank Syria amongst countries with moderate water stress, it will be soon classified as a country with severe water stress if its population continues to grow at its current rate (about 3%) and water use efficiency is not increased effectively.

In Syria and until fairly recently, emphasis has been put on the supply side of water development. Demand management and improvement of patterns of water use has received less attention. Water managers and planners have given high priorities to locating; developing and managing new water resources. The aim was always to augment the national water budget with new water. The most popular way of achieving this aim was to control surface flows by building new dams and creating multi-purpose reservoirs. There are now around 160 dams in Syria with a total capacity of 14 BCM (billion cubic meters).

Irrigation schemes were also built and agricultural activities were expanded greatly to achieve self-sufficiency in essential food products and food security. Over the years, however, the most attractive alternatives for the development of water resources infrastructure have already been implemented and, it is hard to think of feasible alternatives for a further increase in supply. In addition, the cost of developing less accessible water is high and time consuming. Therefore, the emphasis is now to be shifted and a new vision on the utilization of water resources for agriculture is to be valorised.

RESULTS

Water supply and surface water irrigation in Syria

In Syria, the total estimated water use volume is about 15 billion m^3. The Euphrates and Orontes basins account for about 50% and 20% of the water use respectively. Table 1 shows water availability and use in the various basins of Syria. As shown in this table, water balance in most basins has been in deficit (except in the coastal basin and the Euphrates basin). This will be exacerbated further especially in those basins encompassing large urban areas such as Damascus and Aleppo.

Agriculture is the largest water-consuming sector in Syria accounting for about 87% of water use. The domestic and industrial water use was about 9% and 4% respectively. While the urban water demands is rapidly increasing due to strong population growth rate (about 3% per annum) and industrial growth, new water sources are becoming scarce and extremely expensive to develop. Water deficits are expected to worsen placing additional stress on all uses. Since drinking water needs are given top priority in the government's policy, water availability for agriculture use could face severe constraints.

The Euphrates River is the biggest source of irrigation water in Syria. Following are two examples showing the salinity status in areas irrigated by the Euphrates water. The Euphrates valley (lower terrace): The fertile alluvial soils (fluvents) are the prevailing soils in the valley. The Euphrates valley is the largest irrigated area in Syria. Some of the earliest human agricultural activities were started in this valley.

As early as 6000 B.C., the region was inhabited by grain farmers. Irrigation became extensive between 4000 and 3000 B.C. Evidences of historical salinization are almost absent within the Syrian part of the valley. Recent soil salinization processes have started in the valley as early as the late 1940s when large scale irrigated agriculture became possible by using diesel irrigation pumps. The process has remarkably accelerated at the beginning of the 1950s when cotton was introduced into the area as a summer cash crop. Misuse of irrigation water accompanied with the absence of any kind of drainage systems and improper management led to up rise in the ground water level and consequently salt accumulation within the root layers by evapo-transpiration.

In the middle of the 1960s a quite large areas became out of use due to extreme salinization. The first semi-detailed soil survey for 123.000 ha of the lower Euphrates valley carried out In the late 1970s proved that the electrical conductivity of soil paste extract was over 8 ds/m for 50% and over 16 ds/m in about 30% of the area.

The Euphrates higher terraces: Near Rakka about 10.000 ha mainly located within the second Euphrates terrace were brought under irrigation in 1970. The land was prepared for a modern irrigation project. A survey for soil has been carried out in the year 1980. Severe salinization with more than 16 ds/m of the soil paste extract took place in about 24% of the project area, as a result of insufficient and improper drainage system. The salinization processes have been remarkably accelerated due to the introduction of

rice cultivation for the first time in the area. It has been estimated that 3000-5000 ha of the irrigated lands becomes out of the agricultural use every year in Syria due to extreme salinization.

RESULTS AND DISCUSSION

The 'water issue' has certain *general characteristics*, which need to be taken into consideration when thinking about possibilities for private sector involvement in its management. A closer look at such characteristics immediately reveals the consequences and implications to be taken into account, for example the following.

