WATER MANAGEMENT IN IRAN

(CHALLENGES and OPPORTUNITIES)

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In the Name of God

Abstract

WATER is considered the main factor when it comes to sustainable development. It is also considered the most important component of economic and political power in contemporary world.

Countries like Iran, being located in arid and semi-arid region of the world, are in permanent water crisis condition. These countries must concentrate on research, scientific studies and utilize their water resources as optimally as possible and manage their water resources efficiently.

Lack of proper amount of precipitation, inadequate infrastructure for collection, storage and recycling of water and above all, lack of public awareness regarding such issues as standard consumption patterns, force all countries to apply strategic management policies and techniques toward such issues as water resources, maintaining and upgrading water quality, and recharging water resources.

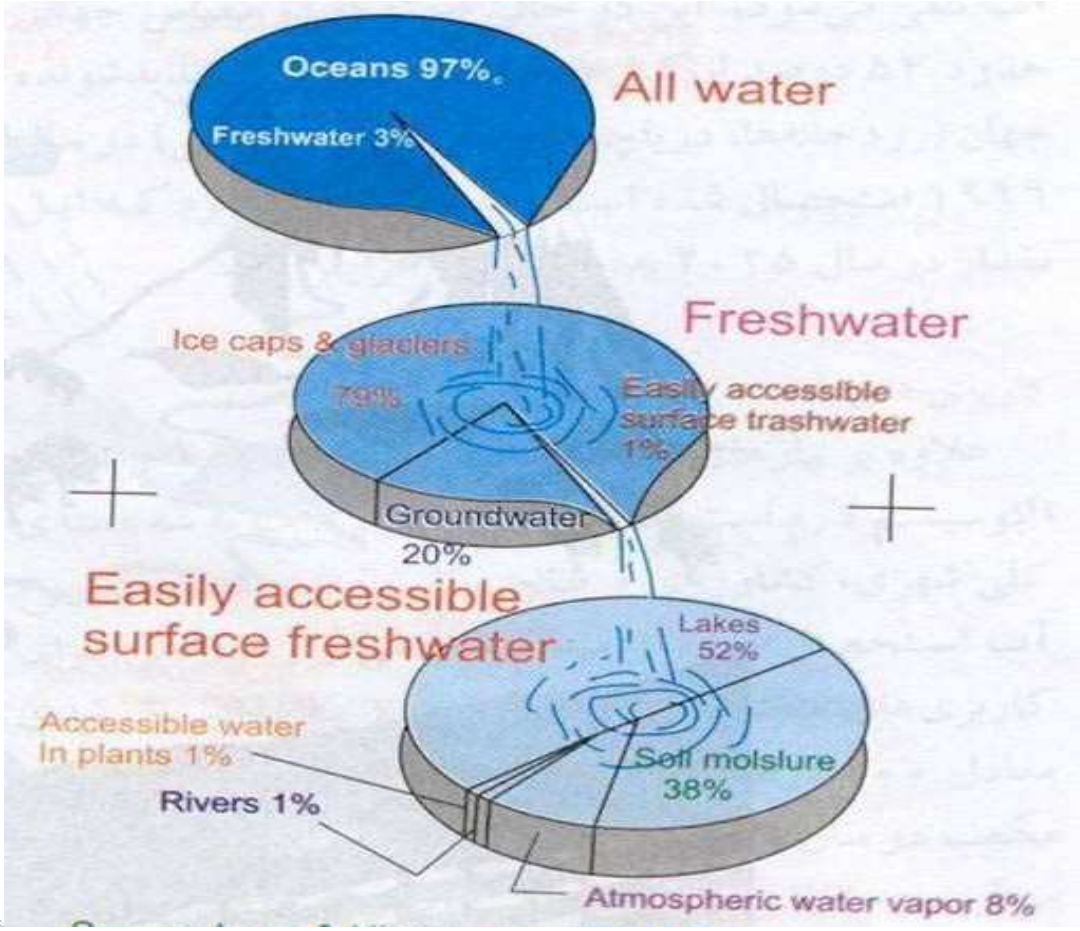
Besides water resources planning & management, proposed strategic management should also cover other areas such as supply, transfer, treatment, storage and also distribution and consumption. For each of above topics, special operational management should be considered and executed.

1 INTRODUCTION:

There is no other valuable element in nature than water, life cannot continue without water. To put it differently, after air water is the most needed element of living creatures.

Although 70% of the Earth is covered with water, in practice, only a small percentage of it is useable. Various studies point out that 97% of available water is saline and only 3% of it is in freshwater form, 79% of this 3% is in ice caps and glaciers form. Only 1% of this 3% is easily accessible and is in various forms of surface water. The other 20% of this 3% is in the form of underground water. Surface and underground water is utilized for various human needs like agriculture, industry and urban use. This is why in arid and semi – arid countries such as Iran, water is considered extremely valuable and they should pay considerable attention to protect it and consume it efficiently. Diagram 1 shows the overall condition of water in the world (Lean & Hinrichsen ,1994 , p.57).

