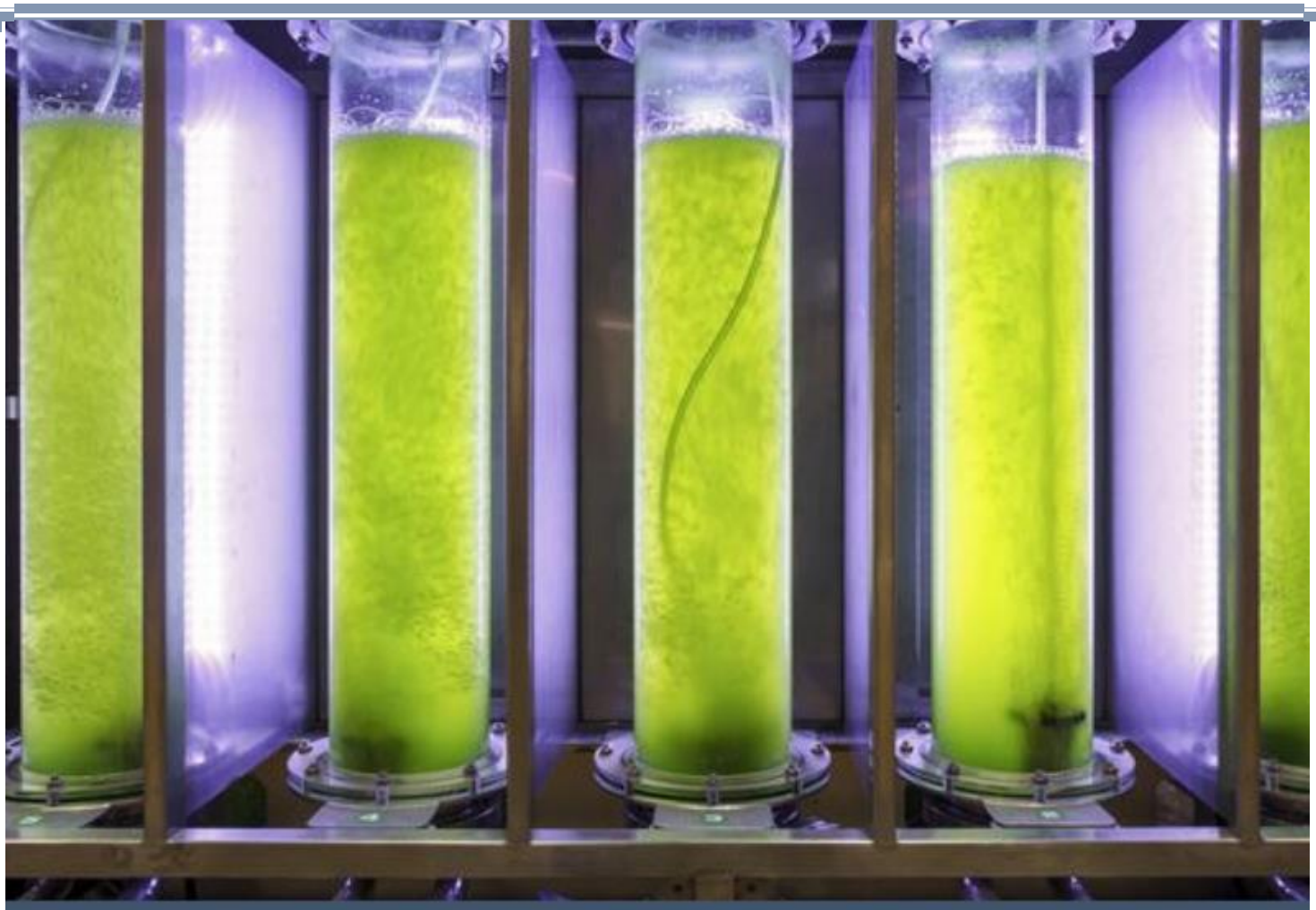


PORTFOLIO

ALGAE POWER

WATER CONSERVATION

2018-1-11232

Table of Contents:

Contents

Introduction :-

We all know that Egypt is confronting a lot of grand challenges that greatly affect its progress. Some of these grand challenges are arid areas, urban congestion, energy production, recycling of garbage, pollution and many others. Our challenge this semester is related to the improvement of the use of water especially in improving the agriculture field. This is because the agricultural field including the irrigation process among the others consume the most of the water available resources which is 82% and as we all know that water is mainly essential to all the aspects of life such as: health care, education, energy economic production, social activities and many others.

It was a must for us to work hard aiming to find a solution in order to save water by reducing the amount of water loss in the agricultural field or by treating and recycling waste water so as to be used in the irrigation process. Prior solutions have already been tried that are somehow efficient, but expensive or have other disadvantages to be applied on the large scale. One of the prior solutions was drip irrigation which allowed water to drip slowly to the roots of plants to minimize evaporation. Another solution was in treating water by bacteria that it grows and feed on ammonia, but water would need another phase of treating after it so it can get rid of heavy metal so it was an expensive way. After searching more, we decided to work on Algae and specially chlorella because it’s cheap, common to find, reproduce quickly and it get rid of ammonia and heavy metals in water so all our design requirements are applied to this solution. We can calculate its efficiency be comparing the results of water analysis before and after purification. In addition to that it will help us to solve another problem which is soil pollution and improving agriculture that there will be a bioproduct from purification process can

be used as a fertilizer and fix any type of soil then we can plant in it trees or oilseeds. Geology helped us so much in the project that we knew because of it what are the steps of water treating and what are the pollutants of water so we can find a solution can get rid of all of them.

SECTION ONE:- PRESENT AND JUSTIFY A PROBLEM AND SOLUTION REQUIREMENTS

Chapter one : - Present and justify a problem and solution requirements:-

Egypt grand challenge:

1- Improve the use of alternative energy.

2- Recycle garbage and waste for economic and environmental purposes.

3- Deal with urban congestion and it is consequences.

4- Work to eradicate public health issues and diseases.

5- Increase the industrial and agricultural bases of Egypt.

6- Address and reduce pollution fouling our air, water and soil.

7- Improve uses of arid areas.

8- Manage and increase the sources of clean water.

9- Deal with population growth and it is consequences.

10- Improve the scientific and technological environment for all.

11- Reduce and adapt to the effect climatic change.

1st : Improve the use of alternative energies

The non-renewable energy resources represent an essential problem that faces the whole world in general and Egypt specifically. As Egypt has been suffering severe power shortages and rolling blackouts over the past years, necessitating the requirement to look to alternative energy options to help meet continuously increasing demand especially for electricity.

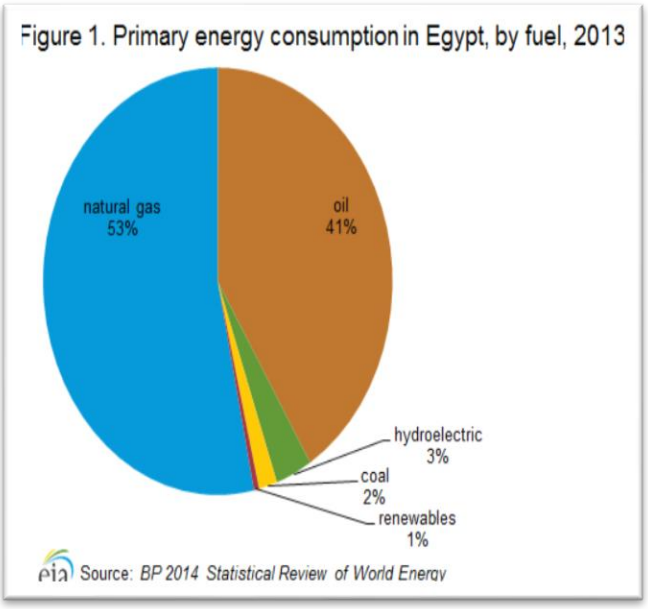


Figure 1

Some of the main reasons why are the non-renewable energy resources represent a serious challenge that Egypt aim to overcome that:

They pollute the environment because of the harmful gas emissions resulted from burning such energy resources.

