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ARAB REPUBLIC OF EGYPT
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THE HIGH DAM

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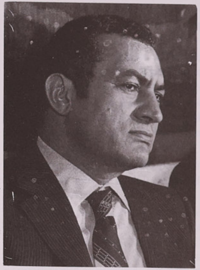


President

MOHAMED HOSNI MOBARAK

INTRODUCTION

Like any other project of its kind or size, there have been varying views from the original conception of the High Dam up to the present time.

The enthusiastic voices claim that it has solved all the agricultural, industrial and economic problems of Egypt. The sceptical voices cast doubts on the Dam, belittling its importance and even questioning its viability of being a sound structure. Side effects have been magnified to remove the Dam from its place as one of the great achievements of the Egyptian people.

However, the High Dam has proven its importance in the development of the Egyptian economy, as well as having protected Egypt from the dangers of drought presently prevailing in Africa.

In 1985, the twenty-fifth anniversary of the commencement of work on the High Dam is being commemorated. The Public Information Service is publishing this booklet as a simplified profile of the High Dam. This includes implementation phases, structural description and operation of the Dam, its economy benefits in reclamation and industrial properts as well as answering criticism with efforts taken to solve any negative side effects.

REASONS FOR THE PROJECT

The Nile River flooded surrounding lands annually. Sometimes the flood waters were excessive and other years were not sufficient. The highest flood water level registered in Aswan over the past hundred years was reached in 1879 at 137 billion cubic meters. The lowest such level was 45.5 billion cubic meters, registered in 1913. High floods threatened embankments on the Nile acting as barriers to protect crops and human settlements from inundation. The most serious threat to agricultural production, however, were successive years of low floods.

The reservoir behind the Aswan Dam during the flood season stored water almost free of silt. This water was then utilized during the same «water» year when the river water level was low. Full storage capacity of water was impossible and in low flood years much water was lost. During the season of the lowest water level, water could be so scarce that even if supplemented by stored waters, cultivated areas could not be sufficiently irrigated. Critical losses in crop production resulted.

A High Dam that could control the flow of the total volume of water was considered seriously. Water volume averages 84 billion m^3 annually and only 52 billion m^3 were utilized by Egypt and the Sudan. The balance of some 32 billion m^3 flowed into the Mediterranean, wasting much needed water.

A dam was needed in low flood years. Also it was necessary that it be large enough to hold accumulated quantities of silt.

Thus a project wa formulated to construct a High Dam, 65 kilometers south of the Aswan Dam. This was the most appropriate location as the Nile basin was comparatively narrow with high banks, forming a narrow valley. This area was also near the materials needed for constructing the Dam and near the city of Aswan.

PHASES OF IMPLEMENTATION

The Revolution in July 1952

The new government was interested in the High Dam project as a necessity for the economic development of the country. Because of the vast scope of the plan, studies were necessary as to purpose, dimensions, cost and possible side effects. Firms of international repute were invited as consultants with national expertise to carry out research work and studies on the technical and economic feasibility of the project.

In 1954, a group of top international experts (American, French and Swiss) were requested to the practicality of the project. The group's report was submitted on December 4, 1954. The agreement was unanimous that the project was technically and economically sound. Its importance was emphasized as a development project in Egypt.

In January 1956, the Director of the World Bank signed the initial agreement for the granting of a loan to finance the project. This loan was to be given after bank experts studied the project thoroughly and submitted a report confirming the technical viability of the project. But, the World Bank withdrew its offer on July 19, 1956 following the intervention of unfriendly powers. In order to provide funds for the High Dam, the Suez Canal was nationalized.

On December 24, 1958, the Agreement on Economic and Technical Aid was signed between Egypt and the USSR for the implementation of the first phase of the project. The second agreement for the completion of the second phase of the project was signed on August 24, 1960.

In 1959, the Nile Water Agreement was signed between Egypt and the Sudan. Egypt was to receive 57.5 billion m and the Sudan 18.5 billion m. Moreover, Egypt would pay LE 1.5 million to the Sudan as compensation for the property which would be inundated by the stored waters.

Un January 9, 1960, the first phase of construction was started and in mid-May, 1964, the Nile waters were channelled to the diversion canal and tunnels. The Nile bed was dried

and storage of the Nile waters in the Lake began.

