WATER DEMAND MANAGEMENT PRIORITY FOR AGRICULTURE OF THE IRAN

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ABSTRACT:

From hydrological point of view, Iran is divided into 6 main drainage basins and potential harvestable surface water resources are estimate at 117 bln. m^3. Economically and technically usable surface water amounts annually to 86 bln. m^3. Nearly 50.5 bln. m^3 of water obtained from the precipitation in high mountainous region along with precipitation in plains is used for recharge of aquifers. Due to the drastic growing of water consumption the variation of ground water balance indicate obviously a rapid decreasing of 5 up to 6 bln. m^3 and the surface flow infiltration has declined from 13.2 bln. m^3 per year.

In the agricultural sectors the water allocation and supply is arranged by the regional sectors of ministry of energy, but it agriculture sector leads management on demand, consumption optimization and on-farm. In addition, an autonomous organization as sponsor and supporter observers and supervise the environmental issues.

With respect to long term water resources development, supreme water council with consumer sectors participation performs demand and supply conjoint management, which required funds, will be provided through general financial resources, leading to establish of hydraulic structures such as dams, ponds, irrigation networks, etc. and the ministry of energy and ministry of Jihad-H Agriculture are accountable for performance of supreme water council policies.

In Iran was not accomplished any study on agricultural water demand, so agricultural water demand is estimated consider to irrigation land farm & water efficiency in this investigation.

Due to international challenges, facing the limitations of new fresh water supply, the government urged highly the optimization and productivity enhancement this substantial vital stuff.

Regarding to long term development strategies of water resources, water supreme council with cooperation of public consumer foundations relating to coincides supply and demand management in water supply put into effect, which finally required founds should be provide through general (financial) resources to perform divers hydraulic structures whereas ministry of energy is.

1. INTRODUCTION

Producing more food without more water will not be easy, but some new approaches will help. Managing water to meet future needs will also involve making water use more efficient, particularly in agriculture, which accounts for 70 percent of freshwater withdrawals from rivers and groundwater.

There appears to be scope for increasing the productivity of water in rainfed agriculture, which provides livelihoods for the majority of the world's poor, generates more than half of the gross value of the world's crops, and accounts for 80 percent of the world's crop water use (Molden,2007).

Options described in the next section, include mulching, conservation tillage, and similar techniques that retain water in the soil so that less is lost to evaporation and more is available to plants. Other options involve small- scale rainwater storage, sometimes called water harvesting.

Of the various interventions to increase rainfed production, some (mulching and conservation tillage) divert some water that would otherwise evaporate unproductively. Others (water harvesting, groundwater pumps) divert some water that would otherwise have been available to users downstream. When water is plentiful, impacts on other users are imperceptible, but as water becomes scarcer, the impacts become more important. Once again, comprehensive accounting for water and integrated planning of land and water at local, watershed, and regional scales can make these interventions productive, by ensuring that the tradeoffs are properly evaluated.

Irrigated agriculture is expected to produce a greater share of the world's food in the future, as it is more resilient to climate change in all but the most water-scarce basins (Molden, 2007).

Crop productivity per hectare will have to increase, because there is little scope for increasing the total area under irrigation. Indeed, irrigated land is expected to increase by just 9% between 2000 and 2050 (Rosegrant, Cai and Cline, 2002). Water productivity (in this case, agricultural output per unit of water allocated to irrigation) will also have to improve, given the increasing water demands of cities, industries and hydropower. New technologies have the potential to increase water productivity when combined with strong policies and institutions (Indian Financial Express on December 1 2008).