They are relatively expensive.

They will run out in the near future based on the scientists' predictions.

Figure 2

On the other hand, Egypt has an abundance of land, sunny weather and high wind speeds, making it a prime resource for the next alternative energy generation.

Figure 3

So, the renewable energy resources are really considered a prime solution for this problem and a really good alternate that :

They will never run out as they are renewable.

They don ‘t harm the environment as they are ecofriendly.

They are relatively not expensive compared to the non-renewable energy resources.

Egypt’s demand for electricity is growing rapidly and the need to develop alternative energy resources is becoming ever more urgent. It is estimated that demand is increasing at a rate of 1,500 to 2,000 MW a year, as a result of rapid urbanization and economic growth.

However, renewable energy makes up only 1 percent of the total energy consumption in Egypt. So, Cairo has redoubled its efforts to increase the rate up to 20 percent.

2nd: Recycle garbage and waste for economic and environmental purposes

Figure 4

Recycling: is a key component of modern waste reduction and is the third component of the "Reduce, Reuse and Recycle" waste hierarchy.

It is the process of converting waste materials into reusable objects in order to: -

Prevent waste of potentially useful materials.

Reduce the consumption of fresh raw materials.

Reduce energy usage.

Reduce air pollution (from incineration) and water pollution.

Build a strong economy.

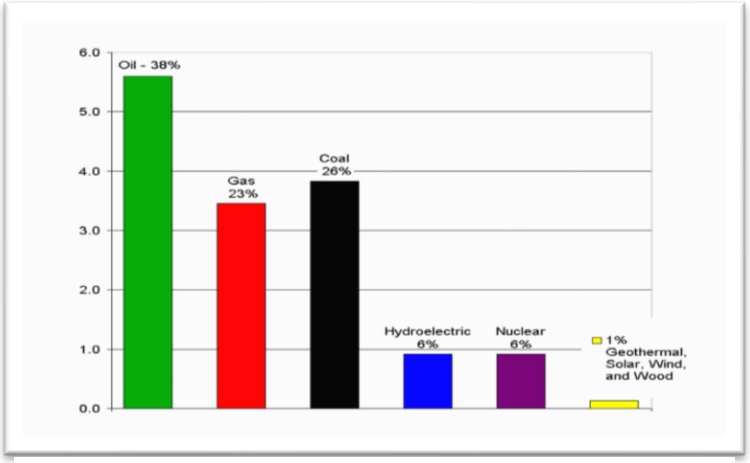
Reduce the amount of garbage.

Lower the greenhouse gas emissions.

Figure 5

Recyclable materials include many kinds of glass, paper and cardboard, metal, plastic, tires, textiles and electronics. The composting or other reuse of biodegradable waste—such as food or garden waste—is also considered recycling.

Materials to be recycled are brought to a collection Center or picked up from the curbside, then sorted, cleaned and reprocessed into new materials destined for manufacturing.



graph 1

Only 60 % of the waste produced in Cairo is collected, of which less than 15 % is properly recycled or reused. A big portion of the waste is released untreated into canals, rivers or streets and open areas which caused a burden on water, soil and air, as well as having a negative impact on the economy and tourism.

According to a 2011 report of the World Bank, Egypt loses 0.4-0.6 percent of its GPD due to the inefficiency of solid waste policies.

In conclusion, Egypt must exploit this precious wealth for economic and environmental purposes.

3rd : Deal with urban congestion and its consequences

The term demographic explosion, population explosion or population inflation is defined as a significant increase in the population density to a level where there is imbalance between the population and its requirements and the economic and natural resources available.

Causes of demographic EXPLOSION: -

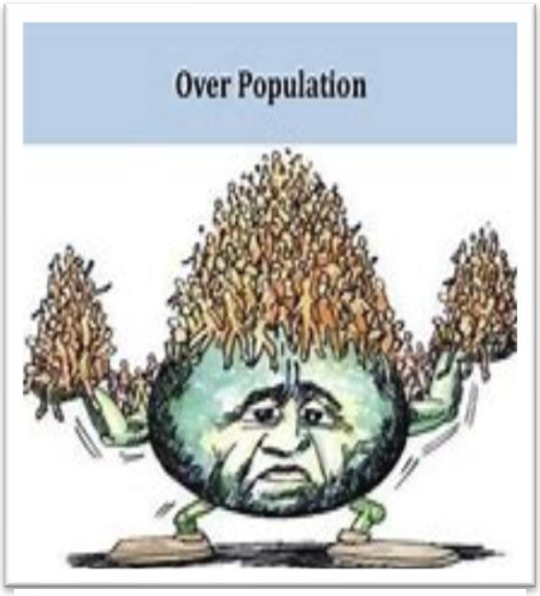


Figure 6

Lack of mortality, frequent and increases births

Early marriage.

Improved health and living standards.

Political stability.

Absence of birth control

Availability of jobs opportunities

Egypt is one of the most populous countries in Africa and the Middle East. With a 2015 estimated population of 84.7 million, Egypt ranks 14th or 15th in the list of countries (and dependencies) in the world by POPULATION.

The distribution of Egypt's population is a problem rivaling the high growth rate in seriousness. Approximately 99% of the population is concentrated in the Nile Valley and Delta, which represent less than 4% of the total land area and this results in the urban congestion phenomenon.

Population distribution in the Valley and Delta is distinguished by the disparity between urban and rural areas and the soaring growth of the cities at the expense of rural populations.

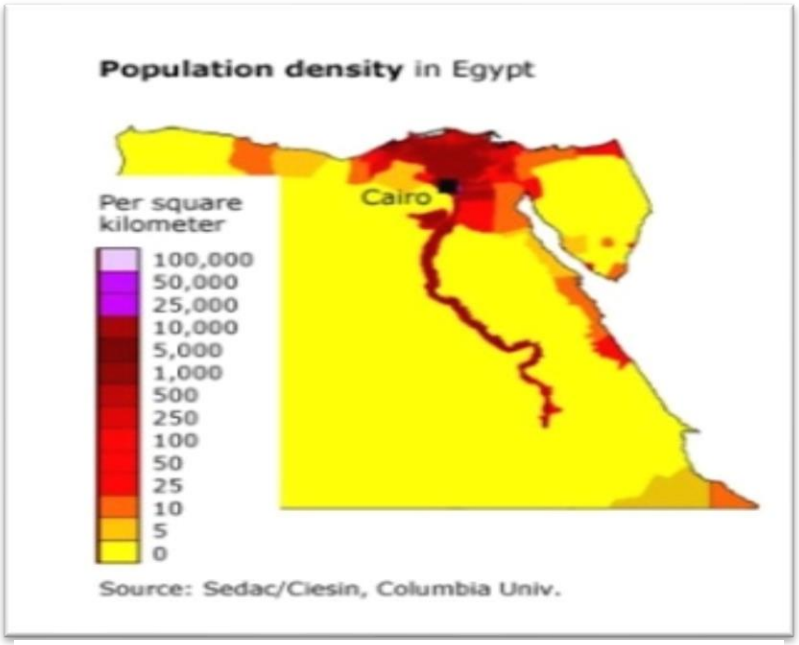


Figure 7

The overall density of rural areas of the Valley and Delta is among the highest in the world at 745 per square kilometer, but great variation is found between regions. Census results indicate that about 23% of the total po pulation live in governorates other than those where they were born.

Proposals to solve the problem:

we can make several suggestions to solve the population problem

building new cities integrated in terms of all facilities.

