MODERN MANAGERIAL TECHNIQUES FOR IRAN'S WATER RESOURCES

TECHNIQUES MODERNES DE LA GESTION DES RESSOURCES EN EAU IRANIENNES

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ABSTRACT

Water shortage is considered one of the restrictive factors for economic development. So far, all the activities related to agricultural, urban and industrial waters have been carried out through water supply management in Iran, paying least attention to the demand management. The following items, taken all together, can result in the improvement of management of both water resources supply and demand: (1) Using the technical, economic and managerial tools for controlling water consumption in agricultural sector without affecting social welfare; (2) Reforming the structure of domestic water management institutes; (3) People's participation in all water management aspects form policy-making to use and (4) Reinforcement of local managements via development of information systems. Water pricing is one of the most important factors in this regard; in addition, other tools should be also maximally benefited from including physical controls for restricting the consumptions, technical methods for limiting or changing the consumption pattern, and direct investments or investment incentives. Reforming the structure of water consumption of our country must be implemented in a way that the agricultural water consumption reduces from the current 92% to at most 87% in the next 20 years. For achieving this objective, there has to be a re-look into the country's water resources development and utilization plan.

Key words: *Agriculture, Water Crisis, Management, Supply and Demand, Food Safety.*

RESUME

La pénurie d'eau est considérée comme l'un des facteurs restrictifs du développement économique. En Iran, jusqu'à maintenant, toutes les activités liées aux eaux agricoles, urbaines et industrielles ont été réalisées grâce à la gestion d'approvisionnement en eau,

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en accordant moins d'attention à la gestion de la demande. Les éléments suivants, en ensemble, donnent lieu à l'amélioration de la gestion des demandes et des fournitures des ressources en eau: (1) L'utilisation des outils techniques, économiques et de gestion pour contrôler la consommation d'eau dans le secteur agricole, sans affecter le bien-être social; (2) L'amélioration de la structure des instituts de la gestion d'eau domestique; (3) La participation du peuple dans tous les aspects de la gestion d'eau depuis l'élaboration des politiques jusqu'à l''utilisation d'eau; et (4) Le renforcement de la gestion locale par le développement des systèmes d'information.

La tarification de l'eau est l'un des facteurs les plus importants à cet égard; en outre, il est nécessaire d'utiliser au maximum les outils tels que les contrôles physiques pour limiter les consommations, les méthodes techniques ou changer les habitudes de consommation et les investissements directs ou incitations à l'investissement. Les réformes dans la structure de la consommation d'eau du pays doivent être mises en place pour réduire la consommation d'eau d'une telle manière qu'elle s'abaisse de 92% à 87% dans les 20 prochaines années. Pour atteindre cet objectif, il est nécessaire d'accorder une grande attention au plan du développement et de l'utilisation des ressources en eau du pays.

Mots clés: *Agriculture, crise d'eau, gestion, demande et fourniture, sécurité alimentaire.*

1. INTRODUCTION

Background

- Per capita water consumption is 20 liters/day in under-developed countries.
- Seventy per cent of consumed water is devoted to agriculture.
- Water-borne diseases cause 6000 children to perish worldwide every day.
- Annually 160 km^3 water is extracted from groundwater aquifers.
- The volume of world's fresh water resources is 240,000 km^3
- Huge population (1.1 billion) do not have access to potable water.
- Global average precipitation is 831 millimeters (Asia: 732 millimeters).
- Iran receives 0.37% of global and 1.29% of Asia precipitation.

Per capita water consumption in Iran and the World

The average annual per capita global water consumption (industrial, agricultural and drinking) is around 580 m^3. This figure in Iran is 1300 m^3 despite shortage in her water resources, causing an annual deficit of 0.5 billion m^3. Despite the serious limitations of water resources, the annual per capita water consumption for in Iran is 191 liters while the global average is 150 liters. Globally, the crop water productivity is 2 kg/m^3, which in Iran is 0.9 kg/m^3. To avoid an imminent water disaster, it is essential to manage the country's water resources more prudently.