In October, 1964, The first electric spark was ignited at the High Dam Power Station.

In 1968, Water was stored at full capacity.

On January 15, 1971, the completion of the project was celebrated.

DESCRIPTION OF THE DAM

The High Dam is a massive barrage blocking the Nile River. It is 3600 meters long, 520 meters of which lie between the banks of the Nile. The remaining 3080 meters stretch outward in the form of two wings on both sides of the river. The right wing, 2327 meters long, lies on the eastern bank. The left wing, 755 meters long, stretches out on the western bank. The Dam is 980 meters wide at the Nile bed and narrows in a pyramidical shape to measure 40 meters at the top.

The Dam's height is 111 meters from the Nile bed (which is 85 meters above sea level). Consequently, the top of the Dam is 196 meters above sea level.

The body of the Dam is constructed of granite, sand and silt, around a nucleus of waterproof Aswan mud, connected in front to a horizontal waterproof screen.

The Nile bed was strengthened by residual material. The Dam has a bisecting vertical screen which extends 180 meters below the nucleus to the residual layer to reach the rock layer. The screen was constructed by perforating and injecting waterproof material such as Aswan mud and certain chemicals. The screen below the nucleus is 40 meters long and tapers off to 5 meters when it reaches the rocky layer.

The Dam nucleus is crossed by three concrete tunnels which are used to inject the vertical screen and ensure regular maintenance of this screen. Measuring devices are also installed in the tunnels.

At the lowest part of the Dam's back slant, there are two rows of vertical drying pits to draw the water that might leak below the Dam.

Storage Reservoir : The water reservoir behind the High Dam forms a big 500 km long artificial lake, with an average width of 100 km, covering 5000 m^3 area. It is the second largest artificial lake in the world, storing 164,000 million m^3 of water, the first largest being the Caribu Lake in Zimbabwe.

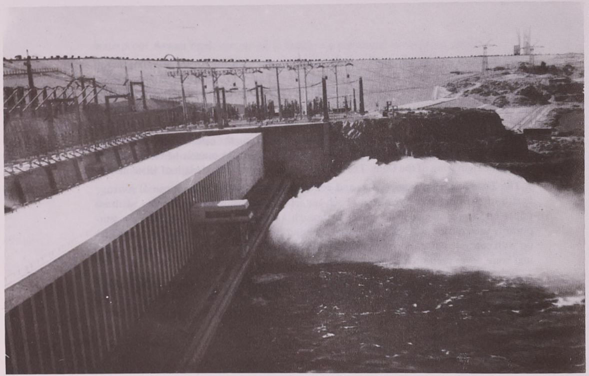
The highest water level stored behind the Dam in Nasser Lake in 183 meters. Its full holding capacity is 164 billion m^3, 33 billion m^3 of which are to hold the accumulation of silt over a period of 500 years.

When the storage becomes full capacity and the water level rises to 183 m, (a maximum depth of 98 meters), the surplus water exceeding that level flows out through the tunnel on the western bank of the Nile, with a flowing capacity of 9400 m^3/sec. These waters flow back into the Nile north of the Dam. Part of the surplus water is also drained by means of the power station.

The Diversion Canals : there are two uncovered canals on the eastern bank of the Nile. One is in front and one is in the back, connected by the main tunnels hewn in the rock below the right wing of the Dam. The diversion canals have a total length of 1950 meters.

The Tunnels : They number six, and connect the front with the back canal. Average length of the tunnels is 382 meters. Each tunnel connects with the front canal, with an upper and lower opening, the upper is through a sloping tunnel, the lower were temporarily used during construction for the flow and control of water. Then they were filled up with concrete before completion of work and filling of the reservoir. The upper openings were never used on a permanent basis.

The openings have maintenance gates and anti-deposit devices. The tunnels were designed to allow for the entire flow of flood water (11,000 m^3/sec or about) billion m^3/day at a rate of 12m/sec.



The Power Station : The station lies at the tunnel outlets and has 12 hydrogeneration units, each with 175,000 kW capacity, producing an annual 10 billion KW/hours.

Over the power station, at an altitude of 142 meters lies the transformer stations, which raises the electric current from 15,750 kv, to 500 KV. Serveral electric lines were laid to conduct the current to consumer areas.