Building the metro lines connecting Cairo with new cities to facilitate the transition

4th : Work to eradicate public health issues/disease:

Poor hygiene, crowding and bad nutritional habits were primary causes for the common illnesses.

People in Egypt faces many diseases such as hepatitis C, cancer and bilharzia.

specially in villages because of many reasons like the enormous pollution and the urban congestion infectious diseases:

Egypt has particularly high rates of hepatitis (22%) one of the highest worldwide.

-The provision of health service in Egypt:

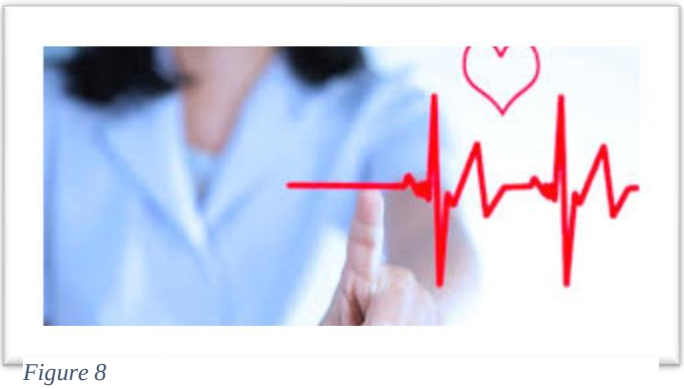


Figure 8

1-Not all doctors have experience and efficiency.

2- some hospitals aren't clean.

3- some medicines have a high cost, so poor people don't have Possibilities to treatment.

To solve this problem:

1-appropriate the level of the health from time to time.

2- choose doctors who has good experience and high efficiency.

3- the government should and be interested in cleaning it and the hospitals and make medicine in low cost.

5th : Increase the industrial and agricultural bases of Egypt:

Agriculture

Agriculture is a craft based on the exploitation of agricultural soils and water resources for crop production and animal husbandry.

Figure 9

Egypt is suffering from a food crisis suffocating. high costs of agricultural production requirements.

Proposals to increase the agricultural base in Egypt

Helping farmers by granting loans, supplying them with fertilizers and feed.

Industry

The industry in its broad sense changes in the form of raw materials to increase their value, making

Figure 10

It contributes to Egypt by more than a quarter of its domestic production.

The development of the industry began in the 1970s due mainly to the development of the oil sector

The industry contributed to the creation of an average of 37,000 jobs per year. time employment and this inability to provide enough jobs.

6th: Address and reduce pollution fouling our water and soil:

- water pollution: -

Water is the base of life, which without it live cannot exist, the main reason behind the water pollution is chemical and industrial process, this is because the factories and manufacturers

graph 2

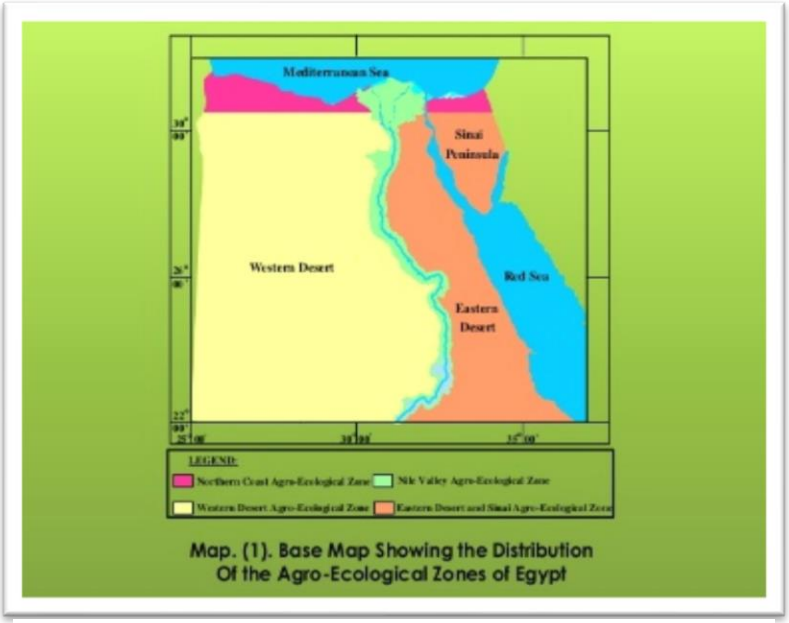
in Egypt are throwing industrial and animal waste into stream and rivers.

-soil pollution: -

Soil pollution occurs when the presence of toxic chemicals, pollutants or contaminants in the soil is high enough concentration to be of risk to plants, wild life, human and of course the soil itself.

7th : Improve uses of arid areas:

The arid areas were previously addressed as deserts or dry lands; these are regions where a combination of high temperature and low rainfall causes evaporation that exceeds precipitation.



map 1

They are characterized by extreme diurnal temperature fluctuations as dry air temperature drops abruptly after sunset. Precipitation is also highly variable, sporadic, and unpredictable. The plants cover also shows notable seasonal variation and the bio productivity is low, the soil is fragile with low organic carbon content and suffers from the formation of hard pans and low underground nutrient content. At the present, dry lands cover 6150 million ha, that is, 47.2% of earth's total surface area. They are located between latitudes of 15 to 30 in both northern and southern hemispheres in what is termed the arid zone.

8th : Manage and increase the sources of clean water:

Water is very important. it is the mainstay of life for every living organism. most of plants cultivated by man on the quantities of water .and we cannot replace the drinking water with any other drink like tea or milk. water is part of our bodies, food and earth. people throw rubbish in it and companies throw wastes also. We chose it because our country suffers from these problems and the water doesn't come to some places the people suffer from this problem. so, we must keep it clean Egypt has been suffering from severe water scarcity in recent years. The major factors affecting Egypt's water, Like water distribution, misuses of water resources and inefficient irrigation techniques, population explosion and of course pollution. Water issue in Egypt is rapidly assuming alarming proportion. By the year 2020, Egypt will be consuming 20 percent *Figure 11*
more water than it has. With its loosening grip on the Nile, water scarcity could endanger the country's stability and regional dominance

It is very important because when the population increase many other problems like pollution and traffic jams increase. Nearly many people live in urban cites because it contains many services like electricity. Egypt's population still grows each year by approximately 1.5 million people and population growth about 1.79% by year 2015, or the equivalent of the population of a country the size of Kuwait. United Nations projections indicate that the population will grow from 62.3 million in 1995 to 95.6 million by 2026 and will reach 114.8 million before it stabilizes in the year 2065, an increase of approximately 84.4 percent over the current total.

This increase will occur for two reasons: fertility rates are still high in many parts of Egypt, and momentum will cause the population to continue to increase even after fertility rates reach replacement level.

