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PLANNING AND MANAGEMENT
OF WATER RESOURCES IN SYRIA

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Table of Contents

- SUMMARY
- 1. Introduction
- 2. Geographical , Economic and Social Characteritics of Syria.
- 3. The Water Resources and The National Policies for Their Management .
- 4. Regional Basins and Possibilities of Long Term Joint Development.
- 5. Future Strategies , Summary and Recommendations .
- References
- Tables .

CONTENTS OF THE STUDY
WATER RESOURCES MANAGEMENT WORKSHOP

1. <u>Introduction</u>	3
2. <u>Geographical , Economic and Social Characteristics of Syria</u>	5
2 . 1 . <u>Geographical characteristics :</u>	6
2 . 2 . <u>The prevailling economic status and possibilities of development</u>	11
2 . 3 . <u>Social status and characteristics and the state of of social development of the society .</u>	14
2 . 4 . <u>Summary</u>	19
3. <u>The Water Resources and the National Policies for their Management :</u>	23
3 . 1 . <u>The Water Resources Locations and Distribution</u>	23
3 . 1 . 1 . The role of rainfall as water source and the possibility of utilizing rains water .	25
3 . 1 . 2 . The role of rivers as a perennial source of water	27
3 . 1 . 3 . Ground water and utilization possibilities	30
3 . 1 . 4 . Summary	34
3 . 2 . <u>The Water Sector and Its Role in the Economical and Social Development .</u>	36
3 . 2 . 1 . The water sector and its role in the development of agriculture and food production.	36
3 . 2 . 2 . The role of water sector in satisfying human demands for potable water .	39
3 . 2 . 3 . The role of water sector in satisfying the water demands of the industrial sector .	41
3 . 2 . 4 . The demands and trends of water for human share in the last decades .	42

3 . 2 . 5 Summary	44
3 . 3 . <u>Policies Adopted by the Government for the Management of the Water Sector :</u>	46
3 . 3 . 1 . Policies for industrial developments and manpower management .	46
3 . 3 . 2 . Water legislations policies .	50
3 . 3 . 3 . Policies regarding dams construction for water storage and improving the utilizations of these dams .	53
3 . 3 . 4 . Policies directed towards improving the environment and compating pollution .	55
3 . 3 . 5 . Policies regarding optimal water use and increasing the efficiency of irrigation .	57
3 . 3 . 6 . Policies regarding economic aspects of management and investment in the water sector .	59
3 . 3 . 7 . Policies for data base building and transfer of technology .	62
3 . 3 . 8 . Summary .	65
3 . 4 . <u>The Government's Strategies to Develop the Water Sector:</u>	67
3 . 4 . 1 . Improvement of irrigation techniques.	67
3 . 4 . 2 . Agricultural and sanitary drainage .	70
3 . 4 . 3 . Hydroelectrical powers .	72
3 . 4 . 4 . Summary .	73
4 . <u>Regional Basins and Possibilities of Long Term Joint Development</u>	74
4 . 1 . <u>Badia Catchment Basin</u>	74
4 . 2 . <u>Euphrates Basin</u>	77
4 . 3 . <u>Tigris Catchment Basin</u>	81
4 . 4 . <u>Orantos (Aassi) Catchment Basin</u>	83
4 . 5 . Yarmouk Catchment Basin	85
5. <u>Future Strategies , Summary and Recommendations</u>	86

SUMMARY

Syria is situated on the east of the mediteranean sea , with a total areaof 18528 thousand hectares . The arable lands represent 33 % , range and pasture 42 % and 3.9 % are forests . The irrigated area represents 11.25 % . The remaining land are rainfed areas .

Geographically and climatically , Syria is subdivided into four regions namely ;

1. The coastal region (1061 mm rainfall) .
2. The mountainous region (1500 mm rainfall).
3. The inner region (250 mm rainfall).
4. The badia region (138 mm rainfall).

Also Syria is subdivided into five agricultural resettlement zones , based on the intensity of rains .

1. The first resettlement zone :
Rainfall is exceeding 350 mm annually , the region is suitable for wheat , legumes (pulses), summer crops , and fruit trees . The region is blessed by large quantities of groundwater resources.
2. The second resettlement zone :
Rainfall is between 250-350 mm annually , the region is cultivated by wheat , legumes and barely . Groundwater resources are found at moderate depths .
3. The third resettlement zone :
Rainfall is about 250 mm annually , suitable for barely cultivation. Groundwater resources are found at more than medium depths .
4. The fourth resettlement zone :
Annual rainfall ranging between 200-250 mm . The region is used for grazing .
5. The fifth resettlement zone :
Annual rainfall is less than 200 mm . The region is used for autumn grazing .

Administratively , Syria is subdivided into 14 provinces . Each province is subdivided into a number of regions . The regions are then subdivided into localities (sub region) . Localities are in turn subdivided into villages .

Syria is exercising a variety of socio-economic plans to increase the rates of economical development and to promote the necessary prerequisites and facilities to increase production and productivity in the different sectors of the economy . The results of these efforts are recognised in sound economic achievements ;

- GDP quadrupled during the last 25 years . Also the per capita income increased from LS 4636 in 1963 to LS 7458 in 1989 .
- The government policies to promote exports and to offer exporters tangible benefits were reflected in decreasing the deficits of the balance of payments which reached LS 9947 millions in 1988 .
- As regard to food balances , the deficits of LS 35484 millions experienced in 1987 decreased to LS 1236.8 millions in 1989.

Syria is considered as a rapidly growing nation , the annual population growth rate is estimated to be 3.5 % .

This rate varies provincially and between rural (4.1 %) and urban (2.9 %) areas .

- The total labour constitute 67 % of the population . Males represent 51.3 % of the total labour force . 30.2 % of the labour force are working in the agricultural and animal raising sector . Industrial and mining sector employs only 14 % of the labour force.
- On considering education , it is recognised that the percentage of illiterates decreased from 54.2 % in 1970 to 29 % in 1986 . Technical and professional education was given special consideration, such trend resulted in 431 % increase in the number of secondary students and 452 % increase in the number of teachers for the period 1970-1986 . The annual growth rate of university graduates reached 9.2 % .

- Also special care was given to health services , a large increase in the number of phsicians (592 %) was attained during the period 1963-1989 . A similar rate of increase was attained in the number hospitals , health centres etc ..

- Syria is considered as a country with limited water resources . According to the geographical location of the water resources it is subdivided in seven catchment basins namely ; the coastal , Orantos , Damascus , Yarmouk , Badia , Euphrates and Tigris , Khabour basins . The annual water discharge of these basins which is available to Syria is about 80 milliard M³ , only 43.6% of this quantity is available for utilization . This quantity represents the rivers , springs and groundwater discharges . The remaining 56.4 % is falling as rains . Only 9 % of this rains are available for use as surface runoff .

The rivers are the second most reliable source . There are international rivers with annual discharge of 1396.7 M³/second as measured at borders of the country . The local rivers , the most important of which is Khabour river . The annual discharge of this river is 34 M³/second .

Euphrates river is one of the most important international rivers. Nowadays , it is irrigating 250 thousand hectares . The river also supplies potable water for many cities and villages such as Aleppo, Rakkah , Deir Ezzor etc.. The future plans for this rivers include irrigation of 644 thousand hectares of new relaim lands .

Tigris river is also an important river irrigating 150 thousand hectares . There are also other international rivers originating in Turkey and has great impact on the syrian economy . Most of this international rivers are shared by a number of countries but still no treaties or agreement are negotiated on the distribution of their water . Such a situation need to be negotiated for the benefits of all countries . Agreements that honour thehistorical rights and distribute the resources with known shares will lead to a rapid development of all the region concerned.The local rivers are utilized almost completely.The ground water resources come the third as regard to the total discharges . The annual discharges

of groundwater is about 5.625 milliard M³ .

This groundwater discharges are extracted from the upper water bearing formations . Deeper aquifers which proved to have great potential and good quality waters are not yet developed for production .

Water is an important factor for increasing and improving agricultural production . Utilization of water to irrigate lands increases production and the intensification programmes . Also improved inputs of production has its greatest impact when used in irrigated agriculture .

- A great attention is given to meet the demand of water for human consumption and domestic uses . However , the quantity needed for human needs (200L/day) is still less than the international standards .
- Industrial development is concentrated in those basins which are not suffering from water shortages . As such some provinces with ample water resources are highly industrialized .
- The agricultural water requirement is estimated round 10.3 milliards M³ equivalent to 47.4 % of all water discharges of the country . The human consumption demands are estimated to be round 828 millions M³ . This quantity is expected to increase to 1.2 milliards M³ during the coming decade .
The per capita water consumption decreased from 1 320 M³/annum in 1976 to 791.7 M³/annum (1989)
- To improve and reform the institutional set up of the water sector, a ministry of irrigation was initiated and was assigned a variety of responsibilities including supervision , institutional modification and monitoring the execution of the plans .
- Legislations regarding the water sector was revised and a plan was approved to unify all the laws into one legislation that would cater for organization , investments , development , and conservation of the water sector-.

- Efforts were directed to construct more dams for multi-developmental purposes , more than 133 dams were constructed with a storage capacity of 14041.6 M³ of water . Such stored water is used for irrigation , electricity generation , human consumption needs , and livestock production .
 - Also dams construction and associated irrigation and drainage networks brought forth the problem of pollution . A department to combat pollution was initiated and assigned the responsibility of combating pollution , protection of river and lakes from pollutants and investigating pollution problems
 - Water losses related to basin irrigation and extended irrigation networks necessitated the improvement of the networks to reduce water losses . Water crop requirements for the different crops were identified also suitable crop rotation were designed to meet the quantities of water available .
 - Water is regarded as public property . Citizens are not paying for its use . The major water projects such as dams and networks are planned and executed by the government . At the present time , water charges are paid by the citizen to cover the costs of operation , maintenance and energy . Also landowners of newly reclaimed agricultural land are paying reclamation charges per hectare . Such charges are only covering the cost of reclamation . The landowners pays this charges with easy terms and installements extending to 30 years .
 - The government encouraged farmers to introduce modern irrigation techniques . Such modern techniques are considered as efficient means of economising water use and also it improves and increases production and productivity . The governments granted the farmers soft easy repayed loans for the purchase and adoption of this modern irrigation techniques .
- The success of this policies requires the provision of the necessary equipments and the dissemination of this new techniques in the water sector .

1. INTRODUCTION :

The role of water sector is highly recognised , as it is an indispensable sector for the other sectors of the economy . Its importance is attributed to the fact that it is a renewable natural resource which is liable for depletion moreover it affects and is affected by all the other sectors ; It contribute to the development of these sectors , however , any development could not be achieved in the absence of a known minimum supply of water .

According to the regional occurrence of water in the form of international rivers or ground water basins , every country seeks to acquire the largest share of water flowing through its territories, due to the limited supplies of water in the region . Such an attitude, is leading to conflicts between the riparian country , on the issue of water . Riparian countries are now seeking solution for such conflicts through friendly agreements to share this regional source for the benefit of all partners .

As regard to Syria , water is becoming an important issue , firstly due to the limited supply of water and its uneven distribution throughout the country , and secondly , to the fact that most of this resources are of international origin.

Accordingly , syrian policy makers should exert efforts to develop and , optimally use the existing water resources . They should also seek . to sign treaties to share the annual discharge with the countries on which rivers originate .

As such this paper is an attempt to explore and to study the Planning and Management of Water Resources in Syria . The paper also traces the policies adopted by the government to conserve the water resources and the optimal utilization of these resources . The study analysis the procedures and method used to promote water use in development purposes and efficiency of utilization of surface water in agricultural and industrial purposes .

The study includes four main sections:-

1. The first section studies the geographical characteristics , the prevailing socio-economic status of Syria and the development in this economy during the past period .
2. The second section presents the water resources of Syria and studies the policies adopted by the government to manage this resources, and the other policies concerning the improvements in the institution set of the organization , optimal water use , environmental improvement and combating pollution together with proper economic management of the water sector . Also the section analysis the future plans and government strategies concerning the water sector .
3. The third sector gives a brief account on the regional rivers and groundwater basins and explores the possibilities of identifying a regional strategy and policies for long term development .
4. the fourth section looks into the future prospects and suggests recommendations .

This study is based on data and information obtained from a number of sources , including seminars and scientific conferences on the subject matter . Also , data of statistical nature and periodical reports . The data obtained , so diversified , with some what great variations in certain areas . Treatment of such data required a personal touch for its verification and the choice of the more reliable sources with estimates closer to reality .

Also a number of experts in this field were consulted and through their efforts and ideas a number of recommendations were discussed and presented in this study .

It is hoped , that the present work will add to the contributions achieved to study this sector , which nowadays is becoming an area increased concern . It is also expected that this water sector will draw more attention in the future .

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2. Geographic , Economic and Social Characteristics of Syria :

2.1. Geographic Characteristics:

2.2. The Prevailling Economic Status and Possibilities of Development:

2.3. Social Status and Characteristics and the State of Social
Development of the Society :

2.4. Summary :

2. Geographic , Economic and Social Characteristics of Syria :

2.1. Geographic Characteristics :

Syria is located in Western Asia between lat. 32° 42' & 37°20' north and lon 35°43' & 42°25' east . It is situated between Iraq on the east , Turkey on the north , Jordan , Palestine and Israel on the south and the Mediteranean sea and Lebanon on the west .

The total area of Syria is 18518 thousands hectares ⁽¹⁾ _ Eighty per cent of which is a gently sloping plains, 5% mountains regions and the rest is a plateau of a moderate hight .

The total arable lands , in 1990⁽²⁾ , were in the range of 6149 thousands hectares. This , in fact , represents 32.2% of the total area of the country . 5626 thousands hectares of the arable lands are cultivated (4773 thousands hectares under rainfed and 692 thousands hectares under irrigation) . Only 85 % of the rainfed area is cultivated annually , the other area is left fallow .

Range and pastures constitute 7870 thousands hectares and this is equal to 42.5 % of the total area . Forests represents 3.9 % , the remaining area which is equal to 20.4 % is uncultivable lands .

According to the abovementioned section the agricultural sector of Syria depends mainly on rainfed agriculture , which is seriously affected by the intensity and distribution of the annual precipitation . The annual fluctuation of rainfalls affects the agricultural production and leads to its variability from year to year .

The irrigated sector represents 3.7 % of the total area , it has a great contribution in food production and plays a great role in the promotion of production and productivity of the agricultural sector .

Syria is characterised by great variation in its physical and natural resources . In spite of its small area , it can be subdivided , physically , into four geographic regions :

Sources :

1. The General Statistical Abstract , Central Statistical Bureau , Primeminister's Office , 1990 .
2. Ministry of Agriculture and Agrarian Reform , Land Use for 1990 .

- Coastal Region : This includes the region between the Mediterranean coast and the coastal mountains in Lattakia and Tartous provinces. It forms a coastal plain with a total length of 130 Km and 1-25Km in width .
- Mountains Region : This includes the mountain series and the plateau extending from north to the South of the country ,parallel to the Mediterranean sea . Including also the coastal mountains series and Lebanon Eastern mountains with ElSheikh mountain , Palmyra mountains series , Badia mountains series , Aleppo mountains . Hama and Gezira mountains in North East also forms part of the region .

The Lebanese Eastern series is considered the longest mountain formation in Syria . It is 175 Km in length , extending from El Kabir Southern River on the north to the Valley of River Jordan on the south . The highest point (summit) being El Sheikh mountain (2814 meters) . The Lattakia mountains are about 170 Km in length , extending from River Aassi on the north and Kabir Southern river on the south . The highest point being Matta mont (1539 meters) .

The Palmyra mountain series is subdivided according to formation and topography into two part traversed by a narrow plain , namely's .

- The northern series of 85 Km in length and 5 Km width , the highest point being El-Shaara mountain (1350meters) .
 - The southern series of the same length and width as the northern series but a little higher , with Zubeida mont as its summit (1390 meters) .
 - The Inner Region: This includes the plains extending throughout the north up to the south of the country , bordering the eastern lebanese mountains and the other mountain series . Including also the plains of Aleppo , Homs , Edleb , Damascus , Hasakeh and Daraa . In the region higher plains are found where scattered volcano cutcrops exist , these plains are trapped between the coastal mountains on the west and the Plmyra mountains , on the southern east , Turkey on the north and the Eupherate valley on the east .
-

- The Badia Region: It includes the desert plain on the south eastern direction . Iraq and Jordan borders are on the East and South . The total area of the Badia Region is about 9 million hectares . The whole area is a range land suitable for animal grazing , grasses are growing in the region with average annual rainfall of 200 mm .

The region is cold and rainy in winter , dry in summer typical to mediteranean climate . Winter is followed by two short transitional seasons' s spring and autumn . Climatically , Syria is subdivided into four regions following the same trend of the geographical divisions mentioned before .