The transformer station and electricity lines were constructed to conduct the electric current to meet the needs of agriculture and industry needs in the area of Aswan and Upper Egypt and the largest consumer, Cairo. From Cairo, power generated by the High Dam is conducted to Lower Egypt while the center in Cairo controls the general electricity network in Lower and Upper Egypt.

Control over the Dam and Injection Screen. To control the High Dam and the injection screen during and after construction, a set of devices and instruments were installed to measure the vertical drop, horizontal movements, and internal pressure, as well as a network of parameters at narrow depths and levels to measure leakage from the Dam. The efficiency of,the main injection screen To ensure the safety of the Dam periodic inspection of the Dam and its tunnels and slopes and summit are carried out.

The High Dam Authority has continuous activities. These include researches on the Lake Nasser, periodic inspection of the body of the Dam and surrounding area, injection of the rocky masses, the tunnel openings, the main screen and the parameters, repair of the back slope casings and surfaces, roads and construction of a river gate on the Barrage Lock.

Appropriations for such activities were made in 1982/83 totaled LE 1,300 million, in local currency, or 700,000 in foreign currency.

THE HIGH DAM COMPARED TO DAMS THROUGHOUT THE WORLD

Whereas the High Dam is neither the highest nor the largest dam in the world, no other dam offers so many advantages in various fields : agriculture, industry, power, fisheries, protection against floods and drought. It is indeed,one of the greatest dams in the world.

The following table sets forth data on massive dams in the world to give the reader a comparison with the High Dam.

Dam	Country	Kind	Height	Size in million m^2	Capacity million m^2	Power in million K.W.
The High Dam	Egypt	massive	111	43.0	164.	2.100
The Norek Dam	Russia	massive	300	45.0	10.50	2.700
Fairnas	Brazil	massive	(earth) 123	9.45	20.20	.900
Meboro	Japan	massive	126	7.90	.32	.215
Randlas Malibasso	Mexico	massive	130	6.00	12.50	.900
Infernillo	Mexico	massive	150	5.50	12.00	.600
Kitti	Canada	massive	104	3.07	22.00	.775

ADVANTAGES OF THE HIGH DAM

Economic Advantages

The High Dam is basically a median project that benefits projects atilizing its waters or industries using the power it generates. It is also a multi-purpose project for, in addition to regulating irrigation and power generation, it develops the fish wealth in Lake Nasser, improves navigation on the Nile and protects against floods and periods of drought. The economic advantages of the Dam are the following :

In the agricultural field.

The storage and utilization of Nile waters in full, which formerly flowed into the sea. It also facilitates horizontal arable expansion in the arable areas, as 1.000,000 feddans can now be reclaimed. Already, 912,000 feddans have been reclaimed in Egypt, and distributed among 255,000 farmers who rely on the High Dam waters distributed to the various governorates. The following table indicates the distribution by governorate of the reclaimed land in thousand feddans :

Gcvernaate	New land	Sallow laud	Total acreage
Ismailiya	68.4	---	28.4
Suez	.3	---	.3
Damietta	---	4.9	4.9
Dakhaleya	13.2	3.9	17.1
Sharkeya	49.1	13.5	62.6
Kalyoubeya	.5	---	.5
Kafr El Sheihh	150.5	9.6	16.1
El Gharbeya	---	.3	.3
El Menoufiya	---	.6	.6
Alexandria	68.	---	68.
Beheira	295.2	31.1	326.3
Giza	3.7	.3	4.
Bani Sweif	---	.5	.5
Fayoum	9.5	5.6	15.1
Minia	62.5	1.7	69.2
Sohag	5.7	---	5.7
Kena	17.	.4	17.4
Asswan	57.2	4.3	61.5
The New Valley	46.8	---	46.8
Matrouh	16.4	---	16.4
Sinai	11.3	---	11.3
Total	835.3	76.7	912.

The above, in addition to approximately 975,000 feddans which were originally basin lands and are now under perennial irrigation. Thus crop area has been greatly increased.

Due to full control over Nile waters, there are no longer irrigation complaints as water needs for various crops are met throughout the year, even in the low flood years. It also allows for greater flexibility in agrigultural planning and enabled expansion in cash crops without fear of insufficient irrigation.