Getting more "crop per drop" involves a complex combination of investments and

institutional changes. Countries from Armenia to Zambia are investing in new infrastructure that delivers the water efficiently from the reservoir to the crops, reducing evaporative losses. However, as the example of the Moroccan farmers described earlier indicates, the investments can work only if local institutions deliver the water reliably, farmers have a voice in decision making, and they can get the advice they need on how to make the most of the new infrastructure or technological developments. New infrastructure will help water management only if combined with strong quantitative limits on each individual's water consumption, covering both ground and surface water. Otherwise, the increased profitability of irrigation will tempt farmers to expand their cultivated area or double- or triple- crop their fields, drawing ever more water from their wells. This is good for the individual farmer, certainly, but not for the other water users in the basin (De Fraiture and Perry, 2007). Good crop management can increase water productivity by developing va-

rieties resistant to cold so that crops can be grown in the winter, when less water is required (Perry, Steduto, Allen & Burt).
Growing crops in greenhouses or under shade screens also can reduce the evaporative demand of open fields, though it does increase production costs (Moller, Tanny, Li and Cohen, 2004).
When crops die before they produce their yields, the water they have consumed is wasted. Therefore more widespread adoption of drought- and heat-tolerant varieties will increase water as well as agricultural productivity (Perry, Steduto, Allen & Burt,2006). Well- timed applications of irrigation water can also help. If farmers do not know exactly how much water is needed, they often over irrigate because a little extra water is less harmful to yields than too little water. By monitoring water intake and growth throughout the growing season, farmers can deliver the exact amount of water that their crops need and irrigate only when really necessary. Remote- sensing systems are beginning to allow farmers to see the water needs of plants with great accuracy even before the plants show signs of stress (www.fieldbook.com).

2. ISLAMIC REPUBLIC OF IRAN

2.1 Geography

Iran with the territory of 1.648.195 km^2 is bordered to the north by the states of Armenia, Azerbaijan and Turkmenistan (Republics of the former USSR) and the Caspian Sea; to the east by Afghanistan and Pakistan; to the south by the Gulf of Oman and the Persian Gulf; and to the west by Iraq and Turkey. Iran is about one-fifth the size of the USA and more than three times larger than France. The country is dominated by three mountain ranges: the fertile, volcanic Sabalan and Talesh ranges in the north-west; the very long, Jurassic-era Zagros range, down the western border; and the dominant Alborz range, home of Iran's highest mountain, the permanently snowcapped Damavand (5670 m), to the north of Tehran. The two great Iranian deserts the Dashti Kavir (more than 200.000 km^2 and the Dashti Lut (more than 166.000 km^2) occupy most of the northeast and east of the central plain. About 14% of Iran is arable land; 8% is forest; 55% is non-arable pastures; and the remaining 23% is desert**.** About 52% of the country area is mountainous and deserts and some of 16% of the country has an elevation of more than 2000 m above sea level. The cultivated area is estimated about 51 mln.ha or is 31% of the total area of the Iran. In the past three years it was considered 18.5 mln.ha.

2.2 Climate

Because of its size, variety of topography and altitude, Iran experiences great extremes of climate. Winters (December to February) can be unpleasantly cold in most parts of the country; while in summer (June to August) temperatures go up as high as 40° C. The average annual temperature increases from northwest to southeast and varies from minus 10° C in Azerbaijan to 25-30° C in the south and southeast the country. The annual precipitation increases with elevation, and spatial and seasonal variation is high. Iran’s annual rainfall is 250 mm which varies from 50 mm in the desert to more than 2000 mm in Caspian Sea region. Country can be divided into eight major climatic zones ranging from arid in the central plain and along the southern cost to semi-arid Mediterranean along parts of the western and northern portion of the country to very humid on the southern shore of Caspian Sea. Precipitation ranges from 100 mm to 550 mm and due to high evatranspiration rates during spring and summer. Total annual precipitation is 413 bln. m^3.