Water crisis in Iran

Iran's percentage of the total world's renewable waters is 0.1 % or about 130 billion m^3 from which 100 billion m^3 are extractible. From the total annual precipitation over the country, only 20% is consumed for drinking, industrial and agricultural purposes, and the remaining 80% discharges into seas or evaporates due to lack of sound management of water resources. The average annual evaporation in Iran is about 70% of the annual precipitation, comparable only to Australia (80%) and Africa (79%). The volume of water consumption in agricultural sector is 22% higher than the global average. This can be reduced to reasonable level by proper management. Meteorological features cause 72% of precipitations occurring in times when it is not directly useful to agriculture. Furthermore, there is no proportionality between agricultural lands and regions of high precipitation. Nearly 290 plains, 120 cities, 6000 villages, and 16 provinces are prone to continuous drought.

2. SOME OF THE MAIN CHALLENGES OF WATER RESOURCES IN IRAN

1. **Inherent limitation of water:** Iran has negligible portion of global fresh water resources due to its specific geographical and climatic conditions.
2. **Precipitation imbalance:** The annual precipitation varies from 50 mm milliliters in arid desert regions to 1800 mm in green northern areas.
3. **Drought:** Drought is not an abnormal phenomenon but the dimensions and destructive impacts are different depending on its intensity and location.
4. **Worsening of water quality:** A natural fall out of over exploitation and misuse vis-à-vis, the limited water resources. Currently, there are 29 billion cubic meters of industrial, agricultural and urban waste waters that are regarded as a potential risk for reduction of water quality. It is predicted that this amount may reach 40 billion cubic meters in 2021 which is more than one third of Iranian renewable water resources.
5. **Population and consumption:** According to Iran Statistics Center, the population has exceeded 74.7 million until 2010 and the per capita water resources have declined to 1700 m^3 annually. This is projected to further decline to 1360 m^3 by 2031 due to population growth to 95 million people by then, reducing the water availability to the critical level. The water loss level in Iran is about 28-30% while this figure is between 9 to 12 percent globally. The main reason is inappropriate management of water consumption.
6. **Low precipitation and exceeding consumption:** The average precipitation volume in Iran is 248 mm, which is one third of global average precipitation of 831 mm. The experts' studies indicate that 93% of the water is used in agricultural sector where the use efficiency is known to be poor.

Water supply and demand management

Water supply and demand management is an important component of the total water management system. The principles and procedures of water demand management are, however, not clearly specified. The dominant aspects of water demand management are economic, environmental, consumption pattern, etc. Water demand management aims to

optimize the demand for a specified goal, which, for a country usually is achieving food and nutritional self sufficiency for a country. In view of Iran's limited water resources, maximum water diversion to agriculture and the current poor crop water productivity in comparison to other places in the world, the above-said 'optimization' may boil down to reduction in water consumption, without affecting agricultural production. There are many known ways, even in Iran, to achieve this goal. Whatever may be the acceptable and adoptable policy in this regard, they have to be permanently and actively pursued via legal, technical and financial leverages as well as by notifying programs and public educations. Increased efficiency of water consumption and allocation is one of the principal components of water demand management.

3. DISCUSSION

Iran consumes 3-times more water than the average global amount while it receives only one third of the average global precipitation and its renewable water resources is 25% of the average global level. Rapid population growth is the main cause for the reduction in domestic per capita renewable water resources in the recent decades. In order to investigate the increasing population trend and the reduction of per capita renewable water, these variations are plotted in diagrams 1-1 and 1-2. Diagram 1.1 shows the increasing trend of population in the last 80 years and diagram 1-2 similarly illustrates the decreasing trend of per capita renewable water during the recent 80 years.