Diagram1: Distribution of the World's Water



About 70% of the world's freshwater is used for agriculture, while the majority of irrigation methods lack necessary efficiency. Around 60% of water is lost due to evaporation, running into rivers or returning to the underground reserves. Incorrect irrigation practices not only waste water, but also threaten the environment, sanitation, and turn fertile farming lands into swamps which is a major problem in certain South Asian regions.

Decrease in the amount of water in certain regions has given rise to considerable environmental consequences. In certain areas in the US, China and India the rate of water consumption is much faster than the rate by which resources could be recharged. Groundwater reserves are declining rapidly. Some rivers such as the Colorado river in the US and the Yellow river in China dry up before they reach the sea.

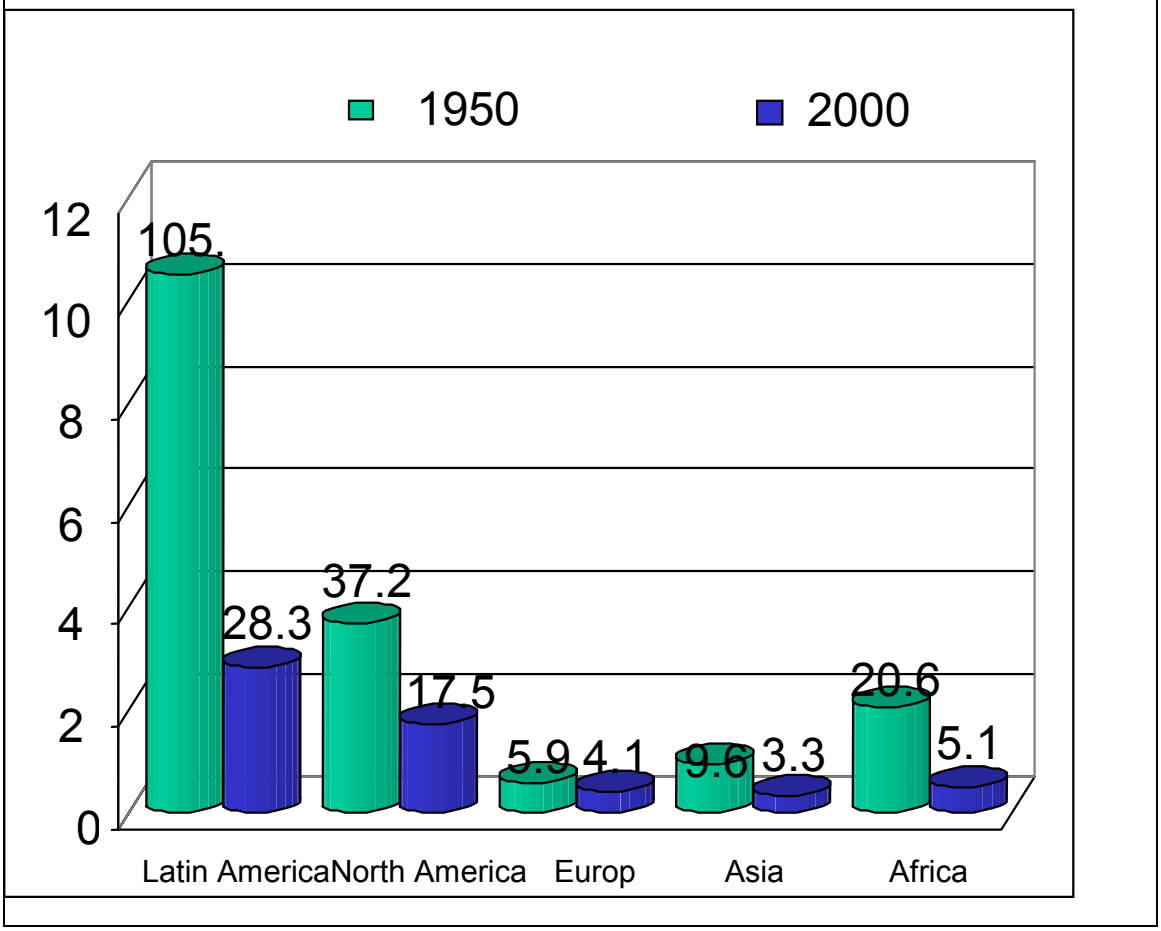
According to FAO, world population is forecast to grow to over eight billion by 2030, and almost the entire population growth will be in developing countries. The agriculture sector in developing countries should use water more efficiently, employing improved management and technologies (FAO, International Year of Freshwater,2003,p.2) .

Our rivers, lakes and groundwater aquifers are under serious pressure. In many parts of the world water is becoming a source of competition and conflict between nations, in particular neighboring countries. We have to plan now, and to act now, in order to secure our future. This is where the central themes of this congress gains ever more importance.