- The coastal region : Precipitation is heavy during winter and spring with average annual rainfall of 1016 mm . Temperature is moderate with 25°C as a maximum and 15°C as minimum temperatures . The relative humidity is the highest in the region with an average annual of 69% reaching 85 % during summer months .

- The mountains region : Situated 1000 meter above sea level with heavy precipitation during winter and spring with average annual rainfall of 1500 mm . Winter is cold and ice is formed at the higher places and tips of the mountains . Summer is moderate .

- The inner region : Rainfall is usually during winter , the average annual rain is 350 mm which is less than that of the coastal and mountains regions . Summer is hot and dry with great variation of temperature during the day .

- The badia region : Low rainfall during winter with average annual of 138 mm . Summer is hot and dry with 26.5°C as an average maximum temperature , reaching in summer 43°C . Relative humidity is the lowest in the country with an average of 52 % .

Syria is particularly affected by winter winds . During the winter months , easterly winds blow the eastern region . The northern winds blow northern and north western regions , while the western and south westerly winds blow the rest of the country . During summer the

country is affected by the northern winds which blow the north eastern region and the western and the south westerly winds, which blow the rest of the country .

During winter Syria is affected by the high pressure extending from central Siberia . The high pressure blows the dry cold winds, which on meeting the maritime air mass coming from the Mediterranean sea falls as snow . Also the country is affected by the low pressure formed at the Mediterranean sea or from the Atlantic ocean carrying with it rains .

The variability and distribution of rainfall brought forth the regional subdivision of Syria into five agricultural settlement zones according to the average annual rainfall ⁽¹⁾:

- The first settlement zone : Average annual rainfall more than 350mm
The zone is suitable for the cultivation of wheat , legumes (pulses), summer crops and fruit trees tolerable to drought . Ground water could be mined from shallow depths.
- The second settlement zone : Rainfall ranging between 250-350 mm on average annually . The land is cultivated with barely , wheat , legumes (pulses) and summer crops . More lands are cultivated where average rainfall is higher . Ground water could be mined from moderate depths.
- The third settlement zone : Average annual rainfall more than 250mm .
The zone is suitable for the production of barely .
Ground water is available but could be mined at more than moderate depths.
- The fourth settlement zone (marginal): The annual rainfall on average below 200-250 mm , but never less than 200 mm as indicated by half the number of years surveyed . This area is a pasture land . Barley is grown occasionally when good rains are expected .
- The fifth settlement zone (badia): Most of area of Syria is found in this zone . The average annual rainfall is less than 200 mm . During spring this badia is used for grazing .

Source :

1. Dr. Yahia Bakour - The agricultural issue in the Syrian Arab Republic
Damascus - 1986 .

Ground water is salty and shows high content of sulphur .

. But investigations has justified the availability of good quality water at deeper aquifers.

Syria is subdivided ⁽¹⁾ into fourteen provinces . Each province is also subdivided into a number of regions , which is further subdivided into localities (subregion) . Each locality is subdivided into villages which form the smallest administrative unit in the country .

The top official of the province is the governor who is appointed by a presidential decree . The decisions in the province are made by the governor and a local assembly . The members of this assembly are elected by the different regions according to the constitution . A number of technical and administrative personnel assist the governor in the performance of the provincial activities .

The top official of the region is a director appointed by the minister of interior . He is in charge of security and other related activities . The technical and administrative work is performed by an elected town council .

The locality (subregion) is managed by a director appointed by the minister of interior. The director is assisted by the town council which is elected by the people of the locality .

At the village level a local leader (MUKHTAR) is the chairman of the village council . Both the council and MUKHTAR represent the administrative authority in the village and supervise the farms found there . All in all , in Syria , there exists , 59 regions , 183 localities (subregions) , 6335 villages -(supervising 7348 farms) .

Sources:

1. Administrative divisions law .

2 . 2 . The prevailing economic status and possibilities of development:

Syria is one of the developing countries which is exercising different socio-economic procedures to increase the rates of economical development and to promote the welfare of its rural populations . Efforts are made to provide the necessary prerequisites and facilities to increase production and productivity in the different sectors of the economy .

The trends of production which were prevailing during the last 25 years were characterized by inefficient means and inputs which were used especially in the agricultural sector , where also low productivity prevails and this has its impact on the per capita income which is very low when compared with that of developed economics .

Statistics have shown that the gross output (commodity price) was L.S. 143615 millions in 1989⁽¹⁾ . The contribution of the public sector increased from 35 % in 1963 to 57 % in 1984 then decreased to 46 % in 1989⁽²⁾ to present .

The contribution of the productive sectors in the value of the gross output is 57 % , services related to production 27 % , governmental and other services 16 % .

Studies have shown that the gross domestic product (GDP) increased from L.S. 28150 millions in 1963 to L.S. 87402 millions in 1989⁽³⁾ which is a four fold increase . The trend of growth varied during that period , it reached its maximum in the period 1970-1975 indicating a 96 % increase , the period 1975-1980 witnessed a drastic decrease of 31 % .

On analysing the composition of GDP it is found that the contribution of the productive sector reached 41 % . Such reasonable contribution indicates sound production capabilities. The other sectors such as production services contributed by 40 % while the other services 19 % .

Sources: 1. The General Statistical Abstract, Central Statistical Bureau
Prime minister's Office 1990 page 470.

2. Abdel Malik El-Akhras, Social changes in SAR, 1989 .

3. U.S\$ 1.0= LS11.20 Official rate - 4. Figures of gross output and GDP are based on 1985 constant prices.

Average per capita income according to market prices increased from L S.4637 in 1963 to L S.8774 in 1981 . Then fluctuated to attain L S.7458 in 1989 ⁽¹⁾. Such fluctuation is attributed to the nature of agricultural production which is affected by the intensity and distribution of the rains during the winter and spring .

Analysis of the utilization of the gross output in the form of services and commodities indicated an increasing trend of expenditure of the final demand , especially the expenditure of the government . This is attributed to the fact that governmental expenditure on education , health , communication (rails and roads) . literacy compaigns and other basic services are considered as an essential preconditions for development . Such expenditure increased from LS20144 millions in 1963 to LS 59770 millions in 1985 (constant prices) .

Inspite of a relatively slow growth in the first years , capital formation was growing steadily in the same period under investigation . Then growth accelerated to reach LS 19784 millions in 1985. Then started to decrease slowly to reach LS 10994 millions in 1989 . This is attributed to a decrease in the rate of capital accumulation in the private sector during 1985 - 1989 .

As regard to exports , during the same period , the value of exports increased from LS 913 millions in 1963 to LS 8273 millions in 1980 . Then started to decrease reaching LS 5199 millions in 1986, then jumped to LS 32740 millions in 1989 . The big increases in exports are attributed to the policies adopted to activate local production , promote exports and apply reasonable exchange rates for the currency .

Savings contributed in the financing of wide variety of developmental activities . Local savings achieved tangible increases from LS364 millions in 1963 to LS 34952 millions in 1988 .

Balance of payments deficits are considered to be one of the most important factors negatively affecting the Syrian economy . During the period under investigation the value of exports were far more less than the value of imports , the gap continued to increase at an increasing rate between 1963 and 1988 .

Source: 1. Statistical Abstract (page 518)- 1990 .

At start the gap was in the tune of LS 1001 millions , it increased to LS 7910 millions in 1980 and LS 9947 millions in 1988. Surplus of LS 10196 millions was achieved in 1989⁽¹⁾. The surpluses attained are attributed to the wise policies adopted by the government for the promotion of exports.

Since 1963 , the country's food balances witnessed a continuous deficit . In 1975 deficits were LS 1017.9 millions⁽²⁾ in 1984 LS 2548.7 millions . The year 1989 witnessed an obvious decrease in deficits , and were only LS 1263.8 millions . This change in the trend is attributed to a change in the policies adopted by the government ; to increase agricultural production ; to supply the necessary inputs ; to export surpluses ; and to offer exporters tangible benefits . This fact is illustrated by comparing the value of food exports which was LS 602 millions in 1987 , and the relatively high value of LS 3865.7 millions attained in 1989 .

The analysis of economic growth attained by all sectors revealed that during the period 1965-1985 the whole nation is developing at higher growth rates. Such trend was achieved at the expence of the agricultural sector . This fact is shown by consulting the growth of GDP, which is growing annually by 7.6 % on average , in the same time , the agricultural sector is growing by only 3.9 % . This percentage decreased to 1.5 % during the period 1975-1980 , this figure is less by 2 % when compared by the annual growth of the population⁽³⁾.

Moreover the relative importance of the agricultural sector and its contribution to GDP declined from 27 % in 1963 to 20 % in 1980 and witnessed an increase to 24 % in 1989⁽⁴⁾ .

The decrease in the rate of growth of the agricultural sector is attributed to physical constraints such as the fluctuation of rainfed agricultural production . Also technological constraints , such as the lack of modern production inputs . Social constraints related to the push and pull factors affecting agricultural labourers and their movement to other sectors and the disparity of income between the urban and rural areas .

Sources : 1. Statistical Abstract page (275) - 1990.

2. Arab Organization for Agricultural Development-Agricultural Policies in Syria 1981.

3. Dr. Yahia Bakour -Food Security in the S.A.R-1984. 4. Statistical Abstract p. 470.

2.3. Social Status and Characteristics and the State of Social Development of the Society :

Extended family obligations is a characteristic of the Syrian society but freedom from such tribal linkage is associated with the urban societies .

In Syria people think that the government is the source of power and authority and by applying by the laws the society can be organized and developed . Also the law defines the rights and roles of the citizens and shows ways to maintain them .

In Syria, parental ties exist . The parents continue to play an effective role on their sons even after their marriage and forming their separate families and homes . However , it is rarely found, that a married son lives with his parents in the same house, especially in urban areas .

The rural society has its own traditions which differ from those of urban societies . In rural society marriage is the most important occasion in the village . Girls preferably are married to their cousins , if not available, then they will be married to the next nearest kin .

The tribal system has a great effect on the rural societies specially in the eastern region , close to the Bedawin societies , While in the central provinces the effect of such tribal ties dwindled to a great extent⁽¹⁾ .

Undoubtedly , the new agricultural organizations, the government administration and the link with the urban communities has brought a variety of socio-economic changes at the village level. Also the presence of farmers youth and women organizations contributed in the emergence of new active leaders . The presence of these new leaders affected and disturbed the powers and the authorities of the traditional leaders (MUKHTARS) and their historical relationship with the government and has also contributed to mistrust , fear and tension of the old organization with its old tribal ties limiting the development and the growth of the productive forces, from

Source : 1. Dr. Yahia Bakour - Analytical study on Major Changes in Agrarian Structure and Land Tenure Systems in Syria - Damascus - 1984 .

incoming new organizations seeking for the satisfaction of the economic and social needs of the people through modern techniques and collective work.

The total populations of Syria⁽¹⁾ in 1990 , was about 12116 thousands inhabitants . In 1963, there were 4565 thousands inhabitants. This figure was doubled in 1981 to reach 9050 thousands inhabitants.

Syria is considered as one of the most rapidly growing countries in population , it annual growth rate is estimated to be 3.5 % such trend is attributed to the stability of fertility rate around the maximum rates and the decline of mortality rate as a result of economical and social achievements during the seventies and eighties. These two decades witnessed improvement and promotion of the health services , installation of clean water networks and sanitation and sewage networks .

Provincially , population growth rates varies , the maximum is attained in Daraa province (5.3 %) , the minimum is in Hama province (2.3 %) .

This rate also varies between rural and urban areas . In rural areas the rate is 4.1 % while in urban is 2.9 % . This is attributed to be the different socio-economic and living standards in rural and urban areas .

Male percentage at birth is 108.6 to every 100 females born . While among the country's , population in 1970 males are 105.3 to every 100 females and 104.4 in 1989 . This trend is attributed to the migration of the male population outside the country .

According to age, the composition of the population shows that children of 15 year and less constitute 47.2 % of the population . Those old people of 65 year and above forms 4.7% of the total population⁽²⁾.

Rural population constitute 52.98 % of the whole of population this percentage varies according to region and province , also, whether

Sources :

1. Statistical Abstract - page(72) .
2. Dr. Abdel Malek El-Akhrass - previous source .

there in the region exists large population centres , they are active in agricultural production etc ... This is further illustrated by the fact that most of the population of Damascus province are urban , while most of those of Qunaitra province are rural . Then for Tartous (79.82 % rural), Edlib (79.6 % rural) , Daraa (78.66 %rural) . Statistics has shown that rural population in Syria are decreasing annually . They were 63 % in 1963 , they decreased to 56.5 % in 1970 and to 53.3 % in 1980 . It is shown that such a decline in the percentages during the sixties was greater than that of the eighties and this is attributed to the betterment of the living standards in rural areas and improvement of services and increase of job opportunities and the inclination of the farmers to settle in their lands .

The average family size in Syria is about 6.5 persons , according to samples taken in 1970 it was 5.9 , in 1960 it was 5.3 persons per family on the average ⁽¹⁾ .

Average family size varies between provinces , it is 5.5 persons in Damascus , 6.5 persons in Homs and Rakkah , and 7.1persons in Der Ezzor and Daraa . Average family size varies even within the same province according to its rural and urban concentrations. In Sweida urban areas, average family size is 5.4 persons , while it is 5.9 persons in the rural areas. In Der Ezzor urban area average family size is 6.1 persons, it is 7.9 persons in rural areas .

According to the geographical distribution of the population, it is noted that 66 % of the urban population are occupying five large cities , namely , Damascus , Aleppo , Homs, Hama and Lattakia , while 10.6% are living in other provincial cities . The remaining 23.4 % are distributed among the 50 other cities .

Statistics has shown that the north eastern provinces including Aleppo , Rakkah, Deir Ezzor and Hasakeh which actually represent half the area of Syria and where 62 % of arable land are found are populated only by 36.6 % of the population . While the provinces of Tartous and Lattakia are populated by 11 % of the total population taking into consideration that both provinces represents only 2.2 % of the country's area and includes 30.9 % of the arable lands ⁽²⁾ .

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- Sources : 1. Central Office for Statistics Research paper - Damascus 1990.
2. This figures are based on statistics supplied by the Central Statistics Bureau - Ministry of labour and social affairs .

Analysis of labour force (10 years age and above excluding handicapped) indicated a figure of 67 % of the population , with an annual growth rate of 2.7 %, males constitutes 51.3 % of the labour force, while urban areas employ 48.8 % of them . The rate of contribution in the economical activities as performed by labour force is considered to be 37.7 %, the figure varies , for males it is 66.1 % and for females 8.1 %. The average contribution of the labour force is 36.7 % in rural activities and 34.3 % in urban activities .

Statistics has shown that the volume of labour force had increased by 2.2 % during the passed period . This figures varies when compared with the average growth rate of population . Actually , this is attributed to rate of increase of the dependency ratio of the society . Also it is indicated by the statistics that labour force in the rural areas is estimated to represent 53.9 % of the total country labour force .

Occupational composition of the labour force shows that the largest group is that of agriculture and animal raising. They constitute 30.2% of total labour in the country and 37.8% in the rural areas. Industrial and mining sectors represents 14 % . It is also shown that the female force working in agriculture is greater than male force , contrary to what is found in industry and mining .

On considering education⁽¹⁾, it is recognised that education became an established institution in the society . The illiteracy rate as related to the labour force decreased from 54.2 % in 1970 to 29 % in 1986 (includes 10 years of age and above) . The rate varies when different provinces are compared and it also varies between urban and rural areas. Generally , the illiteracy rate is higher in rural areas (42 %) when compared with urban areas (20 %) . The rate among females is (50 %), as regard to males the rate decreases to 18 % . Out of the total labour force in 1988 , 14.7 % attained the secondary education and 5.4 % graduated from the universities .

Source :

1. The Central Statistics Bureau : results of the random sample , 1989 -

The state realized the importance of the professional and technical education, as such the government efforts resulted in higher intake of students in the technical secondary schools to a level reaching 431 % in the period 1970-1986, while the increase realized in the academic secondary schools did not exceed 194 % for the same period. The number of teachers also increased by 452 % for the technical education and 228.6 % for the general education.

It is believed, that the educational sector was given special consideration for all the preuniversity stages and the results of such efforts were recognized in a increased rate of education exceeding the rate of growth of the population. In ⁽¹⁾ the period 1970-1986 the rate of the annual intake of students for the pre-university was 4.5 %. The annual rate of increase of expenditure on education was 65.9 % regarding the same period, such trends indicate the efforts and support of the state to promote this educational sector.

As regard to university education, the annual rate of student intake during the period studied was 8.9 %, in the same time, the annual rate of students graduated from the universities was 9.2 %. Actually, these rates are high when compared with annual rate of population growth which is 3.5 %.