9th : Deal with population growth and its consequences:

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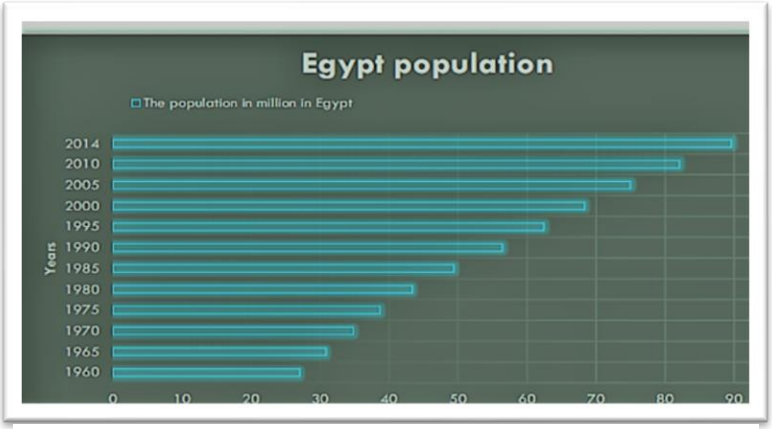


graph 3

Egyptians that are having three or more children are contributing to the overpopulation of Egypt.
The families that are having one or two children are being responsible and realizing that overpopulation is a problem they are trying not to add to. Egypt's theme for population control is "two children per family-- a chance for a better life". This tells families that their life will be so much better if they have less children; less mouths to feed, less clothes to buy, and less things to worry about. The committee responsible for this slogan is the National Population Conference

that discussed the population problem and how they should fix it. They agreed that a two-child policy much like China's would help combat overpopulation and the other problems that come along with it. Many non-profit companies are made for the sole purpose of helping countries like China, India and Egypt; countries that are suffering from overpopulation. These organizations help raise funds and get volunteers to go to different countries to spread the word about the dangers of overpopulation and a healthy reproductive life. This is in hopes that the people that they talk to will spread the word to their friends and family to help fight the war on overpopulation. Egypt's overpopulation is an unfortunate problem that the Egyptian Government is working to control.

10th : Improve the scientific and technological environment for all:

We must focus on how to enable the scientific and technological community, which includes, among others, engineers, architects.

Industrial designers, urban planners and other professionals and policy makers, to make more open and effective contribution to the decision-making processes concerning environment and development.

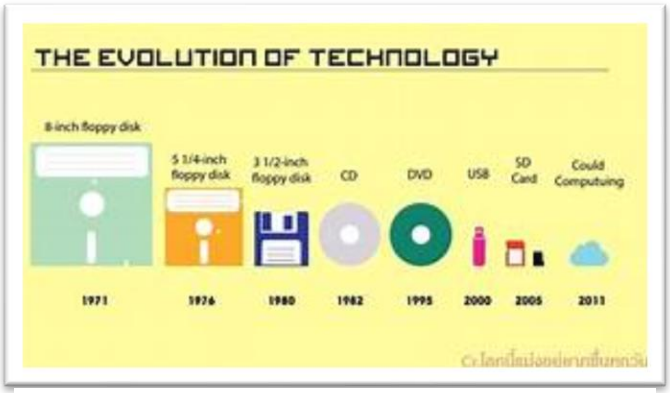


Figure 12

It's important that the role of science and technology in human affairs be more widely known and better understood, both by decision makers who help determine public policy and by the general public. The cooperative relationship existing between the scientific and technological community and the general public should be extended and deepened into a full partnership. Improved communication and cooperation between the scientific and technological community and the decisions makers will facilitate greater use of scientific and technical information and knowledge in policies and program implementation.

11th : Reduce and adapt to the effect of climatic change:

Figure 13

Changing our own behavior can limit climate change: By switching to energy sources that don't release greenhouse gases, increasing the energy efficiency of our homes and offices, and driving less.

no matter how successful mitigation efforts are, the changes already occurring are predicted to increase in the years and decades to come requiring serious planning to minimize risks, vulnerabilities, and impacts. Adaptation strategies that communities are already implementing include:

Building sea walls and moving away from vulnerable coasts in order to avoid sea level rise and storm surges -Diversifying crops and using drip irrigation for agriculture

-Building new public works such as sewers, bridges and aqueducts to handle changes in rainfall and flooding

-Training public health professionals for increased health impacts and emerging diseases

-Developing wildlife conservation plans and new migration corridors to protect endangered species

-Designing buildings to conserve and even generate energy, and

Demonstrating strategies and lifestyles for increased sustainability and resilience.

The relation between improving the use of water in the agricultural processes and Egypt grand challenges: -

1- Arid areas

Sustainable increases in food production in semi-arid regions require efficient use of land and water resources. So we should search about solution and make modification on it from that solution is Agroforestry that solution is the practice of combining tree and crop cultivation on a land parcel and may increase both land productivity and water use efficiency after we treatment water from the water of the soil not needed or the water of Sewage or Agricultural drainage water and measure the percentage of salt or mineral the soil needed and irrigate this area and solve the arid area problem that help us in decrease the over population and decrease the pressure on finite water resources intensifies And increase the yield of agriculture in our planet and we can use the underground in this area and make it from the main sources of water.

2- Alternative energies: -

alternative energies and clean water and agriculture is very important relation when we treatment the water we will increase the sources of clean water that help us to provides water use in our home and in agriculture and to generate energy such as process by turbine and in another fields in current time we tried to generate power from food and that will generate starvation so we will use water to increase generation of power instead of food .

3- Agriculture, eradicate and public health issues/disease

The relation between clean water sources and agriculture and eradicate public health issues/disease is very important relation because the life continue or no depend on it Only 20% of the global population has access to running water and over 1 billion people do not have access to clean water.1 This prevalence of inadequate water affects the health of 1.2 billion people worldwide and contributes to the death of approximately 15 million children annually.7Half of the population in developing countries is suffering from water-related diseases. In these developing countries, nearly 80% of diseases are linked to water, leading to 3 million early deaths and Safe drinking water and freshwater are imperative for development and public health since 21 of the 37 primary diseases in developing countries are related to water and sanitation.so we should treatment the water by any way to decrease that pollution and developed the problem that related to the life of people.

3- Overpopulation: -

Water is a key element of life for everyone on Earth. As the world's population grows, the demand for water mounts and pressure on finite water resources intensifies but we do know that the population will continue growing, and this will impact water availability Population growth is a major contributor to water scarcity. Growth in populations means mounting demand and competition for water for domestic, industrial so we should to think about solution of the clean water challenge to increase the yield of crops and Provides the needs of the population and try to live in all area not concentrated in place and leave another place because The most water scarce or stressed areas are typically those with few water resources, high population densities, and high population growth rates and the agriculture is very important because Agriculture accounts for approximately 70 percent of global water use, and for as much as 95 percent of water use in predominantly agriculture-based countries. Agriculture not only requires a large amount of water, but it is also one of the most inefficient uses of water. A growing population requires more food. More water is needed to produce that food. therefore, water scarcity and hunger are closely interrelated.

Problem to be solved

Since the beginning of life human could get over any problem he faced. His demands were simple, he wanted food & water and a cave to hide inside it at night from wild animals.

He traveled from a place to another just for these simple demands. But he knew the meaning of stability and having home only when he found water.

Through this discovery he knew agriculture to suffice his demands of food. Now and because of that discovery we are 8 billion persons on earth, but unfortunately 803 million persons of them are suffering from hunger!

Water is the bone marrow of life, it's the vain of life which without it everything literally will be damaged.

Water resource in Egypt:

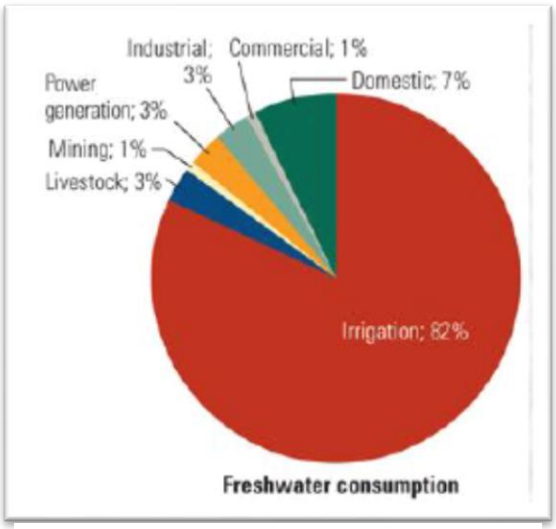
•The Nile river, with a total length of about 6650 km, it supplies nearly all water in Egypt as it is the backbone of Egypt's industrial and agricultural sector and is the primary source of drinking water for the population. Egypt relies on the Nile for 97% of its water needs and consumes about 80-85% of the freshwater consumption in agricultural, irrigation for subsistence crops, as well as fish. The Nile is almost fully controlled by the High Aswan Dam. The water entering Lake Nasser originates for about 85 % from the Ethiopian highlands.