Although the available volume of freshwater is not enough for present human needs, but also, the distribution of freshwater sources on earth and among various continents from geographical

point of view is not even, and its volume is decreasing. Diagram 2 compares distribution of per capita fresh water among various continents in the period 1950-2000(Vojdani , 2002, p.4):

Diagram 2: Accessible Per capita Fresh Water Resources in Various Continents (1950 and 2000)



On the other hand, precipitation rate and continuous accessibility of fresh water, is not on a proper equilibrium in the world. It is very clear that in near future as population of the world grows further, and as humans do not pay enough attention to environmental issues and protection of fresh water resources, the whole world will face a water crisis. This situation will easily turn into political disputes and even war among various nations. International organizations and bodies should exert strategic management over various sources of freshwater, protection of them and finally logical distribution of this vital element.

According to UNESCO, if the current trends continue, by 2025 two-thirds of the world's population will be confronted with serious water shortages. Such a crisis will affect people's health the nutrition and the overall well-being. Again, according to UNESCO sources every liter of contaminated water can pollute seven liters of clean water. Unsanitary water in the world is estimated at around 12000 cubic kilometers, which may increase to about 18000 cubic kilometers by 2050. In terms of water quality, Belgium is the poorest among 122 countries with a quality indicator value of -2.25, while Finland ranks at the top of list as having the highest quality water with an indicator value of 1.85. Iran has been ranked 30th, with an indicator value of 0.52. (Esty and Cornelius,2002).

Currently, from a per capita water point of view, countries in the world have been divided into three categories:

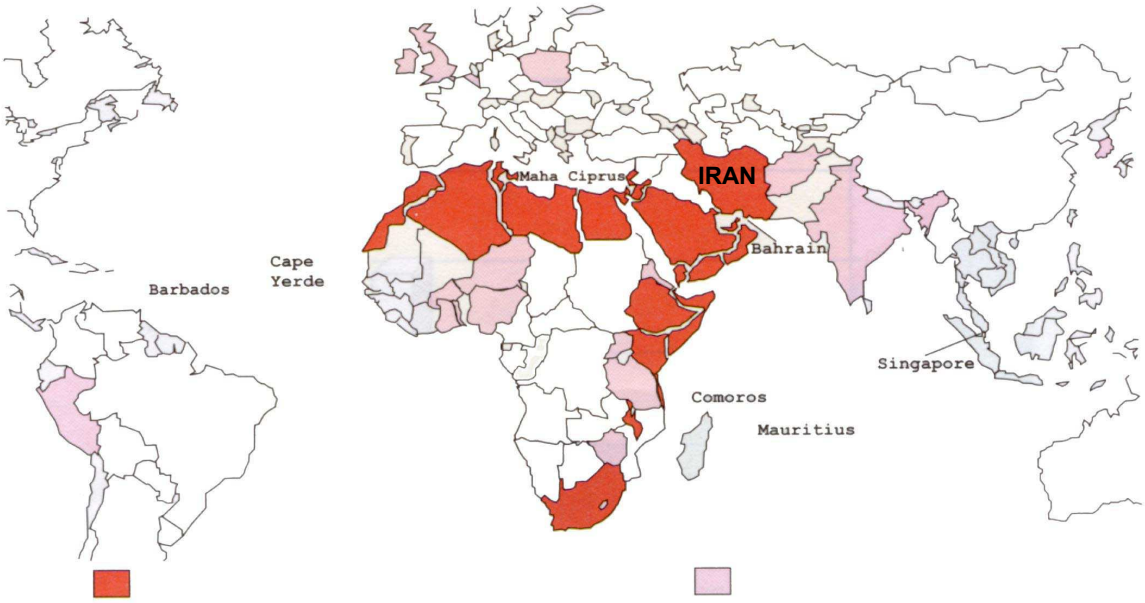
1.Countries without water shortage problems; these countries have an annual water per capita of above 2500 m3

2.Countries with water shortage(stress);the ones with annual water per capita of 1000 to1700 m3

3.Dry countries; the ones with annual water per capita less than 1000 m3 .

Therefore, annual water per capita of 1000 m3 has been defined as an international index for water crisis (scarcity), and also universal index for absolute water crisis is about 500 m3/year.As water per capita of these countries tends to minimum point (less than 1000 m3/person / year), they get closer to water crisis, and as they pass this point and go toward 500 m3/ person /year , they get even closer to absolute water crisis and condition for a catastrophe gets closer. On the basis of international standards, countries with less than 500 m3 of water per person in a year are considered water poor. Diagram No.3 shows this fact (Gardner-Outlow&Engleman,1997,p.19):

Diagram 3: Conditions of various countries from water shortages and water crisis point of view ***(1995-2050)***



At present, almost two- third of countries are facing water shortage. Kuwait with only 10 m3 of per capita is the poorest. The following table indicates water situation in the top ten richest and poorest countries (Water resources,2002,p.15):