The following table indicates the increased productivity per feddan for some crops :

Crop	Production unit	Yield 1952	Yield 1962	Yield 1972	Yield 82/83	Expectation 83/84	Target 84/85
wheat	«ardeb»	5.18	7.30	8.69	10.08	10.08	10.90
maize	ardeb	6.94	11.88	12.33	12.35	12.35	13.
rice	Ton	1.40	2.47	2.19	2.38	2.38	2.5
horse beans	«ardeb»	4.53	2.74	6.92	6.57	6.57	6.75
flax seeds	«ardeb»	3.18	3.38	4.04	4.34	4.37	4.5
peanuts	«ardeb»	10.13	12.52	11.55	10.92	10.92	11.
sesame	«ardeb»	2.81	3.40	4.77	3.63	3.63	3.7

- Land under cultivation increased by over a million feddans annually compared to 370,000 to 705,000 in the fifties. Rice productivity per feddan rose to two tons per feddan as a result of regular availability of irrigation waters.

- The High Dam provides full protection against floods. Without the Dam, there would have been great risk of inundation in 1964, 1977. Fortunately no losses were sustained by the country in these years, and it was spared losses that would have cost millions.

-The Dam also spares the country the ill effects of low flood years in 1965, 1966, 1968, 1969 and 1972, and also the past six years (this year in particular). Had it not for the Dam there would have been a great shortage in irrigation waters, and Egypt would have been exposed to famine such as is presently prevailing in Africa.

- Fisheries : The High Dam Lake is one of the richest fish resources in the world. Having a single outlet, the lake allows complete control over any fishery project. Fish production is estimated at nearly 25,000 tons annually and is expected to rise to 80,000 tons after implementation of fishery development programs. Great emphasis has recently been laid on the exploitation and development of fish resources through establishing a fishery research center at Aswan. The center seeks to develop new species, as well as fishing methods and making research on fish stocks. Egyptian and foreign scientific expertise has been sought in this regard. The Egypt/Aswan Company for Processing and Marketing of Fish has been established with a capital of LE 9 million and $ 3 million.

- The average maximum power capacity generated by the High Dam is estimated at 8 billion Kw/hour with a total flow of 55 billion mm^3. Available power generated increased gradually as a result of increased flow of irrigation water and the higher water level of the Lake behind the Dam. The High Dam power station provided the unified network of Egypt with 47% of the total electric power in Egypt. It is noteworthy that the power

potentials of the High Dam have not yet been fully utilized. What is utilized is only 69.5% of the total power capacity. Since the first power station of Aswan Dam cannot store all the available irrigation waters of the High Dam accumulated throughout the year, they are therefore not utilized to generate power.

A hydro-electric power station behind the Aswan Dam will act as an extension of the first station with a capacity of 300,000 Kw/hour and a generating capacity of 1.1 billion Kw/hour. Total cost of this station is approximately LE 160 million, and is expected to become operational by the end of 1985.

Power generated by the High Dam has realized savings amounting to millions of pounds which were spent on mazut which was used as fuel by thermal plants, Value of power generated by the High Dam is set at LE 100 million annually. The benefits to industry are emphasized by the Kima Fertilizer Plant in Aswan and the aluminium complex in Nag Hamadi.

- Improved navigation. As a result of stability in the water levels of the Nile and the canals, throughout the year, navigation has greatly improved, making possible full use of the Nile basin and its branches as an important means of transport throughout Egypt. Also improved year round navigation closer ties between the two sister countries. In conjunction with the construction of the High Dam, the High Dam Port was established to service navigation between Egypt and the Sudan. It has two wharves, one for passengers and the other for cargo. The two wharves can be operational at various water levels.

Social Advantages

- The Dam ensures a stable productivity that provides guarantees to the hundreds of thousands who become owners of the reclaimed land, ensuring a higher standard of living.
- Urbinizes the Egyptian villages through the introduction of electricity on its roads and houses, so long deprived of such facilities, and the consequent overall development of rural life and easier access to culture.

Advantages for the Sudan

- Expansion of the cultivated area
- Expansion in the cultivation of long staple cotton
- Increase of annual national income from agriculture

EFFORTS TO COUNTERACT SIDE EFFECTS

Consequences of Major Silt Reduction

The Nile Valley was known worldwide for the richness of its soil due to the heavy deposits of silt from the Nile overflow. Now with the High Dam, these heavy deposits have been drastically reduced as water passing through the Dam leaves much of its silt

behind the Dam. This change in silt deposits has caused criticism of the Dam itself. Following are points affected and efforts being made to balance the change.