•Internal renewable groundwater resources of Egypt are estimated at 1300 million m^3/year, including 1000 million m^3/year of external groundwater entering the country from Sudan through the Nubian Sandstone aquifer. The total renewable water resources of the country are thus 58300 million m^3/yr. with average rainfall in Egypt is estimated at 18 mm or 1.8 billion m^3 per year

Water crisis in Egypt:

•Egypt has the longest history of water management and engineering in the world but Egypt has been suffering from severe water scarcity in recent years.

Total water withdrawal in 2000 was estimated at 68300 million m³, divided between agriculture, municipalities and industry. In addition, 4000 million m³ were used in-stream for navigation and hydropower. In 2010, total water withdrawal was estimated at 78000 million m³, including 67000 million m³ for agriculture, 9000 million m³ for municipalities, and 2000 million m³ for industries.



graph 4

•Rising populations and rapid economic development in the countries of the Nile Basin, pollution and environmental degradation are decreasing water availability in the country. Egypt is facing an annual water deficit of around 7 billion cubic meters.

Factors affecting Egypt's water security:

A) Population Explosion

The rapid population increase multiplies the stress on Egypt's water supply due to more water requirements for do mystic consumption and increased use of irrigation water to meet higher food demands.

B) Inefficient Irrigation:

Egypt receives less than 80 mm of rainfall a year, and only 6 percent of the country is arable and agricultural land, with the rest being desert. This leads to excessive watering and the use of wasteful irrigation techniques such as flood irrigation that is an outdated method of irrigation where gallons of water are pumped over the crops.

C) Pollution:

The water of Nile is being polluted by municipal and industrial waste, with many recorded incidents of leakage of wastewater, the dumping of dead animal carcasses, and the release of chemical and hazardous industrial waste into the river.

SO, our capstone challenges this semester is to find a way to reduce the consumption of water in the agricultural processes.

The water cycle: -

The water cycle has no starting point, but we'll begin in the oceans.

Most of Earth's water exists in oceans. The sun heats water in the oceans. Some of it evaporates as vapor into the air, a relatively smaller amount of moisture is added as ice and snow sublimate directly from the solid state into vapor. Rising air currents take the vapor up into the atmosphere, along with water from evapotranspiration, which is water transpired from plants and evaporated from the soil. The vapor rises into the air where cooler temperatures cause it to condense into clouds.

Air currents move clouds around the globe, and cloud particles collide, grow, and fall out of the sky as precipitation. Some precipitation falls as snow and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. Snow packs in warmer climates often thaw and melt when spring arrives, and the melted water flows overland as snowmelt. Most precipitation falls back into the oceans or onto land, where, due to gravity, the precipitation flows over the ground as surface runoff. A portion of runoff enters rivers in valleys in the landscape, with streamflow moving

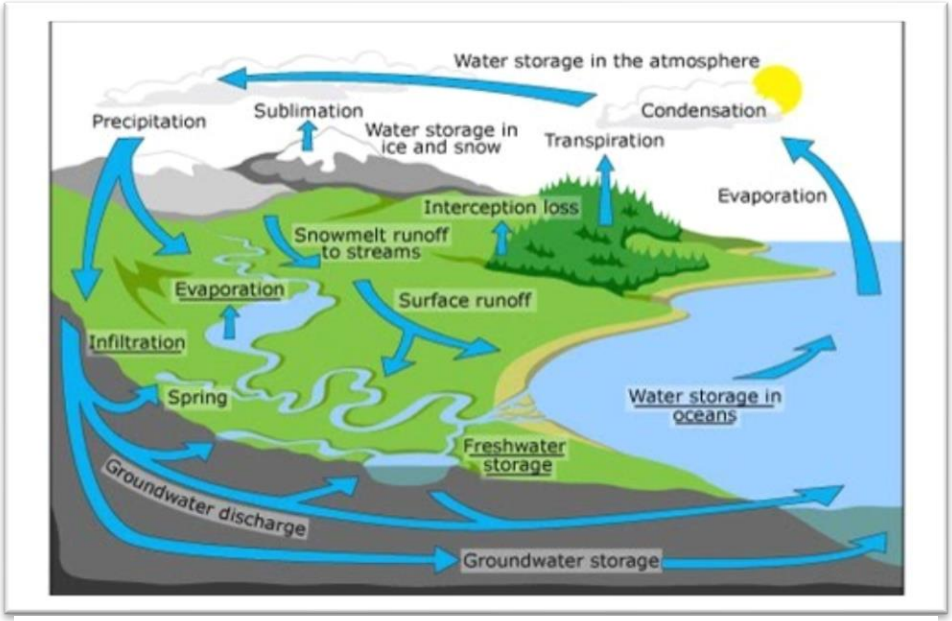


Figure 14

water towards the oceans. Runoff, and groundwater seepage, accumulate and are stored as freshwater in lakes.

Not all runoff flows into rivers, though. Much of it soaks into the ground as infiltration. Some of the water infiltrates into the ground and replenishes aquifers (saturated subsurface rock), which store huge amounts of freshwater for long periods of time. Some infiltration stays close to the land surface and can seep back into surface-water bodies (and the ocean) as groundwater discharge, and some groundwater finds openings in the land surface and emerges as freshwater springs. Yet more groundwater is absorbed by plant roots to end up as evapotranspiration from the leaves. Over time, though, all of this water keeps moving, some to reenter the ocean, where the water cycle "ends" ..

What will happen if this problem is solved?

If the problem solved:

Water is essential to all aspects of life as it sustains families and communities. It is the basis of life. Health care, education, economic production and social activity depend on it.

If we succeeded to improve the use of water in improving the agriculture process in Egypt by rationalizing the consumption of Nile Water or by mainly depending on wastewater as the agricultural drainage water, sewage, industrial waste water or others. This will help us flourish other important fields and overcome other challenges that face our country: -

Economy

It supports economic productivity, from semiconductor manufacturing, to agriculture, to hotels and restaurants, virtually all sectors of the economy rely on water.

Agriculture

We will be able to improve our yield for different types of crops. We will also be able to plant other crops that were once requiring a lot of water to be planted.

Figure 15

Industry

The industry field will be improved as a result of the improvement in the agriculture field especially in the clothing, canned food and fertilizers industry.

Figure 16

Trading

Upon the development of the agriculture and industry fields, domestic and foreign trade will flourish leading to increasing the national income of Egypt.

Energy

Water cools the steam that spins the electricity-generating turbines. Refining transportation fuels requires water, as does producing fuels, that's why improving the use of water and trying hardly to save it will impact positively on the energy production.

Figure 17

Conserving water can also save energy. In order to pump the water from a central facility into your home or office, energy is required to run that equipment, so saving water means using less energy which reduces your carbon footprint and helps the country become more energy independent.

Arid areas and urban congestion.

Water infra structure will improve the life in arid areas which will consequently reduce the overpopulation in the urban congestion areas that will lead to saving our natural resources.

Pollution and garbage.

All recycling operations needs huge amounts of water, so saving water will help us increase the recycling operations in our country which will help us getting rid of our garbage and eliminates from the pollution rate and its consequences.