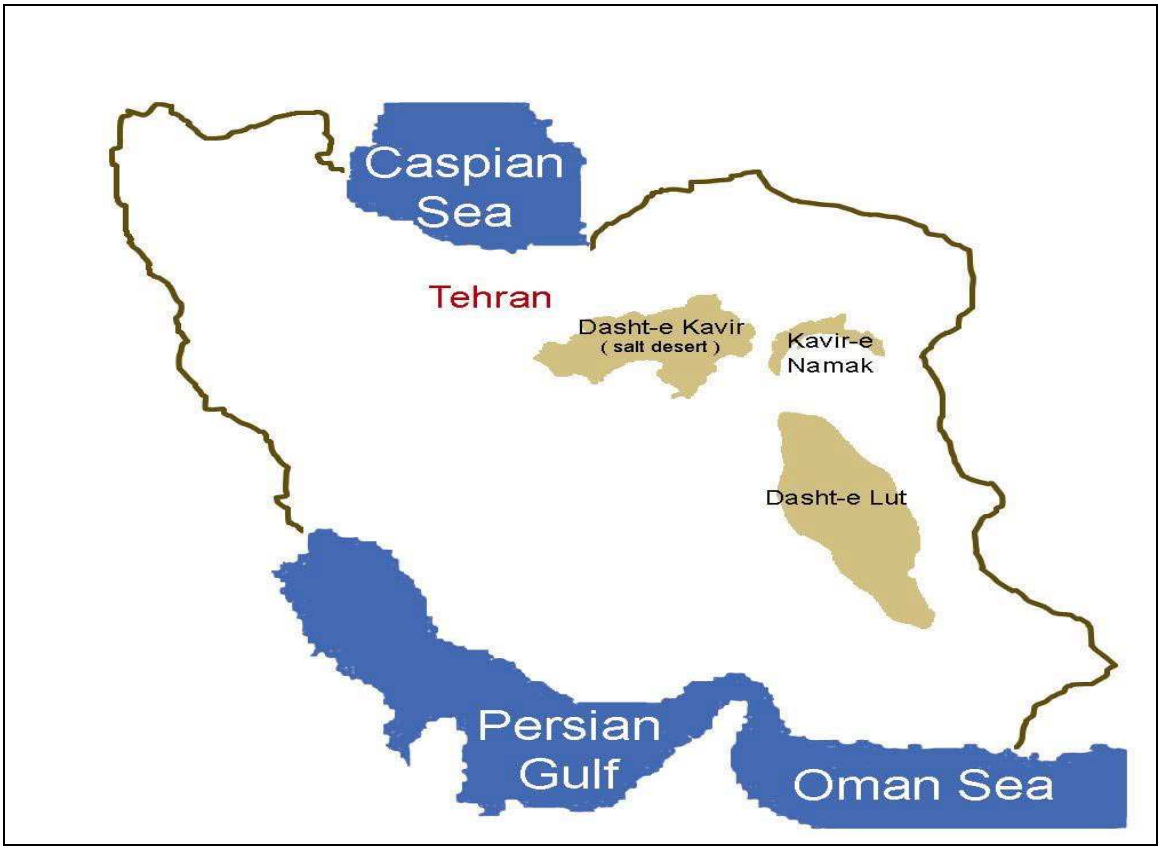
Table 1: Water Availability per Person per year

Ranking	Country	M3/capita year	Position
1	Greenland	10,767,857	Richest in the world
2	United States, Alaska	1,563,168	
3	French Guiana	812,121	
4	Iceland	609,319	
5	Guyana	316,689	
6	Suriname	292,566	
7	Congo	275,679	
8	Papua New Guinea	166,563	
9	Gabon	133,333	
10	Solomon Islands	100,000	
131	**Islamic Rep. of Iran**	**1,955**	
171	Singapore	149	Poorest in the world
172	Malta	129	
173	Saudi Arabia	118	
174	Libyan Arab Jamahiriya	113	
175	Maldives	103	
176	Qatar	94	
177	Bahamas	66	
178	United Arab Emirates	58	
179	Gaza Strip	52	
180	Kuwait	10	

2 IRAN:

As shown in diagram 3, Iran is located in an arid region of the Earth. Although it is located between Caspian Sea on the north and Persian Gulf and Oman Sea on the south, on the center of it , there are two vast deserts (Loot and Namak), this condition has created a arid climate condition in central plateau of Iran, specially Tehran, the capital city of Iran which is on the fringe of the two desert:

Diagram 4: Two vast deserts (Loot and Namak) of Iran



Due to dispersion of population in Iran and also lack of same amount of precipitation in various parts of the country and also lack of planning, most of the rainfall pours into Caspian sea and Persian Gulf and Oman Sea or runs into neighboring countries. For efficient use of water inside Iran, we have not yet defined a strategic management approach (T.W.W.C. Activities Report, 2001,p .19).

Existing statistic indicate that national water per capita during last 40 years has decreased from 7000 m3/ person/year to 2000m3 , and this trend still continues. So, if we look at the whole situation, it becomes clear, that the main reason of water shortage is unplanned population increase in the whole country, and especially in Tehran province.

Although reaching the optimum point of consumption and also production, seems remote and not easily accessible, trying to reach these points, can prevent future catastrophes. An effective strategy, would be to concentrate on reduction of demand and various known techniques of consumption management or to put differently, optimum and proper exploitation of water resources .