As regard to healthcare, the government paid an increased attention to the health services, the efforts covered curative as well as preventive medicine. Health care is considered as a governmental activity. Preventive medicine and raising the levels of health awareness are treated as inseparable parts for providing good health care to the citizens. Accordingly, the number of physicians increased during the period 1963 - 1989 by 592 %. The average number of citizen per one physician attained the reasonable ratio of 1:1194. The number of dentist also increased to reach 3362 dentists in 1989 with ratio of one dentist to 3486 citizens.

The same saying stands true for the pharmacists, their services are reaching the rural areas as well as urban towns. The number of

Sources :

1. Abdel Malik El Akhras : Socio-economic changes in Syria .

pharmacists increased from 857 in 1970 to 3634 in 1986 , indicating a ratio of one pharmacist to 3225 citizens .

The number of government and private hospitals were 215 in 1984 , housing 13416 beds with the ratio of one bed to 864 citizens .

2.4. SUMMARY :

- Syria is situated on the east of the mediteranean sea , with a total area of 18528 thousand hectares. Out of which 6149 thousand hectares are arable land (33 %) , 7870 thousand hectares are ranges and pastures (42.5 %) and 722 thousand hectares are forests (3.9 %) .
- Total irrigated area represents 11.25 % of the total arable areas . The rest is under rainfed agriculture . Rainfall intensity varies in time and space and this actually affects the annual agricultural production .

Syria can be subdivided physically , into four geographic regions :

- The coastal region :

This is 130 Km long coastal plain located between the sea and the coastal mountains with moderate climate and heavy rains (1010 mm annually) .

- The mountains region :

This includes the mountain series extending from north to the southern fringes of the country paralld to the coast of the sea . The highest points of the series is about 2814 meters . The region is characterized by heavy winter and spring rains and snow formation on the mountains. The average annual rainfall is about 1500 mm .

- The inner region :

This includes the plains extending from the mountainous region and western Palmyra mountains , with moderate annual rainfall , 250 mm on the average . The climate of the region is hot and dry in summer with great variability in temperature during the day .

- The Badia region :

It includes the desert plains along the Iraqi and Jordanian borders, The region represents 42 % of the total area of the country . Rainfall is relatively limited in amount with an average of 138 mm annually .

Due to the importance of rainfall on the agricultural economy of Syria , the country is subdivided into four resettlement zones . The first zone includes the region receiving more than 350 mm of rains annually , and suitable for wheat , legumes(pulses) , summer crops, and drought tolerant fruit crops . The region is rich in groundwater bearing formations. The second zone is receiving rainfall between 250-350 mm on the average annually . The region is suitable for wheat, barley and legumes . Groundwater could be mined from moderate depths. The third zone with an average annual rainfall exceeding 250 mm annually, barley is the main crop . Groundwater is available but could be mined at more than moderate depths . The fourth zone receive rains between 200-250 mm on average , but never less than 200 mm as indicated by the results of half the years surveyed . This area is a pasture land . Barley is grown occasionally when good rains are expected . The fifth zone that of Badia region , annual rainfall is less than 200 mm The region is grazed during spring . Groundwater is salty and shows a high content of sulphur .

Administratively , Syria is subdivided into fourteen provinces . Each province is subdivided into a number of regions , which is further subdivided into localities (subregions) . Each locality is subdivided into villages .

Syria is one of the developing countries which is exercising different socio-economic procedures to increase the rates of economical development and to promote the welfare of its rural population . Efforts are made to provide the necessary prerequisites and facilities to increase production and productivity in the different

sectors of the economy . The results of such efforts are recognised in sound economy achievements ; GDP quadrupled during the last 25 years . Also the per capita income increased from LS 4636 in 1963 to LS 7458 in 1989 . The period also witnessed an increased governmental efforts in the field of education , health , roads railways and other infrastructural services .

The government policies to promote exports and to offer exporters tangible benefits was reflected in decreasing the deficits of the balance of payment which reached LS 9947 millions in 1988 . As regard to food balance , the deficits of LS 35484 millions in 1987 decreased to LS 1236.8 millions in 1989 . Such an achievement is attributed to the policies adopted by the government to increase agricultural production , to supply the necessary inputs and to export surplus quantities .

Inspite of food balance deficits , the agricultural sector, still plays an important role as it contribute by 25 % to GDP and supply food to the people and raw materials to the industry .

Syria is considered as a rapidly growing nation in terms of population its annual growth rate is estimated to be 3.5 % . Such trend has lead to an increase in the population from 4595 inhabitants in 1960 to 12116 thousand inhabitants in 1990 . Such growth is attributed to a stability in the fertility rates and a decline in the mortality rates . This trend is actually attained through socio-economic development achieved during the seventies and eighties decades .

The average growth rate varies provincially and between rural(4.1 %) and urban (2.9 %) areas . This is attributed to the different socio-economic characteristics and the living conditions of the people .

Rural population is estimated to be 52.98 % , this percentage differs provincially . The average number of persons per family is about 6.2 . This rate also differs provincially and between urban and rural areas .

The total labour force constitute 67 % of the population . Males represent 51.3 % of the total labour force .

Occupational structure of the labour force shows that the largest group is that of agriculture and animal raising . They constitute 30.2 % of the labour force of the country and 38.7 % in the rural area . Industrial and mining sector represent only 14 % of the labour force .

On considering education , it is recognised that the percentage of illiterates decreased from 54.2 % in 1970 to 29 % in 1986 . Graduates employes are constituling 5.4 % of the total labour force. The annual growth rate of graduates is 9.2 % .

Technical and professional education was given special consideration , such trend resulted in 431 % increase in the number of the secondary school students and 452 % increase in the number of teachers for the period 1970 - 1986 .

Also special attention was given to health care , a large increase in the number of physicians (592 %) was attained during the period 1963 - 1989 .

According to what has been mentioned , the high population growth rates necessitates the adoption of policies and procedures that would accelerate the rate of socio-economic development and growth in the country .

Undoubtedly , the water sector plays the most important role in accelerating the rates of growth . As through water sector , more and efficient utilization of agricultural lands could be achieved, also water is an indispensable item to all other economic sectors and for human survival .

3. The Water Resources and the National Policies for their Management :

3.1. The Water Resources locations and Distribution:

Syria is considered as one of the countries with limited water resources when comparing its arable land areas , the water requirements for both human as well as industrial uses , and other water needs required for social and economical development with the available water resources.

This can be verified by the fact that the total quantities of water available is estimated to be round 82585 milliards cubic meters. 56.4 % falls as rains , 36.5 % flows as local or international rivers and 2 % flows from springs and the rest 4.3 % is mined from the ground water or as surface run-off (table 3) .

Although rainfall is considered as the largest source of water, yet, the possibility of utilizing this source is limited due to the variability in the quantities falling annually and due to the unreliability of its distribution geographically and season wise (it falls only in the winter and spring seasons) . Studies show that only 9 % of water falling as annual rainfall can be used and stored in dams (1) .

The rivers plays an important role in the country , although the quantities flowing are depending on the underground water stored on one hand and on the agreements with different countries through which the rivers are flowing on the other hand .

Studies indicate that the quantities of water of some river, streams and ground water which is replenished from underground aquifer inside the country is part of that water calculated as rains .

Ground water is the third in the list of the important water sources , its importance is increasing as a result of the government plans to drill more underground bores to increase irrigated areas .

Source :

1. Dr. Georges Soumi - Improving the water management and the additional irrigation for rainfed agriculture - Damascus 1991 .

The springs are the fourth in the list of water sources . The rate of flow of this source decreased due to the extension of the drilling programme for ground water mining and this lowered the static water level all over Syria , hence decreasing the flow of springs and depleting the water of some of the aquifers .

According to the geographic distribution of water resources , Syria is subdivided hydrologically , into seven ⁽¹⁾ main catchment basins as shown on table /4/ . Two of them are internal catchment basin and the other are regional catchment basins .

A . The internal catchment basins are :

1 . Coastal catchment basin :

Surface water of this basin is brought from the coastal and western mountains bordering the sea . Surface water flow across the coast forming parallel streams which then runs into the sea . The area of the basin is about 5049 Km² ⁽²⁾ , average annual rainfall is 1294 mm . The basin is inhabited by 1.23 million citizens . There exist other subsidiary basins . A number of rivers are flowing in this basin the most important being Kabir Northern river , Sin river and Kabir Southern river .

2 . Damascus catchment basin (Baradaa and ElAawag) :

The water source of this basin are originating from Haramoun mountain and Sergaya hights . The total area of basin is 8630 Km² average annual rainfall is 268 mm . The annual discharge of this basin is 1683 million M³ . 833 million M³ of which are of surface water and spring origin and 850 million M³ are of renewable underground sources ⁽³⁾ . The region is inhabited by 2.459 million citizens . The whole are subdivided into a number of subsidiary basin .

Sources : 1. Statistics Central Bureau - Previous source .

2. Dr. Salim Kaboul - Water Resources in Syria

3. Barakat Hadid - Strategic Development Syrian Water Resources
Damascus - 1987 .

B . The regional catchment basins are :

1. Badia catchment basin .
2. Orantos catchment basin .
3. Tigris and Khabour catchment basin .
4. Yarmouk catchment basin .
5. Euphrate catchment basin .

Importance and resources of these international basins will be discussed in chapter /4/ .

3-1-1- The role of rainfall as water source and the possibility of utilizing rains water :

The annual precipitation in Syria varies between 100 mm at the Badia to more than 1000 mm at the coastal region . This trend is very much influenced by the local terrain such as the coastal mountains with are acting as a shelter restricting the movements of the wet air mass originating in the mediterranean sea , this is actually leading to the variability of the water quantities which are decreasing along the west-east axix .

On analysing statistical data on precipitation , a number of facts may appear and is discussed in the following ⁽¹⁾:

- Area with mean annual rainfall more than 1000 mm represents 3.3 % of the total area of Syria (574.5 thousand hectares). Areas with mean annual rainfall of 600 mm and more represents 5 % of the total area . This area receives , on average , 22 % of the total rainfall falling all over the country and it is mainly covering the coastal region .
- Al most 54 % of the total area of the country is receiving , on average , no more than 26 % of the total rains falling . This areas includes the Badia region . The rainfall distribution in

Source :

1. for more information please consult table /5/ .

space is very irregular , similar to its irregularity in time-between the year and the other , early or late in the same-season.

- The remaining area which represent 41 % of the total area of the country receives , on average , 52 % of the total rains falling. The area represent the settled agricultural regions , it includes all the inner plains and the Gezira fertile plains in the North. Also it embraces the largest sectors of the Inner Aassi , Aleppo , Damascus , Yarmouk and Gezira catchments basins .
- The annual variability in the quantities falling increases relative to the decrease in the mean annual rains falling ⁽¹⁾. Such trend indicates that , attaining the mean annual rainfall in regions such as the Badia is usually unexpected , but the propability of attaining such levels increases on approaching regions with higher rain intensities such as the coastal mountains .
- The distribution of the rains during the season affects greatly the quantities recharging the aquifers or escaping as surface runoffs or used to irrigate crops . The rain distribution in time and space is very irregular . Sometimes rains starts early in the season and other time late or vice versa . While in some seasons all the annual quantities falls in a limited number of days .
The variation in the quantities falling monthly and annually and between months and years leads to variation in the annual agricultural production . Years with good rains produces bumper crops and years with low rains the amounts produced decrease drastically . This is illustrated by the production of Barely crop in a low rain year (1989) was only 15 % of what was produced in (1988) a year of high rainfall .

Source : 1- State Ministry of Planning - Analysis of the current situation of the water sector - 1988 .

3-1-2- The Role of Rivers as a Perennial Source of Water :

Rivers are the main source of surface water . Rivers can be diverted and controlled to meet the required uses and plans . These rivers are either perennial , flowing continuously , or flow during the rainy season and dry up during the rainless season (summer) .

The perennial rivers are subdivided into two; the local rivers and the international rivers :

- The local rivers :

This are the rivers originating and finally spreading in Syria or flowing in the Syrian coasts . It includes the Syrian rivers shown on table /6/ -

- The international rivers:

This are the rivers originating in neighbouring countries of and flow across Syria , it includes : Euphrates , Tigris , Orantos (Aassi), Sajour , Queiq , Jaghaigh , Afrin . ect

The importance of these rivers and their economic and social impact is discussed below :

A- The local rivers :

These rivers originates inside Syria , They are utilized almostly to the maximum , they flows and end either forming internal lakes or in the mediteranean sea .

The annual discharge of these rivers is about 52.7 M³/second , producing 1700 M³ of water by volume as measured in 1989 . The most important rivers are the following :

1. Khabour river :

This river originates in Raas ElEin region , Hasakeh province . It flows across Deir Ezzor province and finally joins the Euphrates in Sour city . The total length of the river is 442 Km . The average annual discharge of the river is about 34 M³/second it reaches a maximum during flood discharging 41.5 M³/second and a minimum during

the summer (30.5 M³/second). The annual discharge varies according to the intensity of the rains .

The importance of this river stems from the fact that it irrigates large areas of agricultural lands in both Hasakeh and Deir Ezzor provinces . A 150 thousand hectares project is under study on lands extending along the river from Raas ElEin up to Sour city . The area under study will utilize the whole water of the river plus all its tributaries .

2. Barada river :

The river originates in Zabadani near Damascus . The total length of the river is about 71 Km . The average annual discharge of the river is about 6.5 M³/second . The discharge reaches a maximum of 57 M³/second during flood and a minimum of 3 M³/second during summer .

This river plays an important role for it irrigates Damascus (Goutta). Also the river and its tributaries originating from springs , satisfies the consumption needs for potable water for Damascus city and the other small villages along the sides of the river . All the water flowing is completely utilized .

3. Sinn river :

The river originates near Banias and flows across the fertile plains along the coast and finally ends at the sea . The total length of the river is about 6 Km . The average annual discharge is about 5.9 M³/second , it reaches a maximum during flood discharging 11.4 M³/second and a minimum during summer to about 3.2 M³/second . The water of these river is irrigating the coastal plain between Banias and Latakia. The area irrigated is estimated to be round 9 thousands hectares . Also a number of coastal cities such as Latakia , Tartous , Jableh , Banias their consumption demand is met from this river . Accordingly , the waters of this river is completely utilized .

4. Other rivers:

The other rivers denoted on table /7/ are of small discharges . The flow of these rivers and discharge varies greatly between winter and summer some of them dries up in summer . The rivers are mainly utilized

for winter cropping . The plans of the government are directed for constructing a number of dams on these rivers for storing flood water to be utilized for irrigation and human domestic needs .

B- The International rivers are :

1. Euphrates river .
2. Orantos (Aassi) river .
3. Tigris river .
4. Sajour river .
5. Queiq river .
6. Afrin river and its tributaries .
7. Jaghiagh river .

to be discussed in the chapter /4/ with more details .

3-1-3- Ground water and Utilization possibilities :

Ground water resources (bores and springs) are among the most important water sources in the country , which are used to satisfy human needs and to meet agricultural and industrial demands . Water extracted from groundwater resource would be controlled and limited to the rates of the recharge and discharges . The annual discharge of the ground water resource is estimated round 5625 milliard m³ . The springs are discharging 2069 milliard m³ and the bores 3556 milliard m³ of Water⁽¹⁾ .

Although , it proved to be necessary , that the annual discharges of groundwater should not exceed the annual recharge , experience has shown uncontrolled extraction of water is the rule , sometimes , exceeding the rate of annual recharge , leading to significant drop in the static water levels . Such trend is experienced in Damascus , Aassi and Aleppo aquifer .

The drop in the groundwater level is attributed to increasing bore drilling and ground water use for agricultural , industrial and urban needs . noting the case of Damascus aquifers where the drilling activities installed more than 15000 bores .⁽²⁾

The ground water drilling activities are concentrated on the shallow aquifers because it is well studied and mining of water of shallow depth seems to be economically feasible . Accordingly , drilling activities on these aquifers resulted in intensive extraction of ground water (Kalamoun , El Salamieh , Aleppo , ect..) . It is noted that the volume of water stored in these aquifers will not meet the future demand of the country . However a number of hydrological studies were conducted in Syria to investigate the possibilities of the presence of ground water in deeper aquifers under the first layer's and to study the economic feasibility of extracting such waters . These studies were conducted in four different hydrological regions , namely;

1. The western mountainous region :

The region extends along the syrian coast , it includes the aquifers spreading along and nearby the coastal mountainous series . These areas are made mainly of cracking carbonate and calcarious formations and

Sources : 1. Table No. 3

2. Dr. Wathekh Rassoul Agga : Ground water resources in Syria , Journal of Water and Agriculture , Damascus . November , 1987 .

constitute the main aquifers of the region . The permeable characteristics of these rocks and heavy rainfalls and snow in the area increase the water retention abilities of these aquifers . Groundwater of this region is spreading along three directions . The inner regions on the East , the sea on the West , and the vallies on the south .