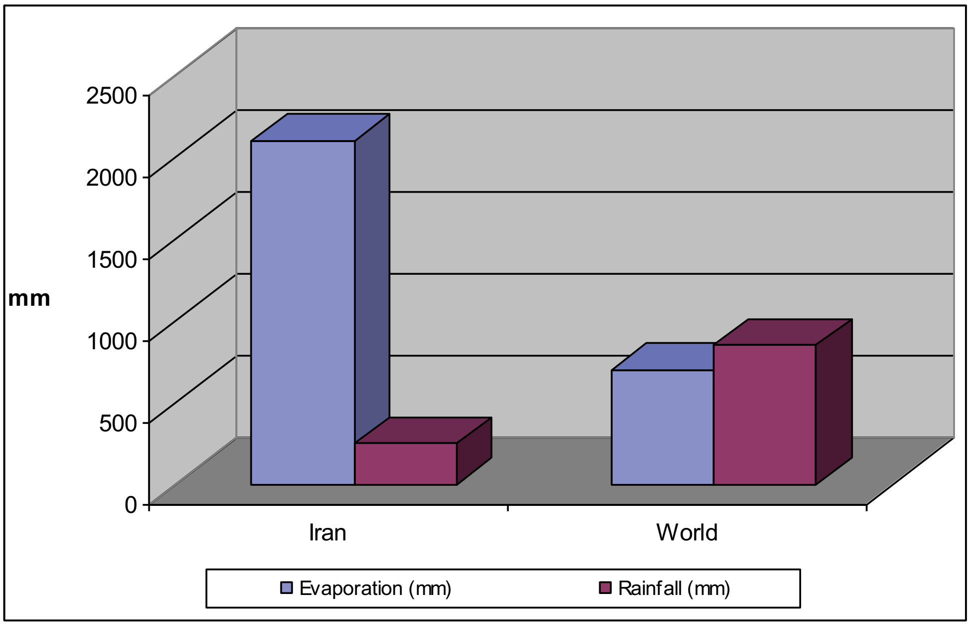

Figure 1. Evaporation and Rainfall means in the world and Iran

2.3 Water resources

From Hydrological point of view, Iran is divided into 6 main drainage basins and potential harvestable surface water resources are estimate at 117 bln. m^3. Economically and technically usable surface water amounts annually to 86 bln. m^3. Spatial variation of water resources is also very large. The largest river in Iran is Karoon in Khuzestan province with 24 bln.m^3 annual volume. Seasonal and annual river flow regimes are also very irregular and safe yield from surface water necessitates the construction of storage facilities. More than 13.000 water supply project including earth dams, diversion dams, pump station and etc put in to operation as of the end of 2003 and total harvested water is equal to 7.2 bln. m^3.

The volume of water obtained from the precipitation is about 413 bln. m^3 in the whole land of which 295 billion m^3. Approximately 71% of the total rainfall returns to the atmosphere by evatranspiration. Almost 105 bln. m^3 of the remaining water along with 12 bln. m^3 entering from borders from the surface water resources of Iran. Nearly 50.5 bln. m^3 of water obtained from the precipitation in high mountainous region along with precipitation in plains is used for recharge of aquifers. Due to the drastic growing of water consumption the variation of ground water balance indicate obviously a rapid decreasing of 5 up to 6 bln. m^3 and the surface flow infiltration has declined from 13.2 bln. m^3 per year. These changes in water supply and demand in the whole land caused many serious problems, which are reverted to the swift population growth in the two last decades. Due to all these constraints and obstacles, the major step in this thematic were the small and large dams to construct as the assured solution considering infrastructure measurements.