Rechargeable water resources volume of Iran is about 130 billion cubic meter a year and Potential annual per capita for the whole country is around 1955 m3. For province of Tehran these figures stands at 6 billion cubic meter and 536 m3. For Tehran megacity these figures are 1.8 billion cubic meter and 255 m3. When we compare with the world's Per Capita Index which stipulate 1000 m3, we can get a clear picture where we are headed. If per capita reaches 500 m3 / year, we have a definite crisis. Tehran's per capita is under 500 m3/year which means that Tehran is always in absolute crisis. The following table compare water situation in the World with Iran, Province of Tehran, Tehran megacity:

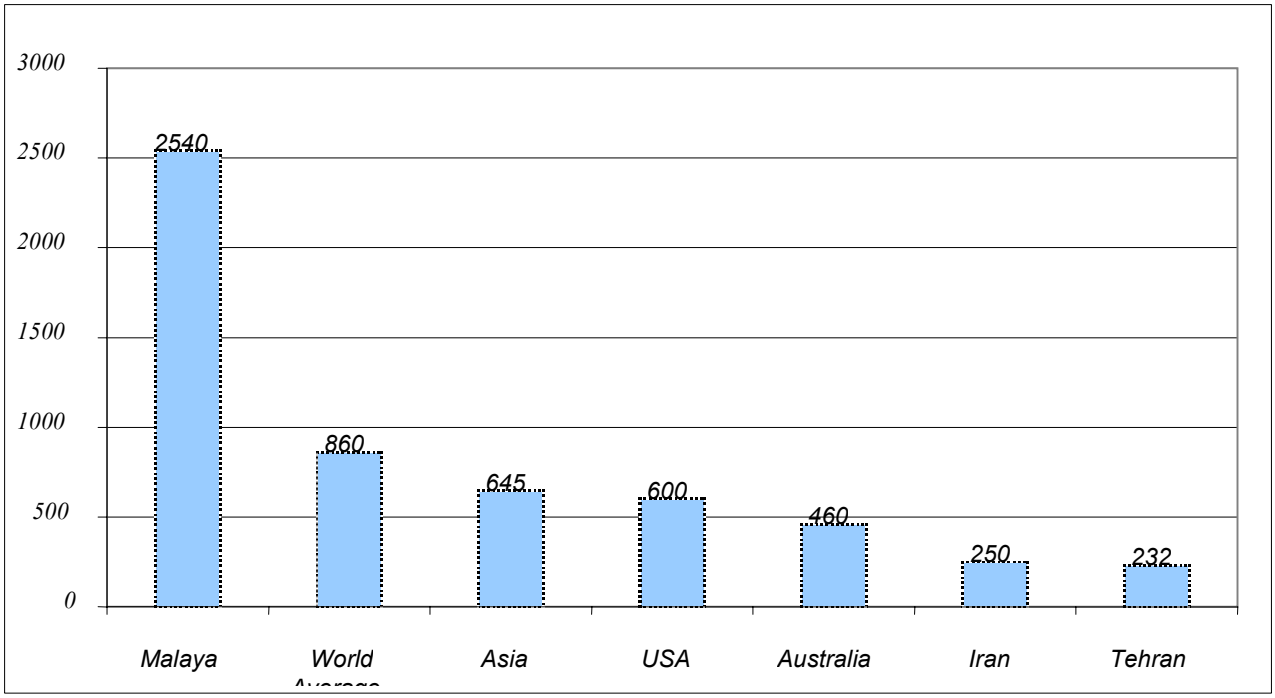
Table 2: Comparison of the World water's Fact with Iran, Province of Tehran and Tehran megacity

No.	Items	Population (million)	Rechargeable Water Resources (bn m3)	Potential Annual Per capita (m3)
1	World	6000	44400	7400
2	Iran	66.5	130*	1955
3	Province of Tehran	11.2	6	536
4	Tehran megacity	7.2	1.8	255

* Reference to the World Bank's estimates it is 117.5

Average annual rainfall in Iran as shown in diagram 5 is about 250 mm which is 40% less than average annual rainfall of Asia and 29% less than average annual rainfall of the whole world(Conference of Planning, 1999,p.43). Also, average precipitation in Iran is not evenly distributed, at one end in Caspian sea, rainfall is about 440 mm and on other end, around Hamoon lake it is about 110mm. This figure for Tehran megacity is about 232 mm, which indicate the situation can easily turn into water crisis at any moment.