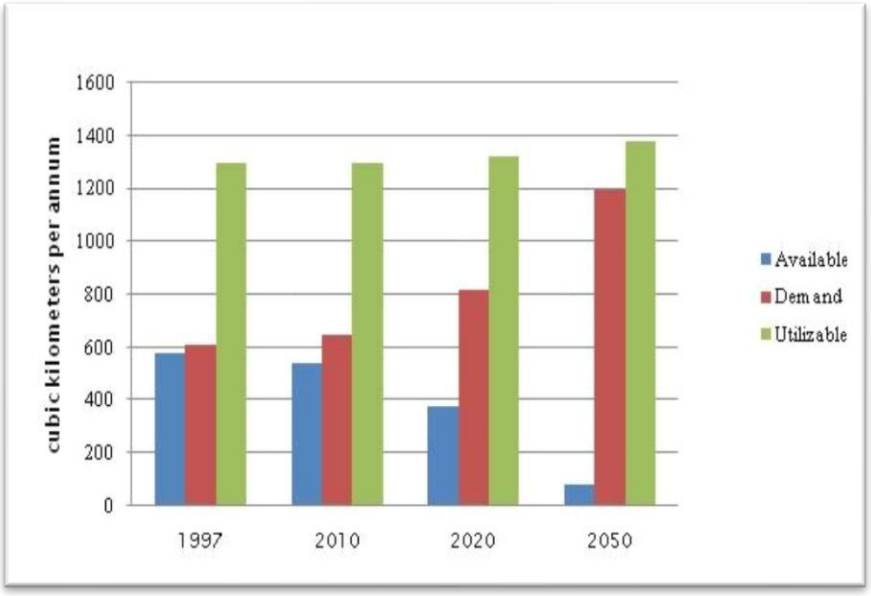
Figure 18

What will happen if this problem is not solved?

If the problem is not solved:

Water covers 70% of our planet, and it is easy to think that it will always be plentiful. However, freshwater—the stuff we drink, bathe in, irrigate our farm fields with—is incredibly rare.

Only 3% of the world's water is fresh water, and two-thirds of that is tucked away in frozen glaciers or otherwise unavailable for our use.



graph 5

By 2025, two-thirds of the world's population may face water shortages and ecosystems around the world will suffer even more and this is because of our current huge consumption rate.

This graph illustrates how much is our demand for water, how much of it is available, and how much is utilizable which indicates that our demand for water is highly increasing while the available of it is inversely decreasing by the time.

If we failed to improve the use of water in improving the agriculture process in Egypt by not being able to rationalize the consumption of Nile Water or by not being able to make use of wastewater as the agricultural drainage water, sewage, industrial waste water or others. This will cause a lot of danger consequences in other important fields in our country: -

Economy

It reduces the economic productivity, from semiconductor manufacturing, to agriculture, to hotels and restaurants, virtually all sectors of the economy rely on water as increasing the use of water by human beings leaves less water behind for being used in the economical fields.

Agriculture

If plants cannot be watered due to shortages, crop yields will be reduced and the food supply for humans and for livestock will be threatened.

Figure 19

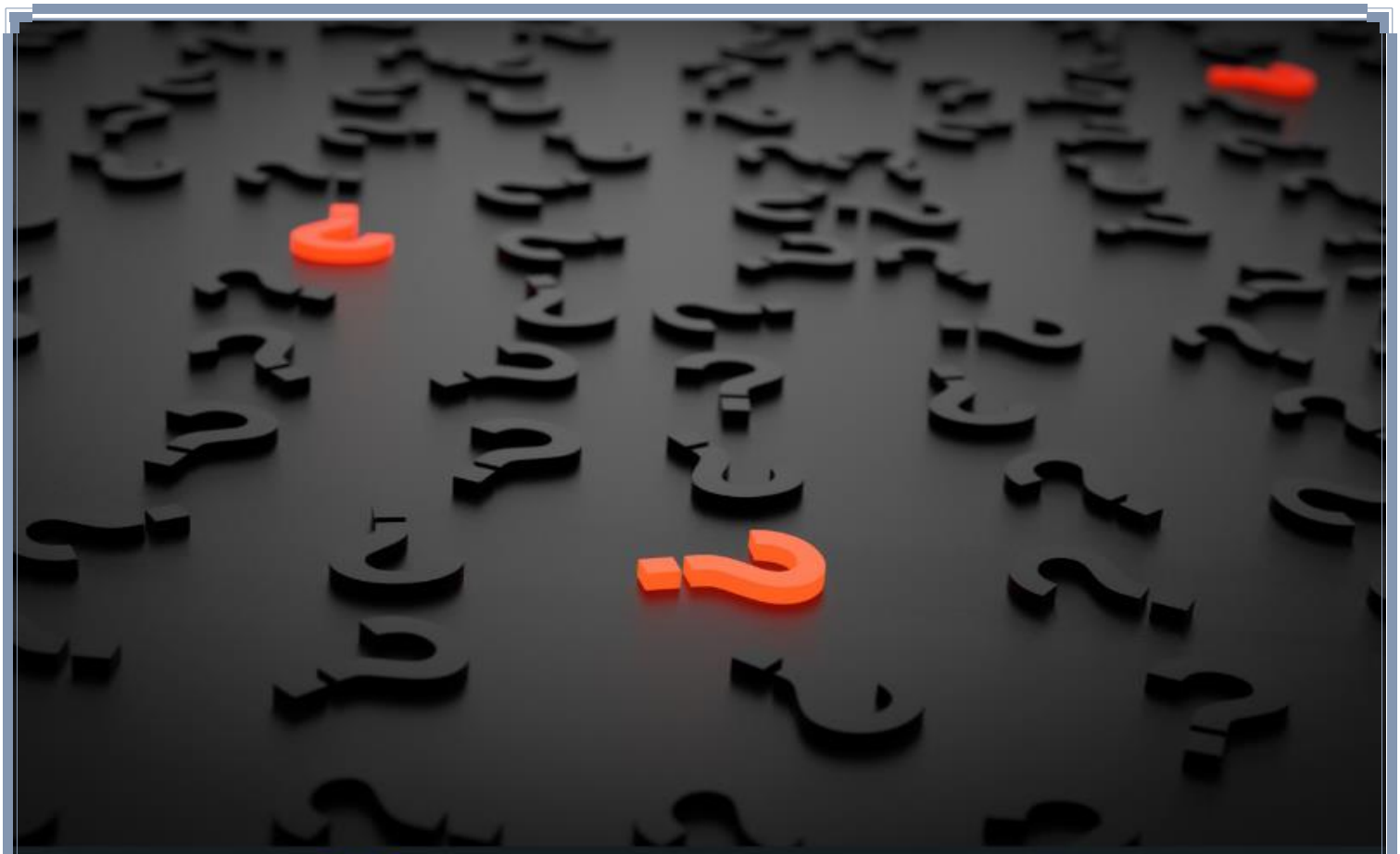
Industry

The industry field will be regarded as a result of the deterioration in the agriculture field especially in the clothing, canned food and fertilizers industry.

Figure 20

Trading

Upon the degradation of the agriculture and industry fields, domestic and foreign trade will degrade leading to the reduce of the national income of Egypt.