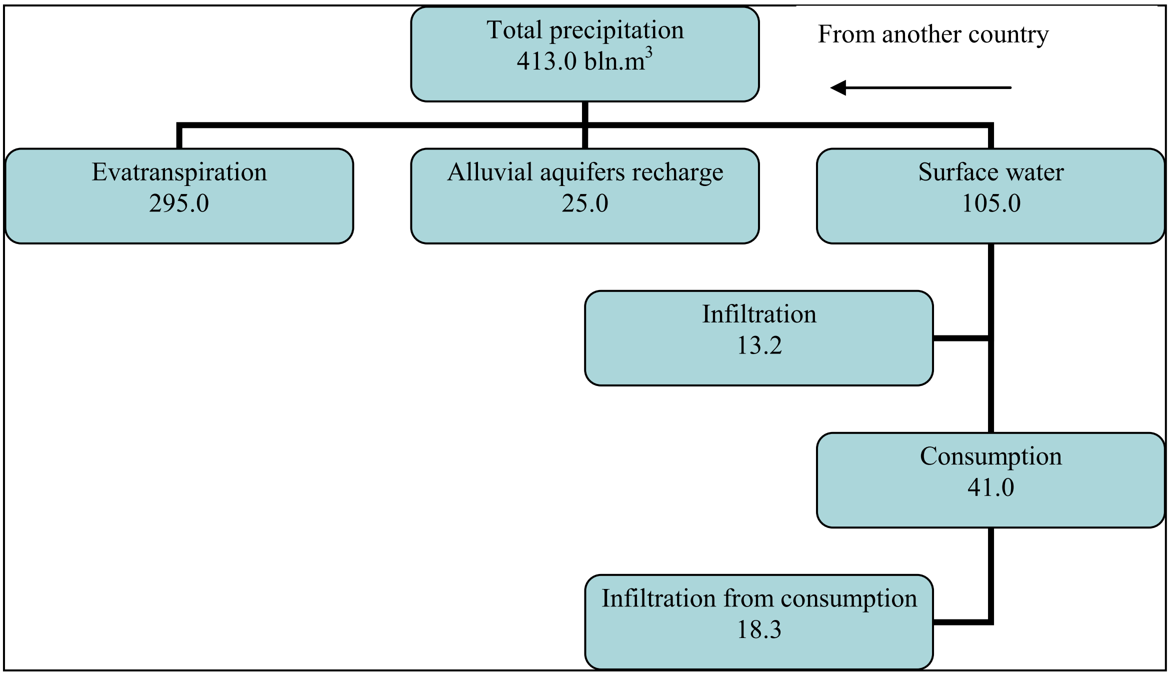

Figure 2. Contribution of the precipitation on the water balance of Iran

Re-sources	Utili-ties	Agricul-ture, bln.m^3	Drinka-ble, bln.m^3	Industry mine, bln.m^3	Sum-mary, bln.m^3
Surface flow	*A*	23.3	2.0	0.4	25.7
	B	11.9	-	-	11.9
	Total	35.2	2.0	0.4	37.6
Under-ground	*C*	40.3	3.0	0.7	44.0
	Springs	6.5	0.5	-	7.0
	Qantas	4.0	0.5	-	4.5
	Total	50.8	4	0/7	55.5
Sum – Total		86	6	1.1	93.1

Notes: Data from Ministry of Energy (2001).

A-Reservoir and diversion pumps; B- Traditional utilization; C-Deep & Semi deep wells.

Table 1 Water resources utilization of the Iran by different Consumptions

2.4 Agriculture

Because of its size, variety of topography and altitude Iran has great extremes of climate and therefore the type of agricultural products depends on the climatic condition of each area. In the south of Iran with its typically hot weather condition, the main product is date with a world-famous quality. One of the Iranian export products is fruit, which is on high demand in the neighboring countries, like Russia in the north and also in Europe. From 163.6 mln. ha of the country's total land area only 11% is cultivable and 63% have not been used, and given the fact that 18.5 million hectares of the present farms are being used with 50% to 60% capacity; about one-seventh of the total cultivated land is sufficient to meet domestic demand. Pistachio is one of the agricultural products that is associated with Iran in the world economy. The other important agricultural product is Saffron, which is beautiful, delicious, and expensive and the best in the world. Khorasan Province in the Northeast of the country is the biggest producer of Saffron and in 1999-2000 years it exported 69 t at the value of $27.800.000.