Diagram 5:Comparison of Average Precipitation in Different Locations of the World

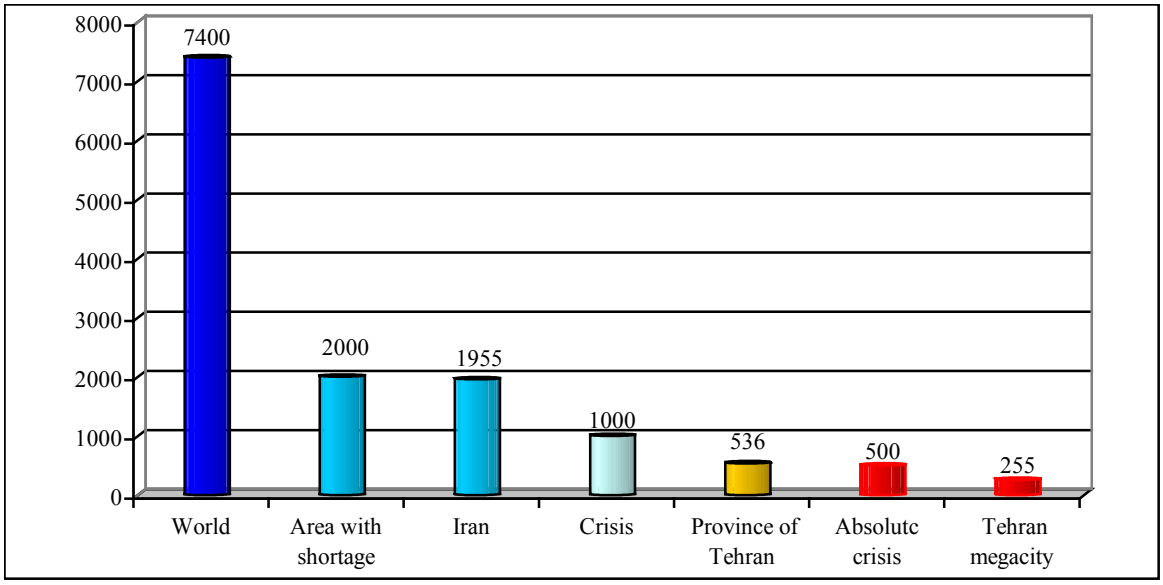


In arid and semi- arid countries such as Iran, water is an extremely valuable resource and considerable attention should be paid to its preservation and efficient utilization. Water resource distribution (both surface and underground) and population distribution in Iran are very uneven compared with the area of the country(for example total potential of water resources of Tehran is less than 2% of total water resources of the country , while 20% of Iran's population live in this city).

3 TEHRAN:

If we divide all water resources volume of Tehran, by the number of its population, we will reach 255m3/person/year,which puts Tehran in absolute water crisis condition(500m3/person/year).In other words, from potential water per capita viewpoint, Tehran is in catastrophic condition. Diagram 6 compares Tehran per capita of water to absolute crisis volume, crisis, areas with shortages, Iran and the world:

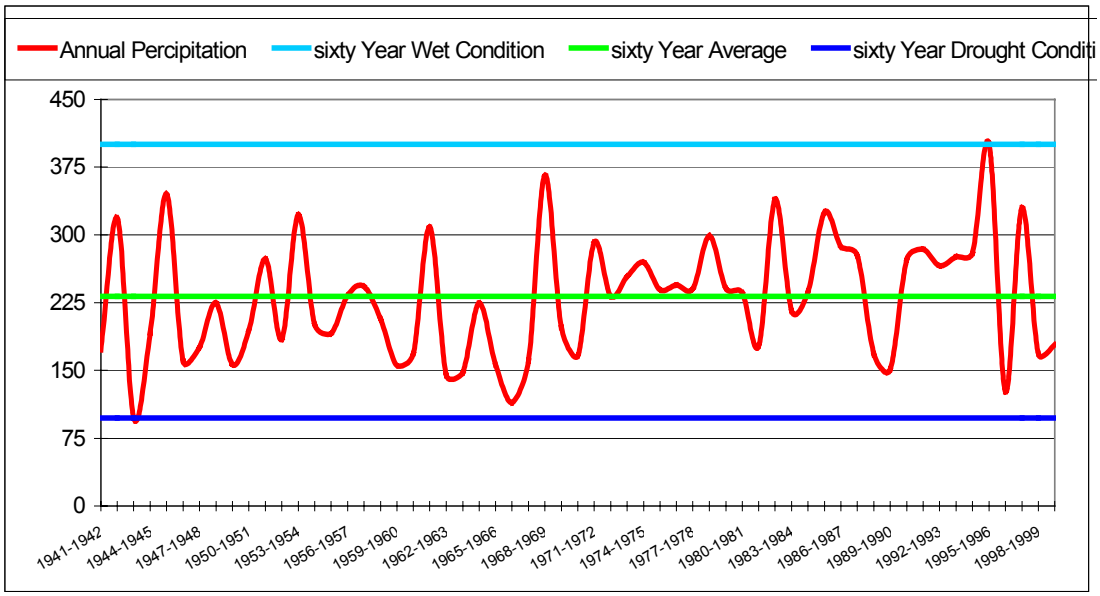
Diagram 6: Comparison of potential per capita of Tehran, Iran with world



Although, Tehran province, enjoys having various surface and underground water resources, and also so called scattered and undirected water resources such as Qanats, springs, treated waste water, etc., still adding all these resources together, they can't quench its thirst. Average annual temperature and rainfall, and also explosive rate of population migration to the province, are main reasons of existing and widening gap between supply and demand. It seems the only alternative left is to capitalize and utilize various techniques to reduce consumption, otherwise Tehran will face a continuous and uninterrupted water crisis.