- *The water sector is a capital-intensive sector,* requiring investments to cover the necessary capacity extensions only and not accounting for the equally necessary rehabilitation, modernization, operation and maintenance costs.
- *Water is vital for human life* and therefore a precious commodity. Water is wasted in quantity, for example through the high incidence of leakage in drinking water supply systems in many cities and towns. In agriculture, irrigation water is often used in an inefficient and unproductive way. In the MENA region, water used for agriculture is accounts for around 89% of the total water. Water is also wasted quality-wise; for example, water pollution is a common phenomenon in industry and at the household level. Apparently the cost of water for the user does not seem to reflect its real value.
- *Management of water has far-reaching impacts beyond the water sector,* for example on public health and the environment. Socio-economic benefits often surpass financial benefits and required sector investments are likely to exceed what a private sector investor (and the consumer) is willing to pay. For a potential investor only the financial returns and not the socio-economic benefits count.
- *Distribution of water is often a 'natural' monopoly.* For example, it would be inefficient to have several—competing—irrigation networks in an agricultural area or water distribution and sewerage networks in a city. Consequently the single service provider is in a dominant position making it necessary to protect the consumer against monopolistic behaviour.
- *Pricing of water is rarely efficient*. Tariffs are often below costs, recovery rates remain below projections and governments are required to finance construction and operational deficits, which makes water (again) a 'public good' in many situations. Charging an appropriate price from an economic viewpoint for water is a politically very sensitive issue in many countries. Each of these characteristics has implications for the involvement and distinctive roles of the public and the private partners in the water sector. Together they highlight the manifold challenges to *public–private partnerships (PPPs)* in the construction and operation of water infrastructure globally, including the MENA region. These characteristics also

help us to define a number of principles that guide us in analysing and tackling the institutional, legal and practical problems for the participation of PPPs in the construction and operation of water infrastructure.

Ground water irrigation

Considerable areas, namely about 701.634 ha has been irrigated by ground water in the year 1997. This area represents 60% of the total irrigated land in Syria It has been gradually increased from 30% during 1970 to 44% in 1980 and 49% in 1990. However acute increase of 10% took place in two years. Considering that, the total renewable ground water in Syria represents only less than 7% of the total available water resources one may notice the irrational and unbalanced policy of using water resources in the country.

According to the FAO guidelines on water quality for irrigation a severe restriction for irrigation is indicated when the electrical conductivity of the water exceeds 3ds/m. Water samples from three wells north of Deir- el-zor within the steppe area have been analyzed. The EC values were ranging between 7 and 10 ds/m.

Furthermore the guidelines also indicated limits for specific ion toxity. In the analyzed samples sodium and chloride are found to be the dominant cations and anions respectively. A severe restriction degree is given in the guidelines when the concentration exceeds 9 meq/1 for sodium and 10 meq/1 for chloride. This concentration and the composition of these salts are considered the analyzed samples and similar waters are not suitable for irrigation.

Table 2: Government projects

Size	Criteria	Total area in ha	as % of total
Large	> 20 000 ha	257 860	74
Medium		47 840	14
Small	< 2 000 ha	44 220	12
Total		349 820	100

Source: World Bank (2001). "Syrian Arab Republic Irrigation Sector Report". Rural Development, Water and Environment Group, Middle East and North Africa Region, Report No. 22602- SYR.

The Government projects, which can be mentioned as a successful PPPs, extended on 349.820 hectare area, which includes large, medium and small scale farms. The small scale government project is under 2000 hectare, but large scale project over 20.000 hectare areas. The Syrian Government wants to ensure the food supply for sharply increasing population based on established governmental agricultural projects, as state-owned farms. There is a wide variation in cropping patterns in the irrigated areas, depending on the water resources available and the agro-climatologically conditions. Strategic crops

such as wheat and cotton are concentrated in the northern and eastern part of the country. More than 50% of the wheat and cotton produced comes from the Al-Hassakeh governorate, in the north-eastern part of the country.