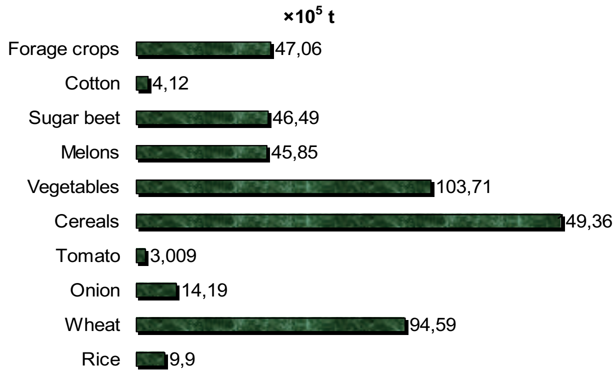

Figure 3. Production of agricultural foods in Iran (Amounts are related to 2001)

Figure 6. Cultivation soil resources of Iran

3. ESTIMATION OF WATER DEMAND FOR AGRICULTURE OF IRAN

In the agricultural sectors the water allocation and supply is arranged by the regional sectors of ministry of energy, but it agriculture sector leads management on demand, consumption optimization and on-farm. In addition, an autonomous organization as sponsor and supporter observers and supervise the environmental issues. This organization implements several important programs in the country, which play a vital role in the protection of eco-systems. One of the most remarkable measures by the government is a great campaign against observing the equity of distribution and fair management in different sectors. Other activities include operating of water management if forming an inquiry commission for water management policy, holding seminars, and conferring environmental marks and outstanding water saving devices. The general laws policy of the country, which substantially based on food security supply, is really economically not justifiable, due to a huge investment and expenses. This terminology specified the volume delivery of water, required in specific time and place in order to requirement of water for the crop in determined region, regarding to the national act or document approved in 1996 confirmed by council of ministers, agricultural consumption optimization pattern.

According Hoekstra, A.Y. and Chapagain, A.K.,2008) the water footprint of a nation refers to the total amount of water that is used to produce the goods and services consumed by the inhabitants of the nation. The total water footprint of a country includes two components: the part of the footprint that falls inside the country (internal water footprint) and the part of the footprint that presses on other countries in the world (external water footprint). Water footprint of a nation – Is defined as the total amount of water that is used to produce the goods and services consumed by the inhabitants of the nation. The national water footprint can be assessed in two ways. The bottom-up approach is to consider the sum of all goods and services consumed multiplied with their respective virtual-water content. In the top-down approach, the water footprint of a nation is calculated as the total use of domestic water resources plus the gross virtual-water import minus the gross virtual-water export. Internal and external water footprint – The total water footprint of a country includes two components: the part of the footprint that falls inside the country (internal water footprint) and the part of the footprint that presses on other countries in the world (external water footprint). The distinction refers to the appropriation of domestic water resources versus the appropriation of foreign water resources. Water footprint of a product – The water footprint of a product (a commodity, good or service) is the volume of freshwater used to produce the product, measured at the place where the product was actually produced. It refers to the sum of the water use in the various steps of the production chain. The 'water footprint' of a product is the same as its "virtual water content" (Hoekstra and Chapagain, 2008).
In the Table 2 present water footprint of the Iran on comparison to same countries of former Soviet countries.

Country	Average water footprint of the country, m^3/capita/yr	Part of footprint falling outside of the country, %
Iran	1624	18
Israel	1391	74
Kazakhstan	1774	1
Kyrgyzstan	1361	0
Russia	1858	16
Turkmenistan	1764	2
Uzbekistan	979	5

Notes: Global average water footprint = 1243 m^3/cap/yr.