The water is discharged through hundreds of continental springs . The discharge varies between 2 litre/second (Bassit) and 23 M³/second (Fijah) . Also groundwater is extracted from thousands deep bores with depths not exceeding 250 meters , as found in the plains of Homs , Hamma , ElGab , Jableh ect...

2. Hauran Volcanic region :

This region is situated in south western Syria . It is formed of quaternary igneous volcanic rocks extending as an undulating plateau surpassing the Syrian-Jordanian borders .

Groundwater is retained in the cracked fissures inside the Basalt rocks . The maximum thickness of the formation is about 800 meters the quantities of water retained by the rock depends on the volume of cracked fissures and its permeability . Accordingly , the rate of extraction of water from the bores drilled varies greatly between 5-15 litres/second . Jolan hights , ElSheikh mountain and Arab mountain forms the main recharging source for this region . The groundwater movement is towards the south and south east directions where it is discharged into the Yarmouk river through a number a springs . These springs are discharging water from different topographic formations, the rate of water discharge varies accordingly . A large number of boreholes were drilled , reaching different depths and layers . The depth of the different boreholes varies between 20 meters (Gabagib) and 300 meters (Daraa) , This variability is attributed partly to the presence and spread of the cracks and whether these cracks are permeable and partly to the topographic nature and the hydrologic role of the sedimentary rocks found under the basalt layer .

3. The Syrian steppe region :

This region is situated to the east of the western and volcanic regions and extends till the Iraqi and Jordanian borders . The region includes upper Gezira , Badia , ElHamad and the Tadmeur series .

Groundwater is retained in the quaternary igneous rocks. This rocks are sometimes mixed with calcareous , marl and basalt . Water is retained at shallow depths which varies between 10-80 meters . The hydrochemical composition of water and its salinity varies greatly . In Damascus plains , there exists calcium bicarbonate levels reaching 500 mg/ litre of water . While sodium chloride with levels reaching 100 mg /litre is recorded in Dawa plain .

4. Northen plains region :

The region extends along the Turkish borders . It includes Aleppo and Northen Gezira plains . Its topographic and hydrologic formation is similar to that of the steppe region but it differs climatically, as the northen plains are receiving on the average 40-600 mm of rains annually . Also the region is characterized by an extensive hydrologic network and the areas of groundwater recharge extends inside the wet Turkish territories on the north and the north western direction .

Hence , a number of water retaining formation (layers) are found in the cracked rocks and the basalt rocks of quaternary igneous origin also on the cracked carbonate and calcareous rocks .

These layers are considered : the most productive water retaining formation in the country . The springs and the boreholes with depths ranging from 40-300 meters are discharging water at the rate of 6 M³/second (Ein ElAarouss) and 40 M³/second (Raas ElEinspring) .

It is recognised that in this area the quality and chemical composition of water differs greatly from place to another .

i.e on the northern parts we find calcium bicarbonate while on the south western areas there exists magnesium bicarbonate . The salinity levels varies between 250-510 mg/litre further north (Rass ElEin), while it is only 5-55 mg/litre around ElRad and Jaboul sites .

Accordingly , we can conclude that groundwater is drilled from layers not exceeding 300 meters . The other deeper layers are not yet studied to investigate the most probable water sites , quantity and economic feasibility of the drilling programme .

However , important information were gathered as a result of petrol and gas exploration . These studies indicated the presence of deeper groundwater at a number of regions in Syria . Information obtained from petrol deep bore drilled in Tanef region indicated the presence of pressurised 20°C good quality water at 410 meters . Also the petrol bore at Deedi region (north eastern Tadmur series) indicated the presence of artesian water formation with salinity levels of 800 parts/million at 1505 meters . The high pressure inside this borholderesulted in an artesian flow from 1.5 Km . Such characteristics were repeated in a number of petrol bores such as ElSalamieh (Hamma), Fedue (Lattakia) and Yarmouk basin . All these bores discharged water from deeper layers with high discharge rates and artesian flow . Such facts indicate that the springs which are found all over Syria and are discharging water with high rates ^{are} receiving their water from deeper layers and far distances .

Studies conducted by the Soviet and other experts indicated two important aspects regarding Damascus , Oranto, Aleppo and coastal basins :

1. All researchers emphasised the presence of large quantities of good quality water at deeper layers .
2. The basins of this water are extending throughout the region , there exists ground water movement in deeper cracking calcareous rocks that enable the free water movement from far distances outside Syria .

According to what has been mentioned studied should be continued to investigate the availability of deeper groundwater and to study ways and means of utilising such resource .

3-1-4- Summary :

According to statistics published Syria is considered as a country with limited water resources regarding the demand for human and domestic purposes , agricultural and food production and industrial needs .

- According to the geographical location of water resources Syria is subdivided into seven hydrological basins namely; Coastal , Aassi (Orantos) , Damascus , Yarmouk , Baradaa , (Aleppo - Euphrates), Tigris, and Khabour basins . The areas and the water resources of each basin varies greatly , also the utilization of the water available in each basin varies in relation to the possibility of its utilization and the reliability of the source itself . It ought to be mentioned that most of the basins and particularly that of Damascus , and Aleppo are considered as water deficit regions , a problem , that require solution , through the efficient use of the existing water resources, and exploring the presence of deeper groundwater sources .
- Although the total water resources of Syria are more than 80 milliard M³ yet, only 43.6 % are available for utilization . This quantity represent the discharge of rivers , springs and groundwater . The remaining 56.4 % is supplied by rainfall - The annual rainfall varies in time and space and within the same season . However the possibility of utilizing rainfall is very limited for the total surface run off is not exceeding 9 % of the annual rainfall .
- Rivers are considered the second water resources by quantity and the most important of all, for it provides reliable water sources that could be controlled , managed and directed to irrigate most of the agricultural lands , supply industries and satisfy human domestic needs. This is particularly related to permanently flowing rivers .
- The international rivers which are originating from neighbouring countries such as Turkey and Lebanon , are a very important source for Syria , for the annual discharge measured on the borders equals to 1396.7 M³/second . Out of which 795 M³/second discharged by Euphrates river and 580 M³/second by Tigris river . The remaining portion which is amounting to 21.7 M³/second is discharged by six small rivers originating in Turkey .

- The local rivers are originating in Syria and are almost completely utilized . There exists eight rivers , the most important being Kha-
bour river , this river discharges 34 M³/second annually , then comes
Barada river which discharge 6.5 M³/second annually .

- The local rivers are almost completely utilized for agricultural ,
industrial and human domestic purposes Utilization of this sources
are further improved through construction of dams to store flood
water . Storage of flood water will guarantee the availability of
water the whole year round .

- Groundwater comes third as a water resource , the total discharge
is about 5625 milliard M³ . 2.069 milliard M³ from spring sources
and 3.556 milliard M³ from boreholes .

Groundwater extraction is concentrated on the upper water retain-
ing strata .

The researches and studies conducted provided information about the
regional the presence of enormous quantities of good quality water
in deeper aquifer , ground water movements are flowing through deep
cracking and caristic rocks . The flow in this water is believed to
originate from long distances outside Syria .

Drilling activities on this strata proved to be economically feasible.
Althrough , more scientific information are now known , yet , deeper
ground water extraction is not developed due to insufficient technical
information and studies .

3-2- The Water Sector and Its Role in the Economical and Social Development :

3-2-1- The Water Sector and Its Role in the Development of Agriculture and Food Production :

The water sector plays an important role in the agriculture development and the supply of food to the population . Such an important role is indicated by the fact that the percentage of irrigated areas is 11.25 % of total arable area , and constitute 12.4 % of the cultivated lands (actually cultivated), 84.8 %⁽¹⁾ of the cultivated land is under rainfed production , the dependence of this area on rainwater is exposing it to the annual fluctuation and distribution which differs from season to the other and leads to a variability in the annual production and productivity of the agricultural crops .

The variability in the yield per hectare^{ia} attributed to the lack of modern technological inputs , also to the little use of improved agricultural inputs such as improved seeds and fertilizers . Such improved inputs respond well on irrigated lands when compared with rainfed areas . This fact proved to be true even in the first resettlement region ,where, the yield per hectare of rainfed wheat varied between 1.9 ton/h in 1988 and 0.8 ton/h in 1989 , such variability in fact has resulted from the good and well distributed rains of 1988 , contrary to what was the case in 1989⁽²⁾ .

Regarding the irrigated wheat in 1988 ⁽³⁾ the average yield per hectare was 3.9 tons , with such yield it seems that the deficit experienced in meeting the demands of the people for food is a result of limited irrigated lands , and the difficulty experienced to control 85 % of the cultivated area . Possibilities of increasing irrigated lands, the optimal utilization of the available water sources ; the efficient use of modern irrigation systems are among the most important issues in these period .

Sources : 1. Dr. George Somi et al : A Study presented to the seminar on the improvement of water management at the farm level-Damascus,1991

2. Statistical Abstract PP 110 .

3. Statistical Bulletin of the Ministry of Agriculture and Agrarian Reform 1990

As regards to the water requirement for the planned irrigated areas for the season 1990-91, the figures shown include the actual irrigated area together with the rate of agricultural intensification in each region . According to the studies conducted by the Ministry of agriculture and agrarian reform ⁽¹⁾ an area of 717653 hectares are irrigated by all different water sources. 281024 hectares irrigated by ground water, 335593 hectares by surface water and 101036 hectares by mixed ground and surface water sources. This includes areas irrigated from Damascus basin which is supplemented by water supplied by Barada and El Aawaj rivers. It also includes areas of the coastal region which are irrigated by the intermittent flowing rivers and boreholes. The areas irrigated by boreholes is estimated to be round 75% of the total area and the other is irrigated by both (mixed) surface and ground water sources.

Accordingly, water requirement to irrigate the estimated area for 1990/1991 season is about 10.3 milliard m³ with an irrigation efficiency of 60% for the whole country. This amount represents 47.4% of the total water available (discharged) from an average rainy season. The different sources of this water are 44 % of groundwater origin ; 27.5 % of surface water sources ; and 1.45 milliard M³ from both (mixed) source (ground and surface) . The required maximum discharge to meet the demand for all irrigated area as measured in July is equal to 594 M³/second ; 317 M³/second from surface water and 179 M³/second from groundwater and the rest from a mixture of both (surface and ground) .

The studies conducted by the Ministry of Agriculture have shown that :

1. The discharges of Gezira and Euphrates basins and their tributaries are representing 72 % of total country's discharges . The total area cultivated under these basins constitute 42 % of the total irrigated area in the country (Hasakeh 149 thousands hectares , Rakka 97 thousands hectares , Deir Ezzor 61 thousands hectares) . The projects directed to increase the irrigated lands are achieved by the dams constructed on these basins .

2. The water required and demanded for agricultural uses represents 83 % of the total discharge of the Damascus basin . 75 % of the requirements are supplied by groundwater . The total cropped area is about 96410 hectares , this represents the maximum area which can be irrigated under the prevailing methods of irrigation .
3. The water required to irrigate cropped areas represent 48 % of the total discharge of Yarmouk basin .
27% are discharged by groundwater , 65 % from surface water (Dams). This basin witnessed an expansion of drilling activities, hence, the total area irrigated by boreholes reached 8652 hectares .
4. The total water requirement for the irrigated areas represent 66% of total discharge of Orantos basin . This water is used to irrigate 16,1 thousands hectares out of which 21940 hecatres under permanent irrigation , 139.2 thousand hectares fallow , and 50 thousand hectares an intensification areas .
5. As regards to the coastal basin , irrigated crops requirement constitute 18.5 % of the total annual discharges . This actually represents the minimum water requirements in the country due to the small area cultivated , which is about 53,3 thousands hectares . 23.9 thousands hectares under fruit trees , 29.3 thousands hectares fallow and 25.7 thousands hectares as an intensification areas .
Due to the fact that the coastal region is blessed by the availability of water exceeding what is required for agricultural production , such fact , is reflected in a high degree of intensification , reaching 188 % , which the highest in the country .
6. Regarding the Aleppo basin , the crop water requirements is about 76% of the total basin discharges . The total area irrigated is about 96.8 thousands hectares . This basin is discharging limited quantities of water . Development and increase in irrigated areas depends on imported water from Euphrates basin .

Accordingly , it is recognised that water is playing an important role in developing the agricultural sector and for providing means to increase the irrigated areas and improve the productivity .

Moreover to promote the standards of livings in rural areas .

Actually , there exists a necessity to utilize the available water in both Gezira and Euphrates basin to increase irrigated areas and satisfy human needs by offering job opportunities and satisfying food demands .

3-2-2- The Role of Water Sector in Satisfying Human Demands for Potable Water :

The problems of satisfying human demands for potable water are drawing the attention of policy makers for there is an inherent fear of an expected future deficits in water supply , which might affect (decrease) the quantities available for human consumption .

Syria is considered one of those countries suffering from limited water resources . The per capita share of water is about 200 litre/day , while in some countries the annual share of water reaches 2000 M³ .⁽¹⁾

Inspite of the limited water resources the government exerted enormous efforts to supply potable water to all urban dwellers and to more than 80 % of the rural villages . It ought to be mentioned that the other villages are blessed with the presence of natural springs . Moreover the government priorities are directed primarily for satisfying human needs, then comes the needs for irrigation and industry .

The quantities consumed for human share and other domestic needs are estimated to be round 828 million M³ per annum (1984). This quantity is expected to increase to 1.2 milliard M³ by the year 2000 and to 2.2 milliard M³ by the year 2025 .

The different sources of the water used to meet the demands for potable water differs in space due to a number of factors such as the quantity of water resources in the basin and the population

Source : 1. Barakat Hadid : Water Hygiene and Quality and the Role of water in Development , Damascus , 1990 .

and their concentrations . This could be recognised by highlighting the following ⁽¹⁾ :

- The quantity of water in use for human and domestic share in Orantos basin is estimated to be round 149.945 million M³ . This quantity is expected to increase to 365.1 million M³ by the year 2010 .
- The quantity of water in use for human and domestic share in the coastal basin is estimated to be round 80.811 million M³ . This quantity is expected to increase to 192.5 million M³ by the year 2010 .
- The quantity of water in use for human and domestic share in Barada and ElAawaj basin (Damascus) is estimated to be round 257.822 million M³ . This quantity is expected to increase to 667 million M³ by the year 2010 .
- The quantity of water in use for human and domestic share in Yarmouk basin is estimated to be round 33.05 million M³ . This quantity is expected to increase to 118 million M³ by the year 2010 .
- The quantity of water in use for human and domestic share in Badia basin and is supplied from boreholes is estimated to be round 7.450 million M³ . This quantity is expected to increase to 27.9 million M³ by the year 2010 .
- The quantity of water in use for human and domestic share in Aleppo basin and is mainly supplied from Euphrates river and some near by boreholes is estimated to be round 192.45 million M³ . This quantity is expected to increase to 276.5 million M³ by the year 2010 . Such an increase is expected to be supplied from Euphrates river .
- The quantity of water in use for human and domestic share in Tigris and Khabour basin is estimated to be round 48.294 million M³ . This quantity is expected to increase to 115.8 million M³ by the year 2010.

Source :

1. Barakat Hadid : Strategies for Water Resources Development; An Emphasis on Long Term Planning , Damascus , 1989 .

- The quantity of water in use for human and domestic share in Euphrates basin is estimated to be round 58.309 million M³ . This quantity is expected to increase to 128.3 million M³ by the year 2010 .

According to the above mentioned we can conclude that human water share will be doubled in the coming 20 years . Such twofold increase is a result of population growth rather than improvements in the standards of water use for human purposes . The expected increase of potable water share in such basins like Damascus will limit water utilization for agriculture unless water needed for human and domestic share is supplied by other water basins.

3-2-3 - The Role of Water Sector in Satisfying the Water Demands of the Industrial Sector :

The demand for water by the industrial sector increased greatly during the last decade as result of the increase in water demanding industrial enterprises . This is indicated by the fact that, the demand for water by the industrial sector increased from 85million M³ in 1980⁽¹⁾ to 826 million M³ in 1989 . The quantities drawn for industries varies between the basins according to the location of the industries . For example , many industries are located in Hamma and Homs provinces , as such , the quantities of water drawn for industrial uses from Orantos basin represent half the total requirement of water drawn by the industrial sector in Syria . While in Euphrates basin the industrial sectors requires 300 million M³ of water . In Barada and ElAawaj (Damascus) basin , the third as regards to water requirements , the industrial sector requires 50 million M³ of water .

The remaining five basins their estimated requirement is about 63 million M³ of water⁽²⁾ . However , large portion of water used in industrial sector could be recycled and used again for other purposes .