1. Soil erosion on agricultural lands

Irrigation in Egypt in the past has followed the flood type of irrigation. Water was directed from the Nile to major canals and then distributed over the land by small open channels which overflowed the land. The excess water was then drained off into drainage canals. When the water was heavy with silt, extra deposits were left behind on the land after the drainage. With clearer water, this type of irrigation carries with it some of the soil in the drainage process.

To counteract this side effect, Egyptian irrigation engineers have been working out new forms of irrigation which entail less drainage waste. One of these methods is the recycling of drainage water by adding a proportion of unused water and then rerouting this water back to the land. Other methods include sprinkling overhead devices.

Also, soil erosion can be prevented by planting certain plants which have deep roots and prevent the washing away of water. Cooperation between the Ministry of Agriculture and the Ministry of Irrigation is making experiments to produce promising results in the near future.

2. The loss of silt nutrients in soil.

Nile silt was known for its nutrients deposited on the soil. Formerly about 110 million tons of silt flowed through the Nile, mostly during the flood period, and consequently much was lost as the water flowed to the Mediterranean. Agricultural in the Nile Valley land/benefited by 13 million tons of silt deposits. To make up this loss of soil nutrients, chemical and animal fertilizers are now being used.

3. Silt deposits behind the High Dam.

The High Dam was designed so that it could accommodate silt deposits in a dead area with a capacity of 30 billion m^3. Moderate estimates are that it would take 500 years for silt deposits to fill this area. The German firm «Hochlis» evaluated the time needed to fill this area to be 750 years.

4. Loss of silt for building materials.

Nile silt deposits dredged from the river and canals were once the basis of the brick industry. Clay is being substituted for present brick factories. Also sand, cement and stone

bricks are alternatives to red bricks. The recent usage of prefabrication in building has decreased the need for bricks.

5. Fish depletion due to low silt deposits.

Certain species of fish thrived in the silt rich shores of the Mediterranean. Some of these fish, including sardines, have migrated to other coasts. However, recently the area along the northwestern coast from Rashid to Saloum has seen evidence that some of these fish are returning. The loss of these species of fish can be compensated by the fish wealth of Lake Nasser. Also fish species not depending on silt rich waters can be stocked along the Egyptian coast to provide sufficient fish protein in that area.

Water losses.

1. Water losses due to evaporation on Lake Nasser

The design of the High Dam took into consideration that losses through evaporation from Lake Nasser would be approximately 10 billion m^3/annually. Maximum losses from leakage were evaluated at 2 billion m^3 annually. These figures were for the total 180 meter level, However, an experiment undertaken on the length of the Lake Nasser reservoir showed that leakage from Lake Nasser would not exceed 1 billion m^3 annually at the 180 meter legel. Since this level hasn't yet been reached, leakage per annum is considerably less.

2. Losses of subterranean waters.

The flood type of irrigation, formerly used, resulted in water seeping through to subterranean levels. In order to keep these levels from being depleted, new forms of irrigation which prevent wastage of water are being innovated.

3. Earthquake Dangers.

1. Danger to the Dam in case of a severe earthquake.

The original design of the High Dam took into consideration the possibility that a severe earthquake or threats from bombing by an enemy power might endanger the structure of the Dam. Thus, safety factors were installed in the original design should such an event occur. There are diversion canals provided for handling any vaguely possible emergency.

2. Possibility of the High Dam triggering earthquakes.

Following some strong earthquakes near the Aswan area in 1982, speculations were made that the pressure of water from Lake Nasser caused earth shocks. At that time the water level was only 50 meters deep and a geological survey made before constructing the Dam confirmed that the earth crust under Lake Nasser was formed/of several kilometers of basalt and granite layers.

Egyptian scientists and Czechoslavakian scientists have drawn up 18 triangles in the

area of Kalabsha to monitor earth currents. The monitoring stations register any earth currents in the area. Also eight stations to register and measure earth waves have been installed in the vital areas adjacent to the Dam as a precaution against any possible threat to the Dam.