RESEARCH

RESEARCH

Topics we have searched :-

Topics related to the problem :

- The water resources in Egypt (natural and artificial)
- The water cycle
- The ratio of the water consumed in the irrigation process to the overall water consumption in Egypt
- The ratio of the wasted water due to the irrigation process to the overall water used in it
- The water demands in Egypt
- The effect of the water rareness on Egypt in general
- The effect of the water scarcity specifically on the agricultural field

Topics related to the possible solution:

- The main phases of the irrigation process of most desert crops
- Different soil types and their pros and cons of each type
- Different traditional irrigation methods used
- The main phases of these traditional methods that contribute to wasting much water
- The impacts of the traditional irrigation methods on wasting water
- Biological water treatment of agricultural wastewater (including bacteria and algae)
- Different types of algae used in water treatment
- Chemical water treatment using the Ultraviolet rays.
- Different irrigation systems and the mechanism of each of them and their pros and cons

Topic	The source	The benefit	APA Format
determining the problem	1- cazri.res.in 2- Usaid.gov 3- Siteresources.worldbank.com 4- Aun.edu.eg. 5- Fao.org.	1- Bad impacts of irrigation process on agriculture in Egypt. 2- Rareness of food in Egypt. 3- Improve wastewater use in agriculture. 4- Water resources in Egypt. 5- Water for Agriculture and Energy Egypt.	1- Dhehibi, B., Ahmed, A. and Hassan, A. (2016). Impacts of Irrigation on Agricultural Productivity in Egypt. [online] Cazri.res.in. Available at: http://www.cazri.res.in/annals/2016/2016SD-2.pdf [Accessed 14 Oct. 2018]. 2- Usaid.gov. (2018). *Agriculture and Food Security	Egypt	U.S. Agency for International Development*. [online] Available at: https://www.usaid.gov/egypt/agriculture-and-food-security [Accessed 12 Oct. 2018]. 3- Siteresources.worldbank.org. (2010). *Improving Wastewater Use in Agriculture: An Emerging Priority*. [online] Available at: http://siteresources.worldbank.org/INTWAT/Resources/ESWWastewaterAg.pdf?fbclid=IwAR37zc239hBBIjYLUPHMwcvtFVqsyNBemWJf3DkR7kAzd5NDjCpf

			JNqFVqU [Accessed 14 Nov. 2018]. 4- Ashour, M., El Attar, S., Rafaat, Y. and Mohamed, M. (2009). *WATER RESOURCES MANAGEMENT IN EGYPT*. [online] Aun.edu.eg. Available at: http://www.aun.edu.eg/journal_files/20_J_5125.pdf?fbclid=IwAR3Nxq_EBAv8ElGsAI2UZO3-0hP-hk64c9xbV6QJag7P9qyrWefCQ7i8scw [Accessed 27 Oct. 2018]. 5- Fao.org. (2018). *Water for Agriculture and Energy Egypt*. [online] Available at: http://www.fao.org/fileadmin/user_upload/agwa/docs/NIP_Egypt_Final1.pdf?fbclid=IwAR1eDr5VUnFNiKux6zl59_0R0_F3xY8auh_1yeDuRdtipn7dddyPjTsA4Mw [Accessed 22 Oct. 2018].
Other solutions* already *tried	1- Ecospheretech 2- Espwaterproducts 3- Bookmetrix 4- Sci-hub.tw 5- Lenntech 6- Fao.org. 7- Fao.org.	1- We learned about chemical can treat water.	1- https://www.ecospheretech.com/water-cleansing-industries/agriculture-wastewater [Accessed 20 Oct. 2018].

		2- We learned about UV water treatment. 3- Using roots to try to use less water through a system depending on that method. 4- Using microbiology in water treatment. 5- Ozone water treatment 6- Treatment of drainage effluent. 7- Drainage water treatment.	2- Espwaterproducts.com. (2018). *Learn about UV Water Purification	ESP Water Products*. [online] Available at: https://www.espwaterproducts.com/understanding-uv/ [Accessed 25 Oct. 2018]. 3- *Raza, A., Friedel, J. and Bodner, G. (2011). Improving Water Use Efficiency for Sustainable Agriculture – Bookmetrix Analysis. [online] Bookmetrix.com. Available at: http://www.bookmetrix.com/detail/chapter/24da21e6-e190-42c7-8af2-4d36e4659ea8 [Accessed 14 Oct. 2018].* 4- *Abdel-Raouf, N., Al-Homaidan, A. and Ibraheem, I. (2012). Microalgae and wastewater treatment. [online] Sci-hub.tw. Available at: https://sci-*

hub.tw/https://doi.org/10.1016/j.sjbs.2012.04.005# *[Accessed 16 Oct. 2018]*.

5- Lenntech.com. (2018). *ozone application in drinking water*. [online] Available at: https://www.lenntech.com/library/ozone/drinking/ozone-applications-drinking-water.htm [Accessed 14 Nov. 2018].

6- Fao.org. (2018). *Chapter 8. Treatment of drainage effluent*. [online] Available at: http://www.fao.org/docrep/005/Y4263E/y4263e0b.htm?fbclid=IwAR2Oe-ZFkEbb3a5kFFGgzCh_7fU1wQTkgvu4GKo7tZ-Rp2R0__Swp4th0WU [Accessed 30 Oct. 2018].

7- Fao.org. (2018). *Chapter 5 - Drainage water treatment*. [online] Available at: http://www.fao.org/docrep/w7224e/w7224e09.htm?fbclid=IwAR0jXYIKC58bbmPWysohd17uN9hxgyUCf9js15WJ_7mk_19khkP_njlbizA [Accessed 7 Nov. 2018].

Choosing the solution	1- Wired 2- Oilgae 3- Livescience	1- We knew how to create an algae water treatment panel. 2- We learned more about the growing process of algae bacteria. 3- We knew more about the definition and the kinds of algae.	1- Squatriglia, C. (2011). *Using Algae to Clean Wastewater, Make Fuel*. [online] WIRED. Available at: https://www.wired.com/2011/02/using-algae-to-clean-wastewater-make-fuel/ [Accessed 24 Oct. 2018]. *2-* Oilgae.com. (2018). *Algae Waste water treatment, Companies - Oilgae - Oil from Algae*. [online] Available at: http://www.oilgae.com/non_fuel_products/algae_wastewatertreatment.html [Accessed 20 Nov. 2018]. *3- Vidyasagar, A. (2016). What Are Algae?. [online] Live Science. Available at: https://www.livescience.com/54979-what-are-algae.html [Accessed 17 Oct. 2018].*

Other Solutions Already Tried

Prior solutions in water treatment

Solar evaporation purification (or solar desalination)

is a process that is often used to make contaminated or saltwater drinkable. It uses only the sun's energy to generate clean, potable water. Solar desalination plants have been installed in areas that are commonly plagued with potable water shortages, like Australia and the Middle East, but you can use this technology to make a small solar desalination unit in your own back yard. Unlike other filtration methods, solar desalination does not require expensive equipment or replacement parts, making it an easy and environmentally friendly choice for water purification.

Step 1

Glue the 1 lb. weight to the base of your glass jar. The weight will be submerged in water, so make sure that you are using nontoxic, waterproof glue that is strong enough to hold both the weight and the glass jar. If possible, find a cylindrical weight that fits the base of your glass jar.

Step 2

Place the glass jar (with weight attached) inside your 5-gallon bucket. The jar should be centered on the floor of the bucket, a few inches below the rim and should allow room for the bucket to fill with water.

Step 3

Fill the space around the jar with contaminated water or saltwater. Make sure you are not putting any water inside the glass jar; rather, between the outside of the jar and the walls of the bucket. Imagine a moat around your jar.

The weight should hold the jar in place.

Step 4

Cover the top opening of the bucket with transparent plastic sheeting. Make sure your piece of sheeting is large enough to fully cover the bucket's opening without leaving any spaces through which water vapor could escape.

Step 5

Secure the sheeting by looping masking tape around the rims of the bucket. The sheeting should be tight, with only a slight bit of give.

Step 6

Place the 1/8 lb. weight in the middle of the plastic sheeting over your bucket. The weight should slightly curve the plastic sheeting downward toward the center.

Step 7

Leave your bucket in an open area that gets a good amount of sunlight. Solar energy will evaporate the water, which will then condense on the plastic sheeting, roll down the curve created by the 1/8 lb. weight, and drop into the glass jar, leaving salt and solid contaminants in the bottom of the 5-gallon bucket.