Source : 1. Kassem Makdad et al: Water Resources and uses in Syria-Damascus - 1986 .

2. Most information are presented on table No. 8 .

Forecasts of future demands of water for industrial uses varies according to the estimates of the agencies conducting the different studies . It varies between 1276 million M³ by the year 2010 (estimated by the State Planning Authority)⁽¹⁾, and 2190 million M³ by the year 2000 (estimated by the Arab Organization for Agricultural Development)⁽²⁾ .

It is expected , that , on the long run , share of water for industrial purposes increase enormously in Euphrates basin to reach the highest share for this sector in the whole country . Followed , then, by Orantos basin , which now , is the first in the country .

3-2-4- The Demands and Trends of Water for Human Share in the Last Decades :

It was already mentioned that Syria is one of those countries suffering from limited water resources . It was also stated , that most of its water are of rainfall origin , surface water constitute only 9 % of the total percipitation annually .

Inspite of the importance of rains , the rivers, springs, and groundwater are the reliable water sources , which could be used in measuring the trends in changes of per capita water share during the last decades .

It aught to be mentioned that our calculation for per capita share neglected Euphrates and Tigris sources waiting for a final agreement with Turkey for sharing the annual discharges of these two rivers .

Sources:

1. The State Planning Authority : Water Resources Utilization .
2. Dr. Mustaff Jabali et al : Water Resources of the Arab Countries- Khartoum 1980 .

The calculations of the reliable water resources is based on data analysing the present , state of the agricultural and irrigation sectors for the period 1976 - 1989 . The data is then compared by the population for the same period and accordingly per capita consumption is calculated⁽¹⁾ .

As shown on table /9/ the water sources fluctuates annually in the country and in each basin separately . The variation in the annual discharge varies between 8790 million M³ (1979) to 11590 million M³ (1980) . The annual fluctuation is attributed to the levels of the annual precipitation which affects the rate of annual discharge of the springs and rivers .

Due the high rate of population growth and the annual increases in population , the per capita share of water demand decreased from 1320 M³ / annum (1976) to 791.7 M³ / annum (1989) . It is noted that there exist a decreasing trend in per capita share .

It is believed , that improving this situation depends on signing a treaty with Turkey to share the waters of Euphrates and Tigris and to guarantee a known shares for both Syria and Iraq. Accordingly an increase of per capita share would be expected , thus, offering chances for the economical development which is directly or indirectly affected by the availability of water .

As regard to the different basins , the demands of the water of coastal basin for human share is the minimum in the country. Per capita water share is about 1898 M³ / annum . While for the Barada and ElAawaj basin (Damascus) , a deficit phase , is recognised , the per capita share is about 486 M³ / annum, this figure, include all the different uses , human, agricultural as well as industrial. A fact requiring the search for other sources to supplement this deficit , either from deeper aquifers or other basins with surplus , such as the coastal basin .

Source : 1. See table No. /9/ .

As regard to Aleppo basin , it is noted that it suffers from deficits for long period . It is supplemented by water imported from Euphrates basin for human as well as irrigation purposes .

3-2-5- Summary :

Water is an indispensable factor for the socio-economic development of Syria , as Syria is part of the arid region which is limited in water resources . This fact is indicated by :

- The improvement and increase in agricultural production depends on provision of more water sources to the agricultural sector . It is known that by supplementary irrigation of rainfed land it is possible to use improved production inputs such as fertilizer, pesticides, chemicals and improved seeds . Such inputs have the effect of increasing the production and productivity four times as much in the irrigated land than rainfed areas . Also it enables a 200 % intensification when the needed water crop requirements are provided for summer crops .
- The problem of provision good quality water for human and domestic purposes are among the important issues of the policy makers . This issue is accentuated by the decrease of per capita share of water (200 litres/day) when compared with the developed countries .
- Due to the limited discharge of some of the water resources , industrial development is concentrated in certain provinces with ample water supply , as the case of Orantos basin . There , half the total industrial requirements of the country are in use . Also , in Euphrates basin , the industrial sector is utilizing 36.3 % of the total country's requirement for industries .
- The water requirements for agriculture and irrigation is estimated to be round 10.3 milliard M³ , representing 47.4 % of the total annual discharge of the country . This percentage varies between basins , for example (Damascus basin)83 % of the annual discharge of the basin is directed to agricultural uses , while its is only 18.5 of the discharges of the coastal basin .

- The water requirements for human share is about 828 million M³. An increase is expected in the coming decade to reach 1.2 milliard M³. The water used for human share varies according to the different basin, population, and water utilization.
- The per capita share of water declined during the last 15 years from 1320.1 M³/annum (1976) to 791.7 M³/annum(1990). This trend is affected by the high population growth rates and the decrease in quantities of water supplied by the rivers. A situation requiring new surface or groundwater sources. Also by negotiating agreements with Turkey to share the waters of the international rivers such as Euphrates and Tigris.

3-3- Policies Adopted by the Government for the Mangement of the Water Sector :

3-3-1- Policies for Industrial Developemnts and Manpower Management:

During the period before 1982 the responsibility of the water sector and the supervision of its activities was shouldered by a number of different ministeries and departments . The most important being the Ministry of Public Works , the Ministry of Euphrates Dam, the Ministry of Municipalities and Villages Affairs and the Ministry of Agriculture and Agrarian Reform . Each ministry was assigned special functions . Roles were dublicating , as such , the whole sector was lacking a central agency for its management .

According to the studies and investigations performed on the water sector and due to the rising needs for a specialised institution to shoulder the reponsabilities of the sector , the law No. 16 of 1982 initiated the Ministry of Irrigation . As such , this ministry was authorised by law to supervise and plan the activities related to the water sector . In the same time , to control , manage and supervise all the governmental corporations and departments working in the different activities such as irrigation , domestic and human consumption and industry .

One of the main term of reference of the ministry of Irrigation was to propose an institutional frameworks to identify the functions and roles and water related functions of the different corporations and institution working in the water sector .

The functions of the institutions as categorised in the institutional framwork of the water sectors are presented in the following:

1. Planning and Monitoring :

These functions are carried by :

- The Planning Supreme Council :

This council is presided by the Primeminister . The members includes Ministers in charge of the main economic and social sectors .

The council approve the water resource utilization plans as proposed by the State Minister of Planning . Planning Departments of Agriculture and Irrigation within the Ministry follow and moniter the

implementation of the plan approved .

- The Agricultural Supreme Council :

This council is presided by the Primeminister . The members include the ministers in charge of economic sectors related to agriculture. Also the President of the Farmers union is member of this council. This council according to the plan submitted by both the Ministeries of Irrigation , and Agriculture , approve the allocated quantity of water for the agricultural sector . The Ministry of Agriculture through its Irrigation and Water use Departments follows and monitor the implementation of the plan . The same department indentifies the crop water requirements , and the suitable rotation for the quantities of water allocated to the different crops in different seasons and regions .

2. Reconaisance Surveys and Researches :

The functions are preformed by a number of institutions .

- Water Studies General Company :

Initiated by the Ministry of Irrigation in 1983 . The term of reference of the company includes the technical studies of groundwater aquifers , optimal utilization of groundwater and to increase irrigation and land reclamation schemes .

- The Department of Irrigation and Water Resources, Ministry of Irrigation:

One of the departments of the Ministry of Irrigation . The term of reference of this department includes :

- The establishment of hydrometeorological networks for ground and surface water and provide the necessary components of this networks .
- Supervision , collection , processing , verification , analysis and publishing the hydrogical measurements released from the different hydrometeorological stations .
- Conduct studies and prepare preliminary outlines and maps delineating the basins and catchment areas of the different water resources such as the lakes , spring and dams .

- Evaluating the ground and surface water resources as related to the main and subsidiary basins . Preparation of the data regarding the annual and seasonal changes in these water resources .
- Appraisal of the existing irrigation projects and the investment on the water sector including all projects such as domestic water supply , industrial needs and agricultural demands .
- Water resource planning management as an integral part of studies conducted to organise utilization of the water resources discharged by the main and subsidiary basins .
- The economic studies concerning the returns of the irrigation projects and regarding water indenting procedures .

- Regional Irrigation Departments (Seven Departments):

The departments are under the supervision of the Minister of Irrigation , assigned a large area of supervision within the region (basin) ;such as establishing hydrometeorological networks , hydrological measurements , analysis of data and planning water resource utilization . these departments are fully delegated to manage the regions under their control .

- Irrigation and Water Use Department , Ministry of Agriculture and Agrarian Reform :

The term of reference of this department includes organising research in the field of (crop) irrigation so as to indentify crop water factors and water requirement by the different crops in the different regions . A number of research stations are supervised by this department .

3. Implementation of the projects :

Implementation is performed by the corporations and companies related to the Ministry of Irrigation . The most important being the General Company of Irrigation Construction , The General Company for Land Reclamation and the General Company for Water Projects etc....

These companies are implementing the water projects and especially irrigation projects .

Also , in each province the Ministry of Housing and Public Utilities is represented by a corporation for domestic water supply and

Sanitary drainage the terms of references of these corporations are the following :

- Preparation ,Co-ordination of the domestic water and sanitary drainage plans . Such plans are then submitted to the specialised ministries for evaluation . After discussion and appraisal by the Ministry of Planning , the plans are then submitted to the Planning Supreme Council .
- Implementation and design studies of domestic water supply and sanitary drainage projects at the provincial level .
- Operation , mangement , maintenance and utilisation of domestic water supply and sanitary drainage projects at the provincial level .

It aught to be mentioned , that the institutional development discussed above indicates areas of dublication as related to the functions and term of references . This in fact is recognised at the ministrial as well as at the provincial levels . A number of loopholes emerged which requires a remidy . The followings are the most important :

- Numerous institutions are involved in similar projects , a trend leading to dublication of the efforts and irrational utilisation of resources and technictions .
- The meagre technical , scientific and administration personel are scattered on numerous organisations . This , infact is reflected in the lack of competent experts needed to raise the standards of performance and achievements .
- The lack of a central agency to study and to unify the systems , suggests standards , identify basic frameworksfor reconaissance studies , designs , utilization and provide incentives for scientific research .
- The responsibility of the maintainance and utilization of dams and irrigation network is under the control of two different conflicting agencies such as Regional Irrigation Departments and the Ministry of Agricultureand Agrarian Reform Departments .
- Increase in the total expenditure as a result of large number of employees .

Although the state policy is directed towards training the necessary

scientific oriented staff in the field of water management , yet achievements in this filed is less than expectations . This fact is illustrated by the number of employees working with the Ministry of Irrigation , there are 2635 employer , 20 % of them(525) are of the technical staff . Only 9 %(250) are university graduates . The training of technicians is performed as a part of inservice training programs . Some are trained abroad , such training facilities depends on the availability of the necessary funds .

The working force of General Company for Water Resource Studies is about 866 employers . 67 technitians (7.7 %) . Technicians are well informed about their roles and activities .

As for the General Company for Construction of Irrigation projects, it employs 5656 , out of which 351 (6.2 %) are technicians .

According to the abovementioned , it is recognised that the technical staff working with the water departments are few in number , moreover, highly qualified technicians with specific narrow specialization in the field of hydrology are still lacking . Such a situation requires procedures to recruit highly qualified experts either through internal or external transfer .

3.3.2. Water Legislations Policies :

Since longtime , water legislation policies were directed by laws defining the basic legal principles . The detailed regulations following the basic legal principales are generated by the certain minister . Also , certain rules and minor details are released as a companian to explain the ministrial regulations .

The legislations applying to the water user rights , are known in Syria since the early period of the French Administration . The first water law(No. 144) was published in 1925 . This law stated explicitly , that all water resources invariably , whether are flowing over surface inside aquifers , all types of spring , lakes , irrigation

and drainage canals and ditches , and dams constructed over rivers are all publicly owned . All are publicly used and as such should not be sold or its legal ownership to beacquired as a result of preminent utilization for long periods .

- In 1926 decission No. 320 was published to control and maintain the public water sources . Also the same rule defined the procedures for utilizing this sources , liquidating theacquired rights and the judiciary and the penal code regarding penalties for water misuses.
- As the need for utilising rivers and boreholes for irrigation has became obvious and due to the lack of the basic legal principles controlling the useof such sources , the water Law (No.163) of 1958 was published . This law defines the utilization aspects of water resources for agricultural production . The law covered the procedures for utilizing surface water and extraction of groundwater, procedures for legal drilling of boreholesand pumping machines . The law restricted the pumping of public water unless an approval is obtained , also drilling to any depth is allowed only on the approval of the department defined by the law .
The Ministry of Public works and Water Resources is identified by the law , as that ministry responsible for the setting of the maximum quantities of water that could be diverted from any regional basin , the total areas to be irrigated , the terms that should be followed on extracting groundwater and conditions protecting misuse of groundwater . All departments and corporations exploring or drilling groundwater should submit to the ministry of geological and hydrogeological data and profiles .
The Ministry of Public Work and Water Resources published a number of regulations for the application of the water law . The regulation covers legel approval for water pumps installed on rivers and boreholes , defining the quantities of water allocated to the agricultural schemes , forbiding water diversion from springs and some regional basins such as Damascus basin .
The need for storing flood , surface and rainfall waters to be used during draught periods , necessitated the publishing of the law No. 3 of 1972 . This law regulated the establishment of small and medium

sized dams for storing flood and surface waters . The water stored by these dams are then used for human consumption , livestock , development of pastures , and forests , for fighting fires, creating water lakes in Badia , increasing irrigated areas through irrigation networks and drainage ditches , control floods , protecting soil from erosion , aquacultures , replenishing groundwater aquifers and for electric generation .

The law identified aspects related to planning, studies , designs , finance and implementation of dams projects . Also, such aspects like land ownership rights , the rights of extending irrigation canals across private lands , and water charges for landowners benefitting from the dams .

- According to the law No. 16 of 1982 , a Ministry of Irrigation was initiated , all the functions regarding water resources , which were assigned to the Ministry of Public Works and Water Resources (now the Ministry of Buildings and Construction) , are transferred to the Ministry of Irrigation . The responsibility of enforcing the laws and regulations on water resources are transferred to the Ministry of Irrigation .

According to what was mentioned , it appears that the water legislation policies in Syria is based on a variety of laws , regulations and rules that control the water sector in such a way , that each law governs an individual aspect or more of the water sector .

It is also recognised , that most of the laws are controlling the irrigation sector and regulating its activities . As regard to the industrial sector it is controlled by general regulations included in the decision No. 144 of the year 1925 and the decision No.320 of the year 1926 which were previously mentioned . Accordingly , efforts should be directed towards revising the laws mentioned aiming for legislative change or improvement and reconsideration of principles , so as to unify, water legislation into one law for water resources , that caters for such resources, whether surface or ground , their quantity and quality. In addition , it should identify relations , rights and basic principles regarding the use of the water resources .

3-3-3- Policies Regarding Dams Construction for Water Storage and
Improving the Utilisations of these Dams :

Since the early seventies , the government increased dams construction as a storing facilities for floods and surface run-off and rivers and winter flowing streams . The targets were directed to construct dams for several purposes such as irrigation projects or for annual production or to replenish groundwater aquifers or to satisfy human consumption or for electric generation etc ... or to meet the demand for more than one target whenever conditions of the water resource permit .

The dam constructed over Euphrates is one of the earliest projects executed following the same line of thinking . There exists a need to store the waters of the river and to tributaries during its flood period and to use the water stored so as to irrigate new lands, to generate electricity , to satisfy human consumption , to control flood hazards and for fish production . Then needs also arose for the construction a number of small dams in Badia Region to provide water for livestock . The livestock in Badia region were suffering from shortage of water also the number of wells are few and scattered . Then , the policies of the government were shifted towards new targets aiming at storing all the readily available water sources and to improve the existing ones .

Dams are subdivided into three type according to its importance and storage capacity :

- Large dams :

This includes Euphrates , 6 Tishrin dams . The storage capacity of these dams is exceeding 10 milliard M³ .

- Medium Dams :

Such dams are of storage capacity exceeding 50 million M³ . It is usually constructed on the bigger rivers and streams in regions with heavy rainfall . Stored water is used for irrigation , electricity generation and other purposes .

- Small dams :

Those dams are of storage capacity less than the medium dams . It is usually constructed on smaller rivers and streams that are discharging smaller quantities of water . The storage on this dams depends of the intensity of the rainy season and the flowing duration of the streams. Hence , the planned storage capacity is always less than the actual , while some of this dams remain empty in some seasons as the case of the Badia Dams .

Dams are also subdivided according to their functions⁽¹⁾. There are single purpose dams , dual purpose and multi-purpose dams .

- Single Purpose Dams :

This are dams constructed for a single purpose , either for irrigation (32 dams) , or for livestock(34 dams) . Also dams are constructed for diversion of the flow of streams or , to replenish water for ground-water aquifers(2dams) . Large numbers of single purpose dams are found in Badia region .