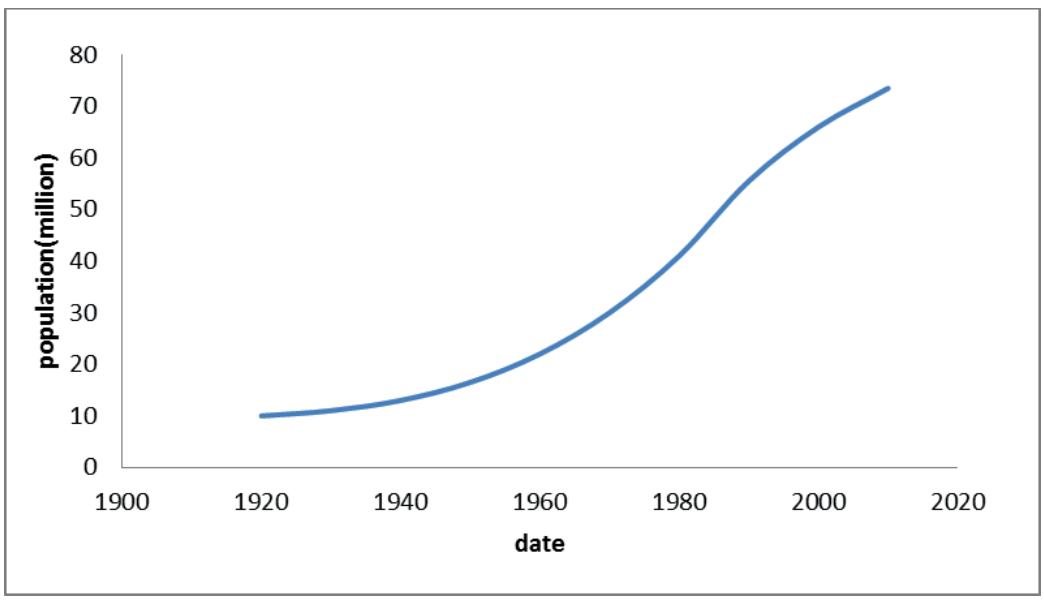


Diagram 1-1. Increasing trend of population during recent 80 years

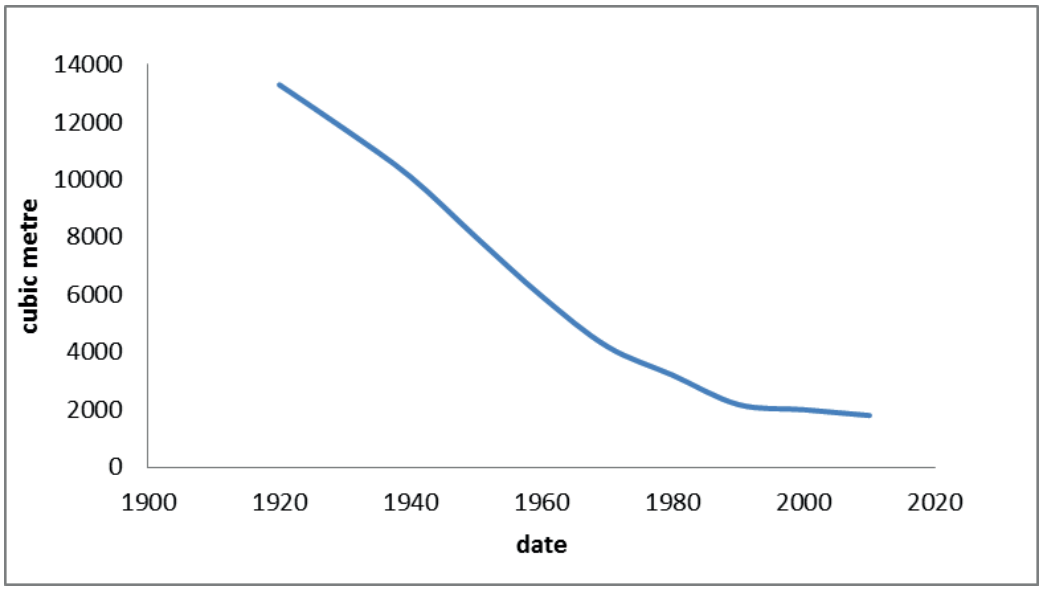


Diagram 1-2. Decreasing trend of per capita renewable water during last 80 years

Food Safety: The Food safety (variously termed as food security, nutritional security, etc.) issue arises due mainly to high population growth. The issue acquires greater importance when agriculture is constrained due to anthropogenic and/or natural factors. All anthropogenic factors may be summarized into one and that is unsustainable use of the land and water resources. The common and recurrent natural factors are floods, droughts, erratic rainfall, soil erosion, etc. The only solution to meet the increasing food demand by the ever-growing population is optimized exploitation of water resources (both fresh water and waste water) for agriculture. The demand management is important in this context. According to experiences, improvement in the management of surface water resources consumption will be more profoundly influential on the enhancement of irrigation output and agricultural performance. And this can be better achieved through the participation and involvement of the stake holders from water resources planning to water resources use stage.

Influential factors on the improvement of water consumption management

1. Technical and physical capability of water transmission and distribution systems.
2. Efficient technical and managerial regulations of water resources.
3. Comprehensiveness of the laws, directives, ratifications and other legal and official rules governing the water consumption management.
4. Skill development of those working in water consumption management in government and private organizations.
5. Enlightened water consumers.
6. Growth and development of country's agricultural activities.
7. Maintaining and using information data base of agriculture.