Nanotechnology in water treatment

The potential impact areas for nanotechnology in water applications are divided into three categories, i.e., treatment and remediation. Within the category of treatment and remediation, nanotechnology has the potential to contribute to long-term water quality, availability, and viability of water resources, such as through the use of advanced filtration materials that enable greater water reuse, recycling, and desalinization. Within the category of sensing and detection, of particular interest is the development of new and enhanced sensors to detect biological and chemical contaminants at very low concentration levels in the environment, including water.

Nanomaterials and water filtration

Membrane processes are considered key components of advanced water purification and desalination technologies and nanomaterials such as carbon nanotubes, nanoparticles, and dendrimers are contributing to the development of more efficient and cost-effective water filtration processes.

There are two types of nanotechnology membranes that could be effective: nanostructured filters, where either carbon nanotubes or nanocapillary arrays provide the basis for nanofiltration; and Nano reactive membranes, where functionalized nanoparticles aid the filtration process

Bioactive nanoparticles for water disinfections

There is a growing threat of water-borne infectious diseases, especially in the developing world. This threat is rapidly being exacerbated by demographic explosion, a global trend towards urbanization without adequate infrastructure to provide safe drinking water, increased water demand by agriculture

that draws more and more of the potable water supply, and emerging pollutants and antibiotic-resistant pathogens that contaminate our water resources. No country is immune. Even in OECD countries, the number of outbreaks reported in the last decade demonstrates that transmission of pathogens by drinking water remains a significant problem. It is estimated that water-borne pathogens cause between 10 and 20 million deaths a year worldwide.

nanotechnology may present a reasonable alternative for development of new chlorine-free biocides. Among the most promising antimicrobial nanomaterials are metallic and metal-oxide nanoparticles, especially silver, and titanium dioxide catalysts for photocatalytic disinfections.

Nitrification

Ammonia removal is becoming more rigorous in permits making it one of the most important and most difficult processes to maintain in wastewater treatment plants. Ammonia can be impacted by various environmental factors, shocks, toxicity and solids loss.

Nitrification is a two-step biological process by which aerobic bacteria oxidize ammonium to nitrate. Nitrifying bacteria oxidize ammonium ions (NH_4^+) to nitrite (NO_2^-) in the first step and then oxidize nitrite to nitrate (NO_3^-) in the second step. The microorganisms can also be described by the step of the process they drive: ammonia oxidizing bacteria (AOB) and nitrite oxidizing bacteria (NOB). Many wastewater treatment systems require nitrification to occur to complete the treatment process. This is accomplished by maintaining two types of bacteria, Nitrosomonas and Nitrobacter. Both types of nitrifies are autotrophs, which means they build cellular materials using carbon dioxide or carbonate and obtain energy from the chemical conversion of ammonia into nitrite and nitrate. Autotrophic nitrifying bacteria obtain less energy during their metabolic processes compared to more common heterotrophic (require organic carbon for growth) wastewater bacteria. This lower energy level results in slower cellular growth. This is especially true in the case of Nitrosomonas. Nitrosomonas are responsible for the conversion of ammonia into nitrite. Conversely, the growth of Nitrobacter is affected because they are responsible for taking the nitrite and converting it into nitrate that is good solution but the problem if it supply it take a long time and finally water will still have impurities that not ne good to irrigate crops .

Treatment with ozone

Because of its excellent disinfection and oxidation qualities, ozone is widely used for water treatment. It can be added at several points throughout the treatment system, such as during pre-oxidation, intermediate oxidation or final disinfection. Usually, it is recommended to use ozone for pre-oxidation, before a sand filter or an active carbon filter (GAC). After ozonation these filters can remove the remaining organic matter (important for final disinfection).

This combination has several benefits that it can:

1-Removal of organic and inorganic matter
2-Remove pesticides
3-Odor and taste elimination

2- Prior solutions of irrigation systems that conserve water

1) Drip or Micro Irrigation

Drip irrigation is a type of micro irrigation system that has the potential to save water and nutrients by allowing water to drip slowly to the roots of plants, either from above the soil surface or buried below the surface.

The goal is to place water directly into the root zone and minimize evaporation Drip irrigation systems distribute water through a network of valves, pipes, tubing, and emitters.

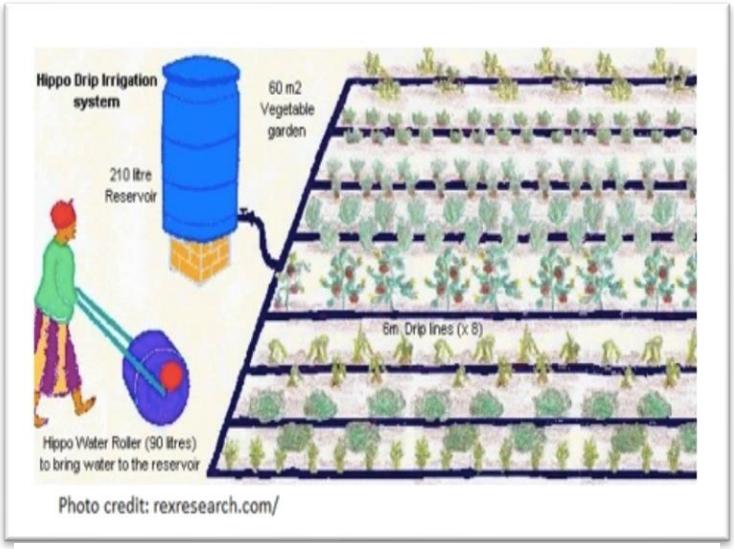


Figure 21

Depending on how well designed, installed, maintained, and operated it is, a drip irrigation system can be more efficient than other types of irrigation systems, such as surface irrigation or sprinkler irrigation.

Drip irrigation conserves 50 to 70 percent more water than traditional methods while increasing crop production by 20 to 90 percent. The water and fertilizer are also more easily absorbed by the soil and plants, reducing the risks of erosion and nutrient depletion.

2) Subsurface Irrigation Systems

it's a specialized sub-set of drip irrigation where dripline or drip tape "lateral lines" (tubes buried beneath the crop rows) and supply and flushing "submains" (pipes supplying water to the lateral lines) are buried beneath the soil surface for multi-year use. Subsurface irrigation is especially suitable for hot, windy regions.

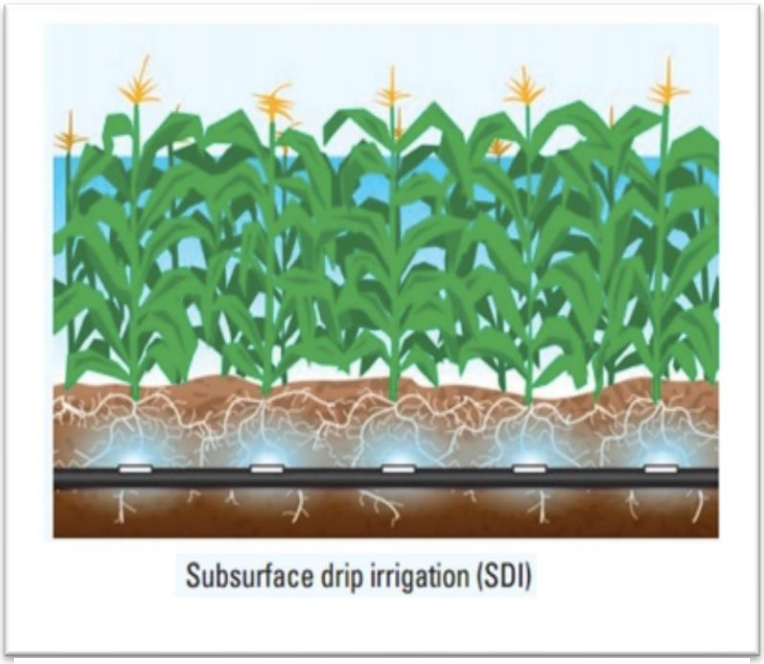


Figure 22

The SDI technique is now