- Dual Purpose Dams :

This dams are constructed to fulfill two functions simultaneously i.e flood control and irrigation (14 dams) , or irrigation and fish production (14 dams) , or irrigation and human consumption (23 dams) or irrigation and livestock (16 dams) . This type of dams are the second as regards to number of dams .

- Multi Purpose Dams :

This are dams constructed to perform several functions such as irrigation , electricity generation , human water needs and ect.. Although, this type comes third as regard to the number , yet , it is rated as first in relation to its economic and social importance .

Actually , the total of dams constructed by the end of 1990, are about 133 dams . The total ⁽²⁾storage capacity is about 14041.6 millionM³ .

Sources : 1. For more details please consult table No. 9
2. For more details consult table No. 10

In 1974, there were only 55 dams , storing 12586 million M³ of water , in 1978 the number increased to 67 dams storing 12659 million M³ of water (1) .

During that period , efforts were directed for the construction of small surface water dams . This has led to an increase in the number of dams . Such small surface dams are relatively cheaper and generate the greatest benefits .

3-3-4- Policies Directed Towards Improving the Environment and Com- pating Pollution :

Since the early seventies , governmental efforts were directed towards maintaining a good quality water to be used for a variety of uses .

A specialised department to combat water pollution was initiated and affiliated to the Ministry of Public and Water Resources . The term of reference of this department includes , investigation of rivers , springs , seas , and boreholes for pollution . The department can carryout the necessary procedures to combat pollution and can also check sources of pollution inside the industries , enterprises and any probable sources . Also , have the right to give instructions to the officials responsible in the different industries to carry the necessary preventive long term procedures that could irradiate sources of pollution .

Legally , combating pollution was first to appear in special articles of water fauna law No. 30 published in 1964 . Article No.22 of this law forbid the drainage of industrial and laboratoties harmful sewage into public water resources . The same law alsoforbid the drainage of chemical and petroleum materials from sources such as sewage networks and ships into water resources . It is indicated that , concerned parties should follow procedures that keep public water clean and healthy .

Source : 1. Arab Organization for Agricultural Development : The
Prevailing Status of Syrian Water Resources ,Khartoum1980.

The construction of industries , laboratories and designing of petroleum or chemical material pipeline near by water resource requires an approval from the Ministry of Agriculture . The approval lists the procedures which should be followed to protect water sources from possible pollution hazards .

Contamination of the water resources are among the important issues of the State Ministry of Pollution . Together with the Ministry of Agriculture published a number of regulations concerning treatment of drainage water produced by industries and Petroleum Refineries . The regulation emphasised the necessity of treating drainage water produced by these industries before diverting it into water canals . In spite of the general policy of the government which put more emphasis on the protection of the environment and particularly water resources and basins from contamination , pollutions hazards are becoming great.

Actually , Orantos(Aassi) is one of those basins suffering from increased pollution hazards . The main source of water in this basin is Orantos river , a number of pollution sources are traced along the river banks , the most important of which being , the by products of fertilizers industries nearby Homs province ; Homs town sewage system . Also agricultural drainage systems flowing into the river without being treated is a dangerous source of hazards for human health . As such contaminated water is used to irrigate vegetable which are consumed fresh . Also all the sources of pollution are flowing into the existing lakes which is also polluted by the rivers as such raising pollution to levels that can not be treated .

As regard to Damascus basin , Barada river is seriously polluted during summer when the river is at its minimum flowing speed. As this river is considered one of the most important factors that support agricultural production in Damascus , then contamination of the rivers by industrial by products and other sources will limit the use of such polluted water for any other purposes .

Aleppo basin is suffering also from pollution ,especially Aleppo town . As the case of Damascus , the lands at the country side of Aleppo and which are cultivated,are mainly irrigated by sewage water . Formerly , Quieq river originating from Turkey was used for irrigation, but the river started to dry up .

As regard to the coastal , Yarmouk , Badia , Tigris and Khabour basin , pollution hazards are still under control . The waters of these basins are considered clean .

Agriculture drainage system is considered the only source of pollution in the Euphrates basin . Euphrates is considered a clean river .

Policies of the government are giving priorities for constructing water treatment stations in the major cities , especially Damascus , Aleppo , Homs and Hamma cities , analysis of lakes and rivers waters for measuring levels of pollution . The State Ministry of Pollution are coordinating the efforts of the Ministry of Irrigation and Local Administration to achieve the plans proposed for this sector .

3-3-5- Policies Regarding Optimal Water Use and Increasing the Efficiency of Irrigation :

Policy maker within the water sector are paying special attention to the problems of optimal utilization of the water resource. Such a trend is motivated by the limited water resources on one hand and to the increasing water deficits of some basin on the other hand . Some basin are , in fact , unable to supply the allocated requirements to the different sectors .

As it is obvious , that the agricultural sector , is the largest user of water (86.1 % of the perennial sources) , then , optimisation in water use is directed towards this sector . As such , efforts will be directed to investigate the irrigation problems and to identify areas of water losses . Then to act promptly in solving such problems and to carry the necessary procedures for improving methods of water use , especially in agriculture .

Water losses are identified in the following :

- Irrigation networks are considered as the main source of water losses. It is known , that the efficiency of irrigation networks are not exceeding 75 % , while it is only 60 % in most of the agricultural schemes . However , within such 60 % efficiency , the agricultural sector water requirements is about 10.3 milliard M³. Such requirement is liable to decrease by 20 % when the network efficiency increase to 75 % , which means that the total requirements decrease to 8282 millions M³, hence , it can be stated , that improving the efficiency of irrigation network by 15 % will release 20 % of the water allocated for agriculture .
- Neglecting the facts that some crops are water demanding is leading to the depletion of water from basins suffering from water shortages and accumulate deficits problems of such basins .
As such it would be necessary to redesign the crop rotation in each regional basin so as to optimise water use . Also supplementary irrigation is recommended for regions deficient in water supply . Moreover , it is advisable that rotations should include those crops which can be adapted to the prevailing climatic conditions , environment , soil , water supply , water salinity levels , labour , mechanisation needed . Hence , the choice of the certain crop in a certain region would be a result of a selection from different alternatives based on the interaction of several parameter aiming at the choice of crops yielding the maximum economic returns per unit land and water .
- The high percentage of rain water flowing as a surface runoff as found in the coastal region is a form of water losses which is directly flowing into the sea . As such storing such water in dams and diverting the water stored to uses in other deficit regions is an important area of investigation .
- Improving irrigation methodology is an integral part optimal water use. Surface or basin irrigation is the irrigation method practised all over Syria . Excessive irrigation in the absence of well designed drainage network causes the rising of water table levels leading to salt

accumulation on top soil . Such salty conditions leads to the deterioration of soil .

Drip irrigation is considered as the most economic method in water use . By using drip irrigation consumption of water is reduced by 45 % . While sprinkling irrigation reduces 20 % of water used .

Surface (basin) irrigation is the most consuming irrigation method, in such methods 50 % of water is lost during irrigation .

3-3-6- Policies Regarding Economic Aspects of Mangement and Investment in the Water Sector :

The state consider the water sector as a public sector and a natural resource , that sould be utilized efficiently and wisely ,in a way , to develop the other economic sectors so as to increase the rate of economic growth .

Accordingly , all legislation published since the independence of Syria , emphasised on this issue , and ascertained the role of the state in shouldering all the financial burdens needed to execute water projects , for irrigation , human consumption etc.. Also , the state finance the development of water resources as well as constructing dams and etc ..

Citizens are allowed by law to utilize waters of rivers , lakes and ground sources without paying any charges . Moreover citizens are allowed to develop their own irrigation schemes and may be granted soft loans by the Agricultural Bank . The terms of the loans and the interest paid are very soft . Loans granted are used for drilling or pump installation on rivers , boreholes or other available water resources . Formerly , water charges were paid by water users to drinking water companies . Actually , those companies used to develop and construct those water schemes .

Since 1970 , decisions to build dams for water storage and to develop gaint government irrigation schemes were taken . This was actually motivated by the needs to achieve large investments in certain regions .

Also , it was recognised that cost recovery plans should be adopted to recycle the money invested in other irrigation projects. As such , the government decided to collect charges for the different agricultural , industrial or domestic water uses .

The law No. 46 of 1972 was the first legal act following the new policies of water charges that should be paid by water users of governmental projects . A nominal charge of LS 70/ hectare was to be paid plus LS 5.0/ hectare for energy , maintainace and operation of the irrigation network . Such a figure , actually , constitutes a very small portion of the actual cost of water . It may represent only the interest rate calculated for the governmental investment in the water sector .

Due to the decrease in the purchasing power of Syrian money (Lira) and to the inflation and rising cost of irrigation . The law No. 19 of 1989 was published raising the annual water charges to LS 1075/hectare plus LS 200 /hectare for energy maintainace and operating the irrigation network .

Also the legal act No. 128 of 1982 was published regarding water charges to be paid by the users of medium and small dams . This charges are LS 1075/ hectare annually .

The Agricultural Supreme Council decided a unified land reclaimed charges. A fee LS100 thousand/hectare has to be paid in a 30 years equal installements .

As regard to domestic water supply , a legal act was published initiating a public domestic water and sanitary drainage corporation in each province . These corporations are now in charge of all the activities of domestic water supplies and investments in such field . The Minister of Housing published the decision No.3072 of 1990 regulating investment procedures in domestic water sector and also indicating the domestic water charges according to the following categories :

<u>Monthly consumption</u> M ³ /month	<u>Charges LS/M³</u>
1-20	1.25
20-30	2.0
30-60	5.0
60 and more	6.0
Government Department	3.0
Industrial, Commercial and touristic consumption	8.0

A unified monthly charge of LS 36 has to be paid by each category as a contribution in the maintainace of the public water supplies network .

By investigating the water charges discussed above certain facts arose and is explained in the following :

- The water charges /hecatre and the maintainace and operation fees are of a nominal nature , and could not be compared with the high cost of supplying water . In the same time , by paying such small charges , it will not be possible to convince users, especially , those using water for irrigation , to economise their water uses . Also users will not be inclined to use modern water economising irrigation methods , methods that also improve and increase production .

- The reclamation charges discussed before is approximalely equal to the average relamation cost per hectare . This cost includes leveling , irrigation and drainage networks. Owner of the new lands are paying this charges with easy terms extending to thirty years without paying any interest rate . Hence , the annual installement paid by the owners is actually equals to one third of the interest calculated for the total investment on the reclamation per hectare .

The legal acts does not charge any ground water extraction fees whatever the quantities extracted or depth attained.

- Irrigation charges are based on area irrigated and not on quantity of water used . Such accounting method leads to over consumption and water losses .

Accordingly , the cost of irrigation per unit increased in the government irrigation schemes when compared by the other schemes. The cost of one irrigation per hectare⁽¹⁾ (600-700M³) , as calculated by the government schemes , was found to be equal to LS 1330 . While it is LS 726/ one irrigation / hectare for pumping from surface bores, and LS402 /one irrigation/hectare for ground water schemes and LS 216 for pumping from rivers .

As field crops requires on average 5-10 irrigations, it is quite obvious , that land owners are paying only 20 % of the real irrigation costs .

Accordingly , the water charges and rates adopted should be revised in the direction to increase this charges to a level covering at least the real irrigation costs . Also , this charges should be based on the quantity of water used and the area irrigated .

3.3.7 . Policies for Data Base Building and Transfer of Technology :

Data base building is becoming increasingly important in this era, it provides the necessary information for preparation of the socio-economic development plans . Also , it identifies areas of possible defaults . Moreover , it explores possible pathes to future actions .

Although the state decided to introduce information sytem as part of ministerial and departmental activities , yet , progress in this area is still rudimentary . In the irrigation sector , the technical hard and soft ware as well as the needed technicians to run such data base systems are lacking .

Transfer of technology in the field of agricultural irrigation became one of the important issues due to the possibilities it offers for improving and increasing production on one hand , and

Source : Dr. Nahi Shaibani : The economics of water utilization in the irrigated sector of Syria - Report - Damascus 1991 .

to the role it plays in optimal use of water and expanding irrigated land on the other hand .

To disseminate the new technology in the irrigation sector a number of research stations were initiated to undergo researches in methods and means of modern irrigation . Then choices of suitable methods to each region in Syria was selected , tested , adapted , and economically appraised . A number a seminars were organised on the subject matter , also field visits were arranged to the experts of modern irrigation techniques . Such activities were aiming at screening the best , suitable irrigation techniques that could be used in different regions .

Accordingly , the department of irrigation and water use of the Ministry of Agriculture and Agrarian Reform , was delegated to extend new irrigation technology to the farmers . This is to be persued after the water crop requirements in the different climatical regions are identified . Mathematical models relating each crop to the pedological and climatical conditions need to be constructed . Also investigating the possibilities of adoption of these modern irrigation methods by the farmers and whether they can use it efficiently .

The FAO experience in modern irrigation technology was followed by the syrian government to transfer such technology to the country . An agreement was signed with the FAO to improve the methods and means of irrigation as practised by the farmers . The agreements provide the farmers new irrigation systems such as drip and sprinklers networks aiming at improving the methods and means adopted by them . This systems are bought by farmers with medium term loans to be repayed by the end of 3-5 years . Also the terms include training of the farmers to know the technique , install and operate the system . Moreover the experts supervise the daily running of the new system till the farmer proves his ability to operate it efficiently .

The Agriculture Supreme Council considering the problems of regions deficient in water resources and aiming to conserve these resources and to economise water use in such regions , decided to

introduce modern irrigation techniques in the water deficient regions. The council ordered all landowners to adopt the modern techniques (drip and sprinkling) and to abandon the old (basin irrigation) water consuming techniques .

The Agricultural Supreme Council also decided to provide the farmers with easy term loans for the purchase and installation of modern irrigation techniques . The agricultural Bank was involved in the implementation of such decision and was asked to provide the necessary funds .

Although , the government is involved in the improvement of the methods and means of irrigation , yet , the governmental irrigation schemes are still using traditional techniques . A fact denoting that the modern irrigation techniques are practised only by the private sector on farms irrigated by groundwater . Nowadays , the areas using modern irrigation techniques in the existing projects are not exceeding 1 % of the total irrigated area of Syria ⁽¹⁾ . The syrian authorities gave more emphasis for the use of modern irrigation techniques for projects under implementation .

Source : 1. Dr. George somi ; previous source .

3-3-8-Summary :

The policies adopted by the government for the management of the water sector stressed on the following :

- The institutional set up of the sector was supported by the initiation of the Ministry of Irrigation which was assigned the responsibility of managing the water resources according to the plans approved by the Superme Council of Planning and the Superme Council of Agriculture . Also the institutional framerwork of the water sector was approved identifying the functions of the different departments and corporations.
- The water laws were revised , amended and improved to include fields such as supervision , investments and fees that should be paid . Efforts were directed towards unifying the water legislation into one effective law , that caters for the rights and the basic principles regarding the use of water resources .
- The government decided to increase the rate of dam construction so as to store flood waters and to organise its utilization for the purposes planned . 133 dams were constructed storing 14041.6 million M³ . Euphrates dam is the largest dam constructed and is the most beneficial due to its multipurpose functions , which include electricity generation , agricultural irrigation , industrial use , in addition to human domestic consumption and fisheries .
- The responsibilities of the pollution department were increased to include investigating the causes of pollution . The department is authorized to carry the necessary procedures so as to irridicate the causes . Priorities were given to install water treatment stations in large cities and to carry investigations on rivers and lakes waters .
- Water losses were given great attention by improving and maintaining the irrigation networks being the main source of the losses . crop water requirements are identified . Rotations are designed to suit the available water and facilities .

- The government considered that water resources are publicly owned, citizens should not pay for utilizing these resources . The government is shouldering the responsibility of constructing dams and irrigation networks, Those benefiting from governmental irrigation schemes are paying nominal charges per hectare to cover the cost of operation , maintenance and the fuel used . The charges do not include the cost of water .
- Also landowners of the reclaimed land are paying reclamation charges per hectare . These charges are approximately covering the actual reclamation costs . The charges are collected annually and paid in 30 years installements .
- Asregard to the introduction of modern irrigation techniques , the government is encouraging the farmers to adopt modern techniques, as such method contribute in the efficient water utilization and economize water use and increase production and productivity. The required funds for the purchase of modern technology is provided by the government as easy repayed loans .
- Such policies to produce good results requires the improvement of the irrigation networks and the increase of the adoption rate of the modern irrigation techniques and to disseminate this modern systems in the sector as a whole .