Water Economy: Some of the upcoming problems for sound water resources management which must be resolved for simultaneous management of supply and demand are listed below: Low Price of Agricultural Water: Unrealistic low water price make the water consumers over use the water resource and it does not encourage them to economize on water use.

Water losses in transmission: It is estimated that 70% of the water released from a dam is lost by the time it reaches the farm. Similarly, 30% of the water is lost during transmission in urban sector. Such colossal losses are to be drastically reduced.

Public unawareness of the drought damages: All of the costs of drought are not fully specified and well-defined. The assessment of indirect damages caused by drought is scarcely done due to rapid decline in public willingness for the associated matters following the first rainfall. The indirect damages are more severe than the direct ones but they are not distinguishable due to being scattered and faded making it difficult to evaluate.

Inefficiency of allocation system: The significance of potable and hygienic water needs as well as the added value of water in industrial processes reveals its priority compared to agricultural purposes. This conflict is on the rise, again mainly due to population growth, higher living standard and health consciousness of the people. One may call it inefficiency or compulsion in water allocation process in the face of overall development and limited water resources. But the important fact is that 'Demand management' applies to all the sectors and not necessarily to only agriculture.

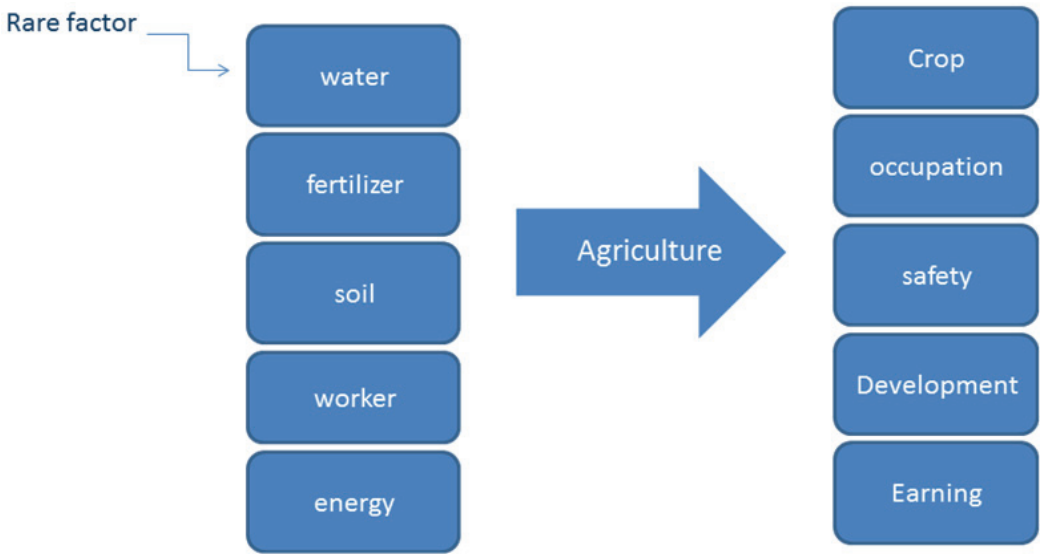
Non-calculated waters: Non-calculated water refers to the water that is not accounted for by the water and sewage companies. It mainly occurs due to inaccurate counter readings, illegal branches, counters with opened plumps, and leakages because of corrosion and broken pipes. Currently, the amount of non-calculated water in different provinces in Iran varies from 25 to 60 per cent. Proper accounting of such losses will motivate different agencies to plug them, which will provide additional water for fruitful use.