Table 2. Water footprint of the same countries

4. CURRENT PROGRAMS AND LONG-TERM WATER RESOURCES DEVELOPMENT STRATEGY OF THE COUNTRY

4.1 Current programs

Providing an adequate water supply and sanitation to the rapidly growing urban population and developing agricultural and industrial activities is increasingly becoming a problem for governments throughout the world. The predominant approach to supplying these increasing water demands has been supply augmentation schemes. But in many developed and developing countries, the cost of developing new sources or expanding existing sources are growing and becoming more physically and economically infeasible. In this trend industrial activity also demands the expansion of urban water supply services. The water resources are threatened not only by this swiftly increasing demand but also through diminishing quality caused by pollution and saline intrusion and overexploitation of water catchments area .in recent year, saving water has been more efficient and considerable rather than developing new resources of water. In many countries this approach has been accepted from both an environmental and economical point of view as being the best solution for meeting growing water demands. In order to above mentioned reasons the government decided to change the supply –oriented approach to demand-management there are several experiments carried out by government agencies, NGO, research institute and private sectors, which is to appreciate and merit careful study and evolution into national policies, strategies and action plans:

- intermediate of some determine universities, research institutes and communities to involve entirely all purposes which have been discussed .The ministry of energy is one of the pioneer in this regard with great and simply equipped research center in Iran;

- research progressing programs carried out by researchers at the universities and technology sectors indicate that are promising to solve some significant problems in the water demand and management considering promotion of public awareness in many different aspects;
- arise many extension groups sending to the villages to promote awareness and declaring the multidisciplinary aspects of water management, which is initiated by formerly ministry of agriculture, throughout the country. In order to merging of two previous ministries namely ministry of agriculture and Jihad-e-Sazandege in the past two years the constitution of new ministry called jihad-e-agriculture initiated multi purpose program considering improvement of water demand management in 2001 up to now and still proceeds it trend. These measures require efficient participation and mobilization of the agrarian society.

Regarding to huge investment for supplying water and performance of drainage and irrigation networks it has been forecasted all necessary provisions particularly to transfer and handing over the operation and maintenance management to the real operation association and arising to economize and prevention of wasting.

The proposed regulation of optimization consumptions presented by former ministry of agriculture, energy, jihad, planning and programming management organization is approved by the council of ministers in 1995, which deal with broad aspects such as water requirement of plant, crop pattern, irrigation efficiency, and substantial revision in prevailing cultivation in more than 600 plains. On this basis should all allocation and delivery appliance in determined points be provided, as volume delivery to the farmers? In order to the lack of national funds and credits in agriculture ministry to perform the studies dealing with establishing of farmer associations and volume delivery of water to the farmers, the ministry of Energy posses sufficient means to perform above mentioned issues. All these effort would have efficient and positive results, when the social and economical and cultural problems met an appropriate solution to promote the agrarian society.

4.2 Strategies of long-term water resources development of the country

- the water national management should be reinforced by a conjointly management;
- based on supply and demand, comprehensive in the water recycle and the sustainable development principle and land provision in the water sheds of the country, in order to management integrity of water recourses the mutual coordination between different economical, social, infrastructure and servicing sectors with water sector is very essential;
- the country fourth development program policy; establishment of proper mechanism to promote the factors production of productivity (Energy, Capital, Workforce, Water and Soil).

5. CONCLUSION

Through out the world poverty plays an important role in making people participates intensively in water issues, one of the most significant factors is to change of experiences on water demand management in different countries, which could account as the major pace to make efficient impact on this topic.

Regarding to long term development strategies of water resources, water supreme council with cooperation of public consumer foundations relating to coincides supply and demand management in water supply put into effect, which finally required founds should be provide through general (financial) resources to perform divers hydraulic structures whereas ministry of energy is in charge for water supreme council policies execution

The Jihad Agriculture Ministry has already initiated the strategic planning of water sector and updating of the national water optimization consumption intensively since emerging procedure of two former ministries, also Agriculture and Jihad Sazandege Ministries .The gestation period is going on considering all peripheries of water laws, regulations, and its legislation by superior council and committees, which are responsible and directly engaged with this highly valuable and precious commodity.

Due to all undertaken policies and efforts, we approached an increasing of 10 % growth in agricultural sector and hope to maintain and improve this trend by water supply and consumption optimization.

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