3.4. The Government's Strategies to Develop the Water Sector :
Analytical frame works :

3.4.1. Improvement of Irrigation Techniques :

Traditional irrigation methods are used in syrian agriculture . As such basin irrigation is practised since time immorial. It is practised by farmer because it is cheaper and easy to achieve, moreover it does not require high skills or advanced technology . 99 % the country's areas are irrigated by traditional methods .

This irrigation system is supplied by water through pumping from boreholes and rivers , 80 % of the total irrigated areas are irrigated by such method . The governmental irrigation networks are supplying water to 20 % of the total irrigated areas⁽¹⁾ . This networks are found in the following basins :

- Damascus basin : the irrigation network of Barada and ElAawaj .
- Orantos basin : The irrigation networks of Homs and Hamma , the network of ElGab plain and Aacharina and the network of ElRoug .
- Coastal basin : The irrigation network of ElSin .
- Tigris and Khabour basin : The irrigation network of Tal Moughas .
- Yarmouk basin : The irrigation networks of Yarmouk and El-Mizerib

All the abovementioned irrigation networks were constructed before twenty years . Investigations of the existing networks indicated that their efficiency is not exceeding 60 % . Actually this means that 40 % of the water losses are resulted from the basin irrigation , also it indicates that high levels of losses might be linked with the main canals and field channels . Hence , this leads to a reduction in total crop water requirement flowing into the system which is less than the actual requirement calculated . Thus , the water received by the crops are less than the requirements calculated . Moreover , the total water allocated as per crop water requirement might be in the range if 30-60 % of the total quantity needed to irrigate a certain area .

This is further illustrated by the fact that the water allocated to the tell Moughas irrigation network is 1.15 L/second/h while the actual quantity is 0.5 L /second/h . For homs network the allocated is 70.7 L/second/h and the actual is 0.35 L/second/h .

As regard to the Yarmouk network the allocated quantity is 0.78L/second/h and the actual is 0.45/L/second/h . Such reduction in the allocated quantities is attributed to the inefficiency of the irrigation network .

The limited water resources and the increasing trend of water utilization for different purposes encouraged the government to improve the existing irrigation systems by adopting modern methods such as sprinkling and drip irrigation , especially , on newly developed schemes .

The different governmental institution adopted these new directivities according to the following :

1. Conducting technical and economical studies in the field of modern irrigation methods . Such studies are performed in a number of research stations representing various habitats and regions. The targets of such researches is to know the best method that suits a certain region and/or environment .
2. The studies of the new land reclamation projects should include , whenever possible , modern irrigation techniques when designing the irrigation networks. Also , modern canalisation systems should be constructed in all new irrigation projects . Construction of coveredfield channels should be linked with the availability of the needed funds and the special conditions of each individual project.

These modern agricultural irrigation technique are now executed in an area of 38600 hectares , 10400 hectares in Upper Yarmouks and 1200 hectares of vegetables in Yarmouk; and 12500 hectares cropped in 16 -Tishrin irrigation project , and 14500 hectares in Khabour irrigation project .

Also other studies concerned with the improvement of irrigation techniques are applied in some areas with a total area of 85000 hectares . These studies recommended the introduction of modern irrigation method in the following projects :

- Irrigation of Pinus in Lattakia , 1500 hectares .
- El Bouqaia and Akkar plain irrigation project 23000 hectares (Tartous).
- Afrin irrigation project 30000 hectares , Aleppo .
- ElGab development project 21500 hectares .

Undoubtedly , the directives adopted by the government aimed to introduce modern irrigation techniques in the newly developed projects . Also it encourages the cultivators to adopt the best irrigation methods available .

However , the large scale adoption of the modern irrigation techniques , which has become a necessity , requires several procedures and regulations which should be followed . Such as the initiation of a national industry for modern irrigation equipments and parts . Encouraging enterpreneurs interested to invest in such field . Also the government should encourage foreign investors to manufacture such equipments in the country . Also the government should supply the foreign exchange needed by the local enterpreneurs for the purchase of the raw materials needed for the local production of the modern equipments . The provision of the foreign exchange is for the promotion of the local production at the initial stages , when those innovators are manufacturing for the first time and possessing no foreign exchange surpluses for the purchase of the raw materials .

The private sector introduced modern irrigation techniques long time before the government , it was a result of individual innovations in the early sixties . As a result of the governmental efforts to introduce and encourage individuals to adopt it , the rate of adoption by individuals increased and it was introduced in the irrigated schemes along the rivers and ground water sources .

The privately owned areas which are irrigated by modern irrigation methods are about 1500 hectares (irrigated by drip irrigation) and 2500 hectares (irrigated by sprinklers) .

3-4-2 - Agricultural and Sanitary Drainage:

Agricultural drainage systems started to attract attention during the late seventies , when its importance was realized as a remedy for draining excess water from fields and as a measure to lower ground water table . The traditional(basin) irrigation method and earth canals lead to the percolation of large quantities of water into the soil , causing the ground water level to rise , and dissolving salt which on the evaporation of water from the surface of ground appears as a salty crust on the top soil .

Such problems appeared in the Euphrates basin and caused to the retiring of large areas of productive lands (about 5000hectares annually) . This caused a reduction in the irrigated areas from 671.2 thousand hectares (1963) to 450 thousand hectares (1970)⁽¹⁾ .

When this problem became very serious , the government decided to construct drainage network with any irrigation system planned as a measure against the problems associated with basin irrigation .

Also , all areas suffered from salinity problems were investigated so as to propose plans for solving the problems and reclaiming land retired due to increasing satinity .

Although , salinity is avery serious problems , yet , the efforts , for reclaiming those areas affected by salinity and was retired from production , are insignificant and did not achieve any known results.

Agricultural drainage networks were constructed in 90 % of the new irrigated agricultural projects . Open networks were executed in the major and minor drains . 5 % of the field drainages channels were covered . Covered drainage networks are still under technical and economical studies .

Source : 1. Central Statistical Bureau: The Statistical abstract. for 1976 - Damascus .

The drainage networks executed were accompanied by a number of environmental problem that might bring disasterous effects in the future , major problems include :

- All drainage networks are flowing into the rivers , such attitude is polluting the rivers and raising its salinity levels especially during summer and autumn when the rivers are flowing with the minimum speed .
- Some farmers are using the drainage water to irrigate their crops . The high salinity levels of this drained water will actually harm the soil . Such problem is associated with regions experiencing water shortages .

As such , farmers should be advised to use good quality water for the irrigation of their crops and to abandon the use of the polluted drainage water . Also measuring the levels of the pollutions levels in the rivers , especially that flowing in the agricultural drainage networks and propose procedures to solve such problem .

As regard to sanitary drainage network a number of networks were constructed in all cities and larger villages . The government is giving priorities for the installation of treatment station in large cities . Also investigation and measurements of pollutions in all lakes and industries is being catered for by the government .

Undoubtedly , more efforts are needed in the area of sanitary drainage , and installing more of the water treatment stations in cities and industry complexes , so as to treat the drained water before allowing it to flow into lakes and rivers . Pollution levels reached an alarming levels in some rivers like the Orantos and Barada . Such high pollution levels might harm the agricultural land and fisheries .

3-4-3- Hydroelectrical powers :

The energy generated from water resources is considered the cheapest sources of energy . As such , this kind of energy was used by the local people since time immorial to operate their flour mills and to raise water using (NAWAIER) from low lands to higher lands for irrigation .

Previously , some municipalities were using water falls for generating electricity and providing electric power for the consumers . When feul generators were introduced water energy was neglected as a source of power or electrical energy . The feul generators replaced the water energy because it is simple and easy to operate . As such , the number of mills using water energy decreased drastically . Also , most municipalities abandoned the use of water energy for electric generation . Moreover , the responsibility of generating electricity in the country is shouldered by a public corporation supplying 80 % of the total electric power of the country . Such electric power is generated by using petrol(fuel) .

One of the main targets of Euphrates Dams which was constructed in the early seventies was electricity generation . Eight turbines were built in the dam to generate 100 megawatt each . It was anticipated , at that time , that the electricity generated will be equal to 80 % of the electricity generated in Syria . Due to the decrease in the water resource of the Euphrates the electricity generated nowadays represents only 15% of the total generated.

It aught to be mentioned that electric generation is among the main purposes of the construction of Baath and Tishrin dams on the river Euphrates .

Also , the policies of the state emphasised , that electricity generation should be one of the main targets when constructing medium and large dams .

3-4-4- Summary :__

The government policies are directed towards improving the efficiency of water utilization in all sectors, especially in the agricultural irrigation sector which is considered the most water consuming in the country .

Also improving the existing traditional basin irrigation systems which is suffering from inefficient irrigation networks with 60 % efficiency , to a modern irrigation system which supplies the crop with it s actual requirement and economize water use .

Inspite of the importance of adopting modern methods of irrigation , the possibilities of large scale adoption is limited by the availability of the necessary facilities needed to convert the old systems to a modern one . Moreover the role of state in supplying the necessary foreign exchange for the purchase of the required equipment and parts sould be investigated .

The state encouraged the study and the development of the new irrigation projects along the modern irrigation techniques . As for the existing projects the studies and improvement of the irrigation system is governed by the availability of the needed funds .

More emphasis were given to the development of agricultural drainage networks and studies of pollution sources. Rivers were protected from sources of pollution, closed field drainage channels were tried in some projects to test its technical and economical feasibility .

As regard to sanitary drainage , priorites were given to the installation of water treatment station in large cities . Investigation and studies of the problems that may arise from the flow of waste and drained water into rivers and lakes became a major concern of the government .

The experience of the local people in utilising water resource as a source of energy is lossing it previous importance as a source of cheap energy . Only large and medium dams are now using water as a source to generate electricity . Formerly dams were supplying 80 % of the electricity generated in the country, this declined, at present, to 15% only .

4 . Regional Basins and Possibilities of Long Term Joint Development :

Syria is subdivided hydrogeologically into eight catchment basins . Three are local basins namely ; coastal, Aleppo and Damascus basins . The other five basins are regional and extending to neighbouring countries . These basins are recharged regionally and developed nationally by each country , such activities which are performed on the country level are affecting the whole region .

These regional basins are playing an important role to Syria , for the largest portion of the water sources of the country are supplied by there basins . As such any disturbances in the water discharged by there basins brings serious effects on the economy and the demography of the region and aggravate a number of problems which will not be easily solved.

The same effects are expected for the other countries benefiting from the regional basin . Actually , the friendly relationship between those countries might be affected . Also a complete depletion of this water resources might lead to losses of indispensable resource needed by the societies .

Hence treaties were negotiated and has lead the joint scientific and paved the way for the joint utilization of the available resources benefiting all countries of the region .

As regard to other regional basin which are not covered by regional agreements like Euphrates , Tigris and Khabour basins . negotiations have already started between riparian countries and hopefully a treaty will be signed to benefit the countries involved .

A brief account on the regional basins are shown below:

4.1. Badia Catchment Basin :

The basin is found in eastern Syria and bordering Iraq on the east and Jordan on the south eastern direction . The total area of the basin is about 70786 Km² , representing 40 % of the total area of the country . Average annual rainfall is about 138 mm . Average annual discharge of the water is about 345 million M³ .

The population of this basin is about 227.264 thousand inhabitants Hydrologically , this basin is subdivided into twelve subsidiary aquifers . Investigations have indicated the presence of numerous water bearing formations with varying water potentialities , with a total water discharge of 175 million M³ per annum .

Badia catchment basin is a regional basin including Hamad region with an area of 31650 Km² . Hamad region is shared by four countries namely ; Syria , Jordan , Saudia and Iraq . The total area of Hamad region is about 166 thousands Km² . The region is geologicaly and hydrologically homogenous .

The Arab Centre for Studies of Arid Zones and Dry Land (ACSAD) conducted a study concerning the ground water resources of the Hamad region . The study was financed by the Arab Fund for Socio-economic Development .

The study subdivided the region into five geomorphological units :

1. Hamad central plateau (Najed)

Representing one third of Hamad region , the area is extending along the southern borders of the project . The climate of the region is typically desert .

2. Harath plateau region :

One fifth of the area of this region is covered by basalt rocks. The area is extending from arab montain in Syria to Thayat mountain in saudia , parallel to the hamadcentral plateau on the west . The length of this region is about 350 Km and the width is ranging between 50-100 Km .

3. Wadi Sarhan region :

The area of the region is about 9000 Km² , extending from the eastern borders of AlAzrak basin in Jordan towards south eastern direction to meet the Saudi region of the Hamad Basin . The length of this region is about 300 Km and the width is ranging between 15-50 Km. The streams of the Jordanian plateau carrying all forms of drained waste are flowing into the region .

4- The Eastern and north eastern streams region :

Represents one quarter of the area of the basin . It includes all the streams flowing into Euphrates depression outside the basin .

5. The south western streams region :

Extending along the Saudi-Jordanian borders on the south western fringe . The region represents one sixth of the basin . It is also extending from Arab mountain in Syria . The climate is typically desert and semi-desert .

Water studies⁽¹⁾ conducted in the region indicated the presence of water in the first layers of water bearing formations in most of the depressions found in the Northern part of the region . Also enormous amounts of water are retained by the second layers of deeper water bearing formation in the western side of the basin especially in the depressions in the vicinity of the Arab mountains AlAzrak and Sarhan .

Groundwater movement was traced in the northern part of the region flowing to the north towards Sabkhat ElMouh (near Tadmor) . Another movement was recorded in the western and north western directions flowing towards AlAzrak (Jordan) . Another groundwater movement in the eastern part flowing towards Euphrates depression .

The basin is recharged through subterranean movement of ground water from one region to the other or from certain water level to the other as the case found in the north western region which is recharged by groundwater flow from the southern Palmira mountain range .

Also recharge may be indirect result of the percolation of the surface water flowing in streams or collected in forms of pools as the case found in the eastern streams regions .

Source :

1- ACSAD : Hamad Basin Studies , Damascus , 1983 .

As for direct recharge by rainfall it occurs only during heavy rainfall storms but this is rarely the case .

The importance of the groundwater sources of this basin and the necessity of conserving such resource induced the four countries concerned , to sign an agreement for the joint development of the basin . The plan for the development of the basin was prepared by the ACSAD and financed by the Arab Fund for Socio-Economic Development . The main activities of the projects as identified by the plan were directed for satisfying human drinking water needs and for the development of the livestock of the region .

As there are no rivers in Hamad basins , the plan was directed to the development of the ground and surface water resources of the syrian part of the basin . The main activities are presented in the following :

1. Drilling deep bores in the second layer of the water bearing formation in a selected sites with the main targets of provision of water for human consumption and livestock production . Surpluses of waters could be used for crop production .
2. Improving the natural ranges by spreading surface water through the use of earth dams . Thus storing the water in a large area allowing it to percolate into the subsoil and hence increasing soil moisture content .
3. Provision of drinking water by installing water sites (storage dams) in natural range areas or areas with dense population that are lacking ground water resources or lacking good quality water .

The agreement to develop Hamad basin by the four countries is considered as one of the best models of agreements on joint utilization of a regional basin shared by several countries .

4.2. Euphrates Basin :

This is considered as the most important regional basin for it is extended into three countries , namely ; Syria , Turkey and Iraq . The water resources of this basin is of great importance for the three countries .

Euphrates represents the second largest catchment basin in the region with a total area of 40830 Km² , average annual rainfall is 178 mm . The annual discharge is 26 milliard M³ which is mainly supplied by Euphrates river as measured at the Turkish borders . Groundwater is so meagre and has no significance . The population of the region is estimated to be 880745 inhabitants .

Aleppo basin is a subsidiary to the Euphrates catchment basin , is situated in north Syria , with a total area of 11155 Km² . The average annual rainfall is about 504 mm . The average annual discharge of the basin is 649 million M³ ; 303 million M³ of surface and springs origins ; 364 million M³ of renewable groundwater sources . The region is traversed by three small rivers , the most important are Queiq and Sajour rivers . The region is inhabited by three million persons .

The most important rivers of the Euphrates basin are :

1. Euphrates river :

Euphrates is one of the most important rivers of Syria , it originates in Turkey and flows across Syria and Iraq . The Euphrates river is considered the main source of water in the Euphrates catchment basin . The annual discharge rate of the river is about 26.8⁽¹⁾ milliard M³ as measured at the Syrian-Turkish borders . The maximum discharge is attained during April and the minimum during summer .

The Euphrates rivers plays an important role in the socio-economical development of the region for it is a perennial water source and the average share tentatively allocated for Syria equals to 12100 million M³ , a quantity twice as much that supplied by all other rivers of Syria . The river is irrigating 250 thousand hectares .