Non-coherence of planting and environmental necessities: The water is not used in its ideal social manner even in the agriculture in many regions. Water shortage in warm and arid plains necessitates planting of crops which require less water, as against growing beets needing large volume of water in Khorasan. Similar situation exists in growing sugarcane in Khuzestan. Generally, it is observed that Iranian plains do not follow a suitable planting pattern. One of the reasons for inappropriate planting pattern is low price of water.

Consumers' problems: Transition stages from traditional agriculture and renovation of agricultural structure have not been implemented yet. Ownership, modification and unification of lands and agricultural exploitation system have not still undergone transformations for appropriate water consumption. Discharging of refined waste water of different consumptions is also a serious obstacle in the course of country's water resources management.

Weaknesses in laws and regulations: The weak points can be listed as follows: Delay in ratifying laws, regulations and directives related to water resources; Non-flexibility of the laws for different water supply and demand conditions; inadequacy in establishment of necessary institutes to reinforce water governance and inefficient exploitation from the existing capitals.

- **Unpreparedness to face natural calamities:** Considering the likelihood of natural hazards including flood and drought in connection to water resources management, the mechanism of handling and controlling the aftermaths of these phenomena is weak.
- **Inefficient work division in the respective organizations:** The following items have led to difficulties and disorder in implementation of consolidated management in water-bearing basins: Inappropriate division of duties of water resources management among the different organizations and ministries; Lack of evaluation mechanisms; Non-proportionality of the scope of the regional managements and areal extents of the water-bearing basins; Lack of regional programming and inadequate local programming system.
- **Excessive exploitation of groundwater:** Currently, approximately 660 plains of the country are over exploiting groundwater resources, amounting to 6.1 billion m^3, much in excess of the natural replenishment.
- **Increase in the water pollution:** The present volume of country's waste waters is approximately 32.2 billion m^3 and as yet, there is no tangible progress in re-using this water.
- **Inadequacy in decision-making system:** Poor level of people's participation in different stages of decision-making and lack of specialised institutes are regarded as the problems of country's water resources management.



(Input and outputs of agricultural sector and determining the rare factor (water))