Tehran has an annual precipitation rate of 232mm which is less than national precipitation rate(250mm). Based on past 60 years of collected data and experience, which indicates, every several years, Tehran faced unusual climatical conditions which cyclically creates dry and wet periods, with uneven periods. Since 1998, a new round of "dry season" started, and lasted all the way to 2001:

Diagram 7: Comparison of Tehran Annual Precipitation Trend with Sixty Year Average Precipitation , Dry year and Wet Year Conditions



Meanwhile, Tehran's population keeps growing and in turn consumption keeps increasing, and the opportunity to replenish the dams therefore would not exist and surface sources decline:

Diagram 8 : Comparison of Total Volumes of Dams (Karaj , Latian and Lar) in End of 1992 – 2001

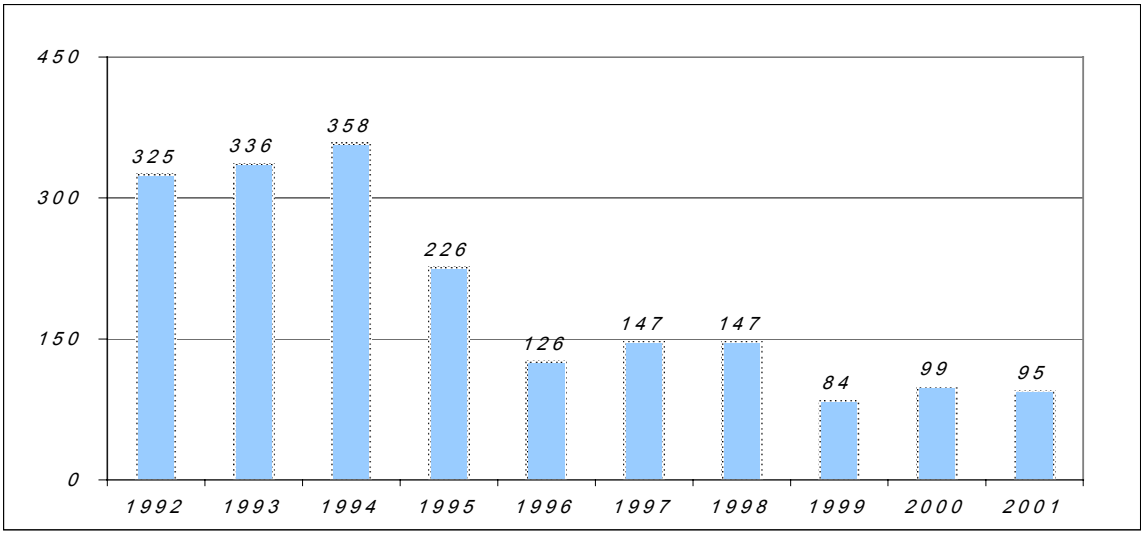
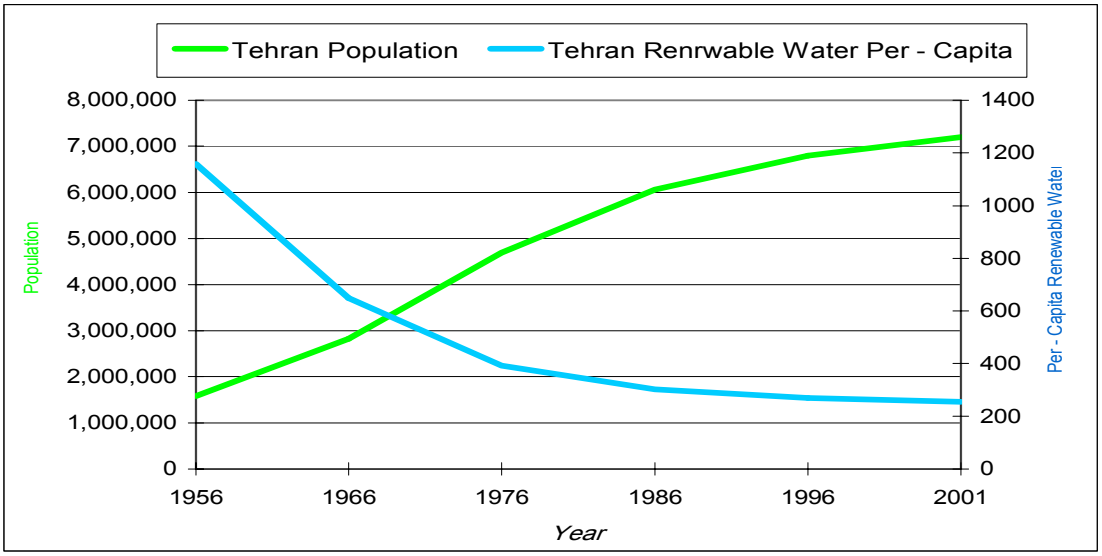