Euphrates dam was constructed on this river to store 12 milliard M³ of water and to generate 800 megawatt of electricity . An irrigation

Source : 1. Ministry of Agriculture : Report of irrigation methods,
Damascus , 1984

and a drainage network was constructed to irrigate 644 thousand of new reclaimed lands . Already 250 thousand hectares were under irrigation , the new plan aimed at improving their irrigation method and to provide the existing project with a drainage network. In spite of the importance of this river to many interrelated vital activities to the Syrian people , the discharge of the river is continuously declining as a result of expansion of the Turkish land reclamation projects which required more waters . The Turkish government constructed a number of dams to meet the demands of such projects .

Due to the trend of increased utilization of the rivers water by the Turkish authorities to meet the water demand of the new projects , the average discharge of the river as measured at the Syrian-Turkish borders started to decline from 1063 m³/second in 1982 to 698 M³/second in 1984 , to 559 M³/second in 1986 . Then it started to increase and attained 725 M³/second in 1987 and 795 M³/second in 1989. Such a trend indicates that the average discharge of this river is now only two third of its levels before six years .

In spite of the importance of the rivers to the countries sharing the same catchment basin , there exist no treaty to allocate the waters of the Euphrates among competing countries .

The Turkish government promised to release at least 500 M³/second of water as measured at the Syrian-Turkish borders . The same amount of water will be released annually as emphasised by the Turkish government till the date on which an agreement on the distribution of the Euphrates water will be negotiated by the two governments . Co-ordination between the countries sharing the catchment basin for the joint implementation of projects for the utilization for this water resource , especially , irrigation projects , might lead to an optimal use of this resource and reduces conflicts and problems that might arise from the implementation of isolated inter country projects .

It ought to be mentioned that the three riparian countries, especially Syria is totally depending on her share of water which is used to irrigate the already developed lands or which is under development

and reclamation , also some of the water is used to meet the human consumptive needs .

Syria constructed another dam (Baath Dam) down-stream below the Euphrates Dam with the main targets of storing the required quantities to maintain a constant flow that keeps the electric turbines of the Euphrates dam rotating and to use the same water again for generating electricity and irrigate more lands and to regulate the flow of water downstream . The storage capacity of this dam is about 300 million M³ and generates 75 megawatt of electricity .

Another dam is under construction at the Turkish borders(Tishrin Dam) with the main targets of generating electricity and storing water (1883 million M³) . The construction is expected to be completed by the year 1994 .

Undoubtedly , signing a treaty to distribute the discharged waters of this river among the three riparian countries taking into consideration their historical rights would pave the way for an accelerated socio-economic development activities in the region .

2- Sajour River :

Sajour river originates in Turkey with a total length of 108 Km , 48 Km of the river is flowing in the Syrian territories . It is one of the tributaries of the Euphrates river in Syria . The average discharge of this river as measured at the Syrian-Turkish border is 3.9 M³/second(1975) . The maximum discharge is about 33.8 M³/second as measured during full flood between April and May . The minimum discharge is attained during July (1.0M³/second) , this is infact the dry period .

The discharge of this river began to decrease during the last years as a result of the construction of water projects by the Turkish government . This had actually affected the average discharge which when measured in 1985 was only 3.1 M³/second and reached zero level during the dry period . The variability of the average discharge is affected by the intensity of rainfall and the rate of Turkish water utilization .

The Syrian government is planning to construct^a dam across the river to store the water during the maximum flow for irrigation and human consumption purposes . As such it is advisable that an agreement should be reached with the Turkish government to share the waters of the river by both countries so as to be utilized for the development of both regions .

3. Queiq River :

Queiq river originates in Turkey , the total length of river is about 126 Km , 110 Km are flowing in the Syrian territories . The average discharge is about 0.3 M³/second . In 1975 , it was discharging 3.1 M³/second . During years of good rains discharges reaches its maximum level of 60 M³/second as was recorded in 1988. The river plays an important role for Aleppo town . It is used to irrigate tangible areas cropped by vegetables . Also the water of the river is used for human consumption .

It is advised to negotiate a treaty with the Turkish government for the proper utilization of this resource for the benefit of both countries .

4.3. Tigris Catchment Basin :

This basin is situated on the north east Syria , with a total area of 21129 Km² . The annual water discharge of the basin is 2388 million M³ , 788 million M³ are surface water and 1600 M³ are groundwater . Tigris river is flowing across this basin and lining the Syrian-Turkish borders along 39 Km of its length , also it is lining the borders with Iraq along 5 Km of its length . Khabour river is also flowing across the southern fringe of this basin .

The basin is inhabited by 786.211 thousand persons .

1. Tigris River :

The river originates in Turkey . The total length of the river is

1718 Km . 1418 Km of the river is flowing in Turkey⁽¹⁾ . The annual water discharge of this river as measured at half the distance of its total length is 42.230⁽²⁾ milliard M³ . While its average discharge as measured at the Syrian-Turkish border is 580 M³/second which is equal to 18 milliard M³ by volume .

Due to the importance of this huge water source and as Syria is not utilizing it to the maximum possible extent , a number of studies were conducted to propose a development plan and projects for the reclamation of Tigris basin . The plan estimated an area of 150 thousand hectares for development . Malkia dam is proposed as a storage facility together with other dams .

The importance of utilizing the Tigris river in the north eastern regions of Syria , a region which is lacking water resources , and to divert water to this region , requires an agreement between the three riparian countries , to allocate shares between them . Such an agreement would enable all partners to utilize their shares in the planning of socio-economic development plans in their countries.

3. Jaghiagh River :

The total length of this river is about 124 Km , 100 Km of the river is flowing in Syria . It originates in Turkey . It is one of the tributaries of Khabour river . The annual discharge varies between 103 M³/second (1980) and 7.2 M³/second(1989) . According to the rainfall intensity and Turkish utilization its discharge might reach zero during summer .

The Syrian government is planning to utilize its water , a project for the development and reclamation of Khabour land will include this river in the over all plan .

Sources : 1. Wasif ElAssad & Abdel Aziz Ghadban - Tigris irrigation project , damascus , 1987 .

2. International strategic studies centre : USA foreign policies as related to the water resources of the Middle East, December 1987.

4.4. Orantos (Aassi) Catchment Basin :

Water sources of this basin originate in the Lebanese eastern mountains . The area of the basin is about 21624 Km² . The average rainfall is about 403 mm . The average discharge of the basin is about 2707 million M³ of water . 1110 million M³ are of surface water and springs and 1607 million M³ are of renewable groundwater arigin. The basin is inhabited by 2.32 million persons . It includes a number of regions namely ; Kalamoun , Homs , Hamma , ElSalamieh and ElGab . The river Orantos is flowing across this basin and is considered the main water source . Also Afrin river is flowing across this basin .

1. Orantos River :

The Orantos river is of a vital importance to the country . The total length of this river is about 571 Km measured from its origin in Lebanon till it flows into the sea at Alexandaron . 366 Km of the river is flowing inside the Syrian territories . The discharge of the river at the Syrian-Lebanese borders is about 6.5 M³/second . The discharge varies between a maximum of 10.6 M³/second and a minimum of 3.4 M³/second ⁽¹⁾ . This river is of great importance to Syria as it is flowing through a plain in which the water of the river is utilized to irrigate large productive lands .

A number of springs are flowing into Orantos such as ElDamamil , ElSamak , Eain ElTanour and Eain ElSukhna springs . The waters of these springs are used to meet the human domestic needs and to irrigate the agricultural lands in the area . The Orantos river is irrigating the agricultural lands along its both banks by means of a network of irrigation canals .

Although other riparian countries are sharing the water of Orantos , yet , there exists no conflicts about its utilization . Lebanon is unable to utilize the river due to certain difficulties . As regard to Syria , there exists historical rights concerning the utilization

Source : 1. Social and Economical Planning Institute : Water Resource at Hamma Province , Damascus , 1989 .

of the waters of the Orantos . Moreover the flow of this river is very weak during summer .

Since the early fifties the Syrian government started to construct a number of dams across the river to store the quantities discharged at its maximum flow . The most important dam is that of Katineh which is forming a 61 Km² lake and storing 200 million M³ of water and irrigating 12 thousand hectares . Also the other dam Rastan with a storage capacity of 250 million M³ , other dams include Mahardeh ,..... etc ..

2 : Afrin River and Tributaries :

The river originates in the Turkish territories with a total length of 149 Km , 49 Km are flowing in the Syrian lands . The average discharge of this river is about 4.4 M³/second . During the maximum flood average discharge reaches 15.7 M³/second , during summer it reaches 0.8 M³/second .

The variability of the flow of this river is caused by the intensity of the annual rains and the utilization in Turkey . This fact is shown by the measurement of the discharge of different years , in 1980 the discharge was 9.7 M³/second , in 1985 (8.6 M³/second) and in 1988 only 3.0 M³/second . A dam was constructed on this river to regulate the flow of the water and to irrigate 25850 thousand hectares and also to satisfy human demands .

4.5. Yarmouk Catchment Basin :

This is a regional basin jointly shared by Syria and Jordan. Most of its water sources originate in Syria . The basin is situated in the south western direction of the country , with a total area of 7500 Km² . The average annual rainfall is about 263 mm . The basin is bordering a mountain range , the most important features are ElSheik and AlArab mountains . The annual discharge of this basin is about 445 million M³ , 181 million M³ is of surface water origin and 264 million M³ of spring and groundwater sources .

The area is subdivided into five subsidiary basins ,
The population of the basin is about 650 thousand inhabitants .

- Yarmouk River :

The length of this river is about 57 Km , 47 Km are flowing across the Syrian territories . The average annual discharge of the river is about 7 M³/second during flood . This river originates from a number of springs flowing into ElMizaireb lake . A number of important irrigation projects were developed in this region utilizing the Yarmouk waters . The importance of this basin motivated the governments of Syria and Jordan to negotiate its joint utilization and development . An agreement was signed in 1987 to develop this basin and to organize its utilization for the mutual benefits of both countries . The activities include the construction of a dam on ElKarn stream to provide water for Jordanian (GHOUR) and for other uses .

4.6. Summary :

The regional basins are playing an important role to Syria, for the largest portion of the water sources of the country are supplied by these basins. As such any disturbances in the water discharged by these basin might bring serious effects on the economy of the country .

As these basins are also of equal importance to all other riparian countries , treaties were negotiated with Jordan , Iraq and Saudia for the joint development of Hamad basin .

- Euphrates basin is considered the most important regional basin and represents an essential water source for Syria . The Euphrates river is considered the mainsource of water in this basin . The river plays an important role in the socio-economic development of Syria , as it is discharging a quantity of water twice as much of that supplied by all the other rivers . Now, the river is irrigating 250 thousand hectares , also it is supplying water for the domestic needs of many cities and villages . Also future plans include the development of 644 thousand hectares to be irrigated by the Euphrates river . The discharge of the river is continuously declining as a result of the expansion of the Turkish irrigation projects . This has led to a decrease in the annual discharge from 1063 M³/second (1982) to 795 M³/second (1989) as measured at the Syrian-Turkish borders . Actually , such issue increased uncertainly and both Syria and Iraq became concerned and worried about future development and their historical rights . Actually , signing a treaty to distribute the waters of this river among the three countries would pave the way for an accelerated developmental activities in the region .

Tigris basin is considered as a subsidiary of the Euphrates . Both Sajour and Queiq rivers which are originating in Turkey are flowing into ~~Tigris~~^{Euphrates} river . The river plays an important role to Aleppo town . An increase in the Turkish utilization of this rivers resulted in a decrease of the flow as measured at the borders .

Tigris basin is considered as the second most important source of water , most of its water are supplied by Tigris river which is lining 44 Km along the Turkish and Iraq borders .

- The water resources of the Orontos basin are efficiently utilized, as such these basin of great importance to Syria . The Afrin and Orontos rivers are the most important rivers flowing through this basin .
- Yarmouk basin is jointly shared by Syria and Jordan . An agreement on the joint development of the basin was signed between the two countries .

Due to the importance of these regional basins and the water resources which might be utilized , motivated Syria , Iraq and Jordan to negotiate an agreement for the future development of these basins .

5. Future Strategies and Recommendations :

5 . 1 Future Startegies :

Investigation and analysis of the water resources of Syria indicated that this resource is very limited and is not meeting the increasing demands of the nation . Moreover , the water sector witnessed , during the last 25 years , a decline in its total discharge . The decline was a result of two outcomes :

1. Decrease in the discharge of the international rivers which are considered the main stable source of water available for utilization.
2. Decline in the per capita water consumption due to the increasing rate of population growth on one hand , and to the decrease in the water discharged on the other hand .

It was also noted that to attain increased rate of growth and sound socio-economical development require the provision of new water sources and the efficient utilization of what is now available. Taking into account the priorities of supplying good quality water for human needs , meeting the demands for the expansion in irrigated lands so as to increase and improve agricultural production with the aim of reducing deficits between food production and consumption of strategic crops .

The main water problems facing Syria is of spatial nature . The water resources are located in unpopulated regions . This has lead to water shortages in many regions where the demand is very great . This fact is demonstrated by the northern region of Syria, where 85 % of the water resource are found as surface water . This region which has great water potential is relatively unpopulated . Other highly populated regions are suffering from the lack of water and are depending on groundwater which is liable for depletion .

Generally , more water shortages are expected . In the future it will be difficult to supply the required quantities of water for the different uses . This will be the case in most of

the basins and particularly Damascus , Orantos and some subsidiary basins such as Aleppo (included within Euphrates basin) .

New strategies should be adopted to tackle such deficits. The most important steps are the following :

1. Utilization of groundwater resources . Efforts should be directed for drilling in deeper aquifers (+400 m) . Developing such deeper aquifers requires feasibility studies to justify any investments in such programme .
2. Storing any quantities of water flowing as seasonal floods and streams or surface runoff . Building of the necessary dams for storage and using the stored water for different uses .
3. Increasing the number of water treatment station to deal with sewage and agricultural drainage . The treated water might be used in several purposes .
4. Exploring the possibilities of new water sources such as desalinating sea water , rain harvesting , artificial rains and other innovations in this field .

5.2. Recommendations:

1. Water Resources studies :

More data and information are needed about the existing water resources . Detailed studies of the surface and groundwater resources need to be conducted . The studies should concentrate on deeper aquifers , quantities available and proposals for alternative uses of the water .

Agreements with other riparians countries to distribute and allocate the final shares of waters discharged by rivers , surface streams and groundwater is a necessary step toward the efficient use of this resources .

2. Improving the institutional set up of the water sector :

Institutional improvement requires the recruiting of competent technicians . Training of the technicians in the proper and scientific management of the water resources is a precondition for institutional improvement . The experience of the international organisation and the developed countries will be followed, especially, the facilities which might be offered for training and reseaches .

The initiation of an institution to coordinate the activities between the various regions and basins and between the administration and corporation involved in the water sector .

3. Unified legislation for the water sector :

The present study, illustrated the various legislations governing the water sector . The need to issue a new law defining the legal principles applying to the management of water resources and the approval and implementation of water programmes . These law should include : economic , environmental , balanced allocation of funds for investment , efficient utilization of the water resource . Also to define systems for identifying water charges and the taxes which ought to be paid by users , in addition to operation and maintainance charges .

4. Future plans for water storage and dams construction :

The last decade witnessed great efforts in the construction of dams . Such trend is expected to continue in the future . As such , surveys and reconaissance studies of all streams and surface water should be conducted in order to measure the quantities flowing and the technical and economical justification for storing such water. Included in these studies the importing of water by deficit regions such as Damascus from water surplus basins like coastal region .

5. Modernizing irrigation methods :

The aims of the modernization programmes are to improve the existing traditional basin irrigation methods which is inefficient in utilising water resources to the efficient modern irrigation techniques . As such more land could be irrigated in addition to economising

water use and improving production and productivity .

Moreover winter supplementary irrigation could be introduced according to dual rotation patterns (wheat and fodders) . Such system economise the water use by 30 % of the quantities required by summer rotation .

Hence , it will be possible by using the same quantity of water in winter to increase the area irrigated three times more than summer areas. Actually , by adopting such a change a tangible increase in production could be achieved . Moreover winter supplementary irrigation economise water use by reducing water losses as a result of minimum evaporation and percolation into the subsoil .

6. Financial provision for land reclamation projects :

The development plans associated with more land reclamation requires financial provisions. As such contacts with financial institution should be continued to provide the necessary loans and foreign exchange for financing the implementation of the planned projects which are scheduled for water provision . The development of these new project will be supplied with modern irrigation techniques for economising water uses .

7. Hydrological power :

The general trend is to use hydrological power for generating electricity . Such trend requires the investigation and studies of all water falls that could be used for generating electricity , operating mills and diversion of water to high lands . Such cheap energy might be useful and satisfies the growing demand of energy by various sectors of the economy .

8. Data base building and transfer of technology :

A corporation is recommended to compile all data and information regarding water resources . Also to promote the work in the water sector by transferring technologies suitable to Syria . This actually requires training of technicians and to acquire the experiences of the developed countries .

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