4. CONCLUSIONS

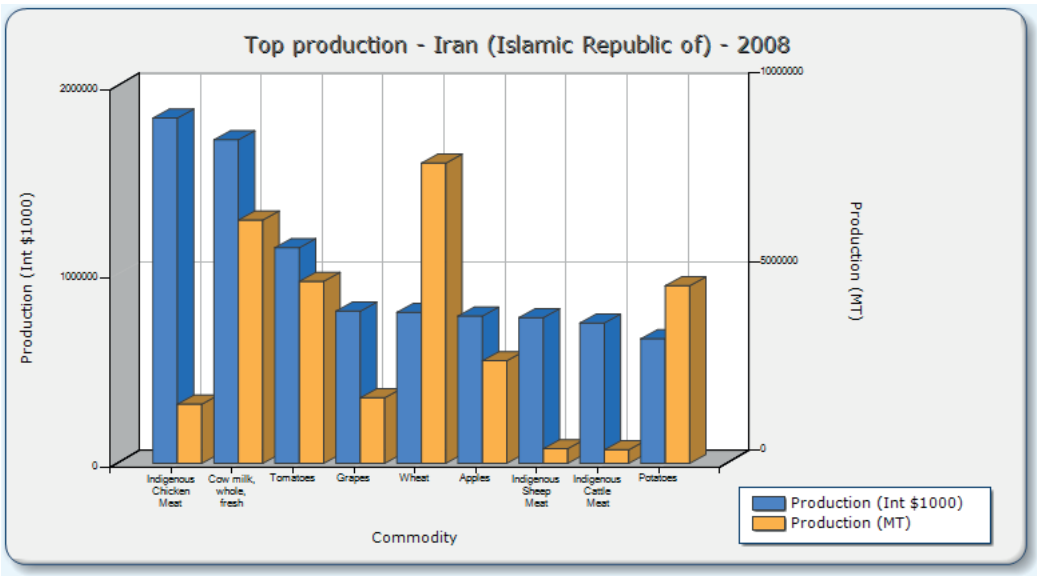
Securing the country's food safety: FAO has cautioned: "The hushed crisis of hunger has involved one sixth of world's population jeopardizing the worldwide peace and safety. Thus, we need a quick and extensive effort as well as a global consensus to eradicate this universal hunger." Perhaps, the top priority action for food safety is fortifying the office of Supreme Council of Alimentary Health and Safety. This council must incorporate a think tank consisting

of the experts in the fields of nutrition, agriculture, economy, education and social science, and all other relevant officials. The Agriculture Jihad Ministry plays the role of superintendent for food safety in this regard.

Performing timely agricultural activities including land preparation, nurturing operation, pest and disease control, optimal use of chemical fertilizers and timely harvesting all together reduce the harvest and pre-harvest losses.

Streamlining transportation system, applying sorting machinery for separation of imperfect or unhealthy crops, and effective control on preservation place temperature remarkably help quality maintenance of garden crops and reduction of their post-harvest losses.

Avoiding delays between various post-harvest stages, crop processing for value addition and increase in the shelf life of the processed product are important activities towards food safety. Development of research, education and extension services to farmers are to be included in the country's agricultural policies.



Water management in Iran: Clarified notification and promotion of people's knowledge regarding water-associated issues including operational expenditures of water provision projects can result in the change in attitudes about water consumption. It appears that the officials must first take the necessary steps for determining the optimized agricultural patterns for different geographical locations in terms of precipitation and plant water requirement. Besides enhancement of irrigation output, they should quickly take actions to modify the consumed water in the agriculture sector. Exponentially increasing water price may not be an effective policy for creating motives of husbandry in water consumption by the consumers. On the other hand, people's health and hygiene essentially relies on water supply, and consequently, the increase in water price will make the public hygiene encounter serious problems. Nevertheless, it is crucial to grant the required authorizations to governmental agents and officials for supervision on precise execution of drought-specific programs.

Consideration of the following items will be instrumental to resolve some of the managerial challenges in water supply and demand:

1) Enhancement of irrigation efficiency.
2) Applying suitable irrigation methods (Pressurized irrigation).
3) Lining of irrigation canals.
4) Balancing water allocation to various sectors.
5) Reforming the pricing system, gradually bringing to actual cost of water.
6) Re-using waste waters, including saline water.
7) Comprehending the economic value of water.
8) Protection of water resources against contamination.
9) Supervision and surveillance on optimal consumption of drinking water, minimization of water losses and promoting water demand management.
10) Farmers' participation in irrigation network management.
11) Monitoring quantitative and qualitative impacts of improvement of agricultural water productivity.
12) Using affordable and efficient technologies.
13) Enhancement of irrigation efficiency using modern irrigation methods.
14) Emphasize water demand management along with supply management.
15) Reducing the evaporation losses from irrigated farm.
16) Less frequent irrigation in order to promote water productivity.
17) Efficient application of virtual water concept.

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