The production of winter vegetables is centred in the coastal region, while summer vegetables are produced mainly in the internal plains, especially in the central and southern regions. In 1993, of the total area equipped for irrigation of 1,01 million ha. about 0,12 million ha were planted with fruit trees and olives, while 0,89 million ha were used for annual crops. The cropping intensity for annual crops reached 121 %, leading to a total cropped area of annual crops of about 1,08 million ha of which 0,19 million ha with double cropping (winter and summer), 0,49 million ha planted during the winter only and 0,21 million ha planted during the summer only.

The average yield for irrigated wheat was estimated at 4 tons/ha in 1993, varying between 2,5 and 5,2 tons/ha over the different governorates. The yield for rainfed wheat varied between 1,3 tons/ha for standard varieties and 2 tons/ha for high productivity varieties. The average yield of irrigated cotton was 3,1 tons/ha. Irrigated barley is mainly used as fodder crop with yields reaching 15 tons/ha.

The average cost of surface irrigation development varies between $US 3800/ha for small, 6600/ha for medium and 7600/ha for large schemes. The average operation and maintenance cost varies between $US 60 and 85/ha per year for gravity and $US 155 and 238/ha per year for pumping. However, private farmers using water from government schemes pay only $US 26/ha per year. The current capital cost of installing 1 ha of micro-irrigation is estimated at $US 1000 for locally manufactured equipment and $US 1 400 for imported equipment. There is no fee charged for irrigation water, only for operation and maintenance.

Drainage is mainly developed in the governorates bordering the Euphrates river. In the Al-Reqqa governorate, for instance, 62% of the irrigated area is drained. About 24% of the total drained area is power drained. The drainage systems are generally mixed systems of surface and subsurface drainage.

In 1993, 60.000 ha of irrigated land were estimated to be affected by salinization. Some 5000 ha in the Euphrates basin have been abandoned due to water logging and salinity problems. In the new irrigation scheme, open drainage systems have been installed on 90% of the irrigated land. Only a small area has been equipped with subsurface drains.

Unit costs for irrigation development have increased considerably in the last two decades and this is one of the reasons why since the 1970s attention has also been given to drainage and irrigation rehabilitation, mainly in the Euphrates valley where irrigation through pumping from the river has developed rapidly since the 1950s. Appreciable progress has been made in restoring large irrigated areas which went out of cultivation due to water-logging and salinity especially in the lower and middle parts of the Euphrates valley.

CONCLUSIONS AND DEVELOPING ASPECTS

As the economy of Syria has been primarily based on agriculture, agricultural policies have been given great attention by the government and placed at a high level of decision making. Agricultural self-sufficiency has been the major stated objective of the government.

The concept of self-sufficiency has been recently modified into a more flexible oriented one as to the increase of the production of certain crops and thus exports of these products to counterbalance the need to import other commodities. Overall, self-sufficiency has remarkably shown improvement especially in wheat, cotton, and barely production. Though this remarkable improvement has led to an accepted level of insuring both internal stability and buffering the country exposure to the international market fluctuations, it came at the expense of unsustainable water use patterns. Water deficits are in most basins especially with groundwater.

Government, therefore, should review its agricultural policy regarding the production of wheat and cotton and thus encourage the growth of diversified high value and / or less water intensive crops as a primary avenue for increasing water availability and to ensure gains from its other policy of transforming the existing irrigation systems, i.e. irrigation modernization. In recent years, the government of Syria has set a legal framework which responds to specific policy objectives.

Each policy objective includes several policy strategies. One of the objective related to water is the conservation of water resources and one of its strategies is to adopt modern irrigation techniques. In the year 2001, the government has decided that all irrigated areas will be equipped with modern irrigation techniques in 4 years and has established financial and technical measures to help farmers converting into the use of the modern techniques. A study by FAO in collaboration with the Ministry of Agriculture in Syria has analysed different policy scenarios as regards to the adoption of modern irrigation techniques at macro as well as micro levels (FAO-MAAR, 2001). One of these scenarios at macro level was the government present policy of combining irrigation modernization for a 10 period of 4 years and irrigation expansion for a period of 15 years.