Possible overflow of Lake Nasser

A project to offset overflow of Lake Nasser is the talkha Dam which was constructed on a large depression in the Western Desert some 40 Km from the High Dam near the town of Talkha. The depression is to store excessive water from the Dam's reservoir in case of successive high flood years to withstand an unexpected flow of large quantities of water which could affect the basin behind the Dam : erosion, collapse of the banks of the Nile, or a threat to the big irrigation installations such as barrages and bridges. The first phase was completed in 1981/82 at a cost of LE 29 million. Further research work is to be carried out on the depression and existing apertures. To set up the necessary installations, LE 150,000 were allotted in the financial year 1982/82 to complete some works of the first phase of the barrage canal.

THE HIGH DAM PROTECTS EGYPT AGAINST DROUGHT

The drought problem in Africa has made us realize the importance of the High Dam in sparing Egypt such disasters as suffered by large areas in Africa.

Famine in Africa

Africa is now plagued by the worst famine ever known in its history, and is living a tragedy that is affecting most countries south of the Sahara, known as the «drought belt» where desertification is gaining appalling ground. Two broad drought belts cut across the continent from east to west, one in the north, and the other in the south. Twenty-four countries lie within these belts and are the most affected by the drought. Another six countries face the danger of famine, but in a less acute form.

It is reported that 150 million face death by famine in three countries. Already, 200,000 have died in Mozambique and 300,000 in Ethiopia. The death toll from famine is expected to rise to one million this year, the worst disaster ever to hit mankind.

In truth, such a tragedy did not come as a surprise, but was rather expected and was the subject of warnings by the information media for more than a year.

Drought is a common phenomenon in Africa. Africa has a dry climate and has one third of the arid lands in the world. In 1979, Africa suffered an appalling famine as a result of drought. Ethiopia sustained a similar scourge which killed 300,000. The problem, after ten years,is very much aggravated; whereas the people facing famine numbered 400 million in 1970, this number at present, after forteen years, rose to 800 million.

Drought is not the only factor underlying that tragedy. Other factors are invisible, but it is the major factor. Drought and lack of water constitute a major production problem in Africa. Very few African countries have a regular precipitation rate, but is subject to great fluctuations from one year to the other. In addition to acute differences in density between the first drops of rain fall and heavy downpours, the same conditions apply throughout the continent.

Hence the problem of agriculture development in Africa is that of control of water and water flow, control of floods when rains are heavy, and when the precipitation is moderate to provide for irrigation, which will also protect agriculture during drought conditions such as those now prevailing.

The implications of drought on Egypt

A look at the drought map in Africa emphasizes the importance of the issue as far as the security of the Nile Valley is concerned, Foodwise, economically and socially. The eastern wing of the northern drought belt includes countries loaated in the Nile basin and countries lying on its periphery. The Nile is the longest river in Africa and cuts across nine African countries, the last being Egypt All these countries, with the exception of Egypt, have rains. This geographical fact has imposed on Egypt an entire dependence on the Nile. In the light of the cruel drought conditions which have prevailed in Africa for the past few years, including the Nile basin countries, resulting from scarcity of rain and low precipitation rate, we can easily imagine what the situation Egypt would have been in had it not been for the High Dam, because we depend entirely on Nile waters.

The water resources of the Nile in the past few years were as follows :

In 1929/1930 water reaching Aswan stood at 48 billion m^3

In 1980/1981 water reaching Aswan stood at 50 billion m^3

In 1981/1982 water reaching Aswan stood at 45 billion m^3

In 1982/1983 water reaching Aswan stood at 40 billion m^3

In 1983/1984 water reaching Aswan stood at 43 billion m^3

The current year, 1984/1985 estimated quantity is 35 billion m^3

Bearing in mind that the average volume of Nile waters we receive is 48 billion m^3 and that the worst drought years in the present century were 1912 and 1913 when the water flow in Aswan stood at 40 billion m^3, we can easily grasp the full meaning of the

meagerness of the water flow this year and how much we would have suffered had it not been for the Dam.

There lies the importance of the High Dam, the stored waters that can be used in times of need. That is exactly what has taken place in the past five or six years. We will be using 20 to 22 billion m^3 of the Dam's stored water this year. We have, therefore, to take care of and preserve every drop of water because such water is our life artery.

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Photographed by : Ahmed El-Maghraby
Designed by : Nabil Saber
Technical Supervision : Ezzat El-Leithy