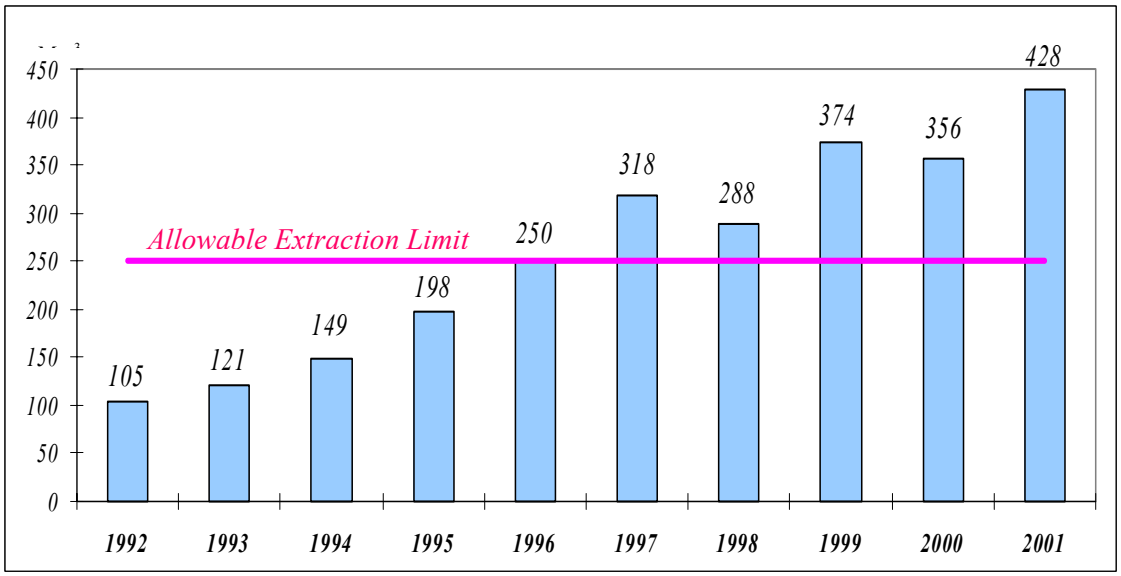
Diagram 9 indicates that per capita rechargeable water has a reverse relation to the rate of population growth. As Tehran's population has grown, per capita of rechargeable water from 1157 m3 /year has decreased to its lowest level of 255 m3 /year. In 2001, Tehran population reached 7.2 million (plus 2 million non-residents) and number of people with access to clean water reached 7.06 million (Tehran Water Crisis, 2001, p.11) :

Diagram 9:Comparison of Trend of Per Capita Renewable water with Tehran's Population 1956 – 2001



Based on the studies carried out by consultants, the overall annual potential of underground water that can be extracted is about 250 million m3. During dry or drought seasons due to reduction of surface water volume, there is a tendency to extract more water from underground resources than the defined limits. This, in turn reduces underground water level and experience has shown that any extraction more than this recommended level, causes extreme damage to these fragile resources:

Diagram 10 :Comparison of Deep well Extraction (1992-2001)



Therefore, if we look at the whole situation from a proper point of view, it becomes clear, that the main reason of water shortage is unplanned population increase in the whole country, and especially in province of Tehran. Tehran also was faced with unplanned and continuous increase of migration, which intensified the situation. These two factors, migration and uncontrolled population increase, should have been controlled and limited many years ago, and from city

management point of view, Tehran dimensions should have been defined and restricted long ago.

4 WHAT SHOULD BE DONE?

As pointed out by the Commission for Sustainable Development, changing unsustainable patterns of production and consumption and managing the natural resource base of economic and social development are the focal objectives of, and essential prerequisites for, sustainable development.

We are aware of the problems and possess the expertise and financial resources to deal with them. We have developed excellent concepts such as poverty alleviation, equity and sustainability. Yet , inaction at the leadership level, combined with a world population not fully aware of the magnitude of the problem, indicates that we have failed to take necessary corrective measures, and to put these noble concepts to work.

Governments, experts and water specialists across the world should join efforts to achieve a common cause in developing sustainable patterns with regard to water resources management. Undertaking improvement activities such as the following will mitigate the scale of the problem:

1. Reduce population growth in countries with rapid population increase or with poor water resources.

2. Prevent water pollution through proper wastewater disposal systems.

3. Reduce the use of fossil fuels that eliminate moisture and damage resources.

4. Adopt improved irrigation system to minimize water loss.

5. Use proper and improved water systems in urban and industrial areas.

6. Forge cooperative measures and actions at the international and regional levels in order to converge contrasting perspectives and interests, particularly among neighboring countries.

7. Strengthen cooperation among countries through reputed and well-known international organizations such as the World Bank, IMF, and UN system agencies including UNESCO, WHO, and FAO.

8. Raise public awareness and responsiveness regarding the true value of water, and build and promote appropriate consumption culture inspired by popular concepts such as religious beliefs.

9. Develop and strengthen regional and trans-regional cooperation and experience sharing initiatives to cope with water related challenges.

10. Create necessary technical assistance programs whereby developing countries could benefit from the expertise of the developed countries in addressing water shortage, and implementing water development projects

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