The study has shown that in spite of the substantial impact that could be obtained with the modernization programme, the expansion of the irrigated area has a marked counterbalancing effect. In other words, the current policy may only be sustainable for medium term and gains in deficits may not be remarkable. The study suggested a differentiated water basin policy that has an intensive plan of modernization directed to the most critical basins, e.g. Al-Khabour basin, with a lower rate of expansion in those basins while new irrigation areas are to be developed exclusively on basins with positive water balances, e.g. Coastal basin (FAO-MAAR, 2001; Varela-Ortega and Sagardoy, 2002).

At micro level, FAO study has indicated that though the substitution of traditional irrigation systems with modern irrigation techniques, the new system would not insure an effective use of water. Farmers benefit from subsidies for water, energy, and products.

The study of IPTRID (2002) has shown that farmers have no incentives to use water efficiently even with the new techniques since the fees are not related to the volume of

water used but based on a flat rate per unit of land they own. It is, therefore, necessary for the government to consider new water tariffs that will give more incentives to farmers to use water more efficiency and make sure that the transforming of the on-farm irrigation system will not be dispersed. Evidence showed that the recent lifting of the subsidy on the price of electric energy and diesel fuel has undoubtedly contributed to groundwater conservation. Similar increases in the early nineties have affected many irrigators in the country and forced them to reduce their total volume of groundwater pumping.

However, reforms in irrigation tariffs will not be sufficient to improve sustainable water use unless it is accompanied by other non-price measures like the transferring of management responsibilities to water users, e.g. the establishment of water user associations. Finally, none of the measures, whether price or non-price, will be effective to increase the efficiency of water use unless a clear shift from water mobilization to demand management occurs in the courses of thought at all levels of decision making. This shift will combine all measures: technical, legal, financial, and institutional.

Water balance for Syria indicates that most of the basins are in deficit. This will be exacerbated further especially in basins encompassing large urban areas and if the country's population continues to grow at its current rate (about 3%) and water use efficiency is not increased effectively. New water resources are becoming scarce and extremely expensive to develop. Therefore, shifting from water development/water mobilization to water management, in particular water demand management, is necessary to reach sustainability in water use and agriculture. While there are many hurdles and challenges towards proper development and management of the agriculture sector in Syria, these can be overcome by suitable planning and implementation of management, institutional and policy measures. From a management perspective, there is an urgent need to strengthen data collection and better analyse as this is central to developing an accurate understanding of water management challenges and options.

While groundwater irrigation has rapidly expanded in all basins for the last two decades over-exploitation has been a serious problem that requires careful management and enforced legislation to control. Though modernization has been introduced at both distribution and on-farm levels, technical and managerial problems seems to exist urging for the need to a careful adoption that takes into account the local conditions and the available

They developed level of management skills. Capacity building appears to be crucial as organizations involved in activities related to water have limited capacities and skilled staff. Intensive programme for staff at different level, knowledge sharing, and performance enhancement are required. Financial reforms as well as the enhancement of water users in management have a key role in sustainable agriculture sector. New legislation with strong enforcement and water user associations, thus, need to be established. Finally, the preparation for national policies and the adjustment of existing ones should be carefully considered in recognition of priorities or in response to major shifts or needs.

Also the role of the public sector should ensure that sufficient water of good quality is available and accessible for the different users and to ensure the optimal socio-

economic division of scarce resources. The comparative advantages of the private sector should be in terms of efficiency and productivity. The provision and enforcement of a clear conceptual and regulatory framework should be worked out.

An effective framework of financial incentives directs market parties to provide the goods or services as required and as efficiently as possible. Monitoring the effectiveness of implementation can be realised by market parties and by the government, and adequate instruments to measure performance. The need for transparency to protect the consumer, safeguard the resources and assets and ensure optimal information to market parties; markets need to be transparent. Prices of water use need to reflect all the costs. If they do not, the market mechanisms will be ineffective for achieving a self-financing allocation and production of goods and services.

On the hand transaction costs of shifting from one supplier to another one should not be too high. Especially in water resources management this principle may prove to be impossible to meet to its full extent. On the other hand, the public sector has to ensure that the interests of the consumers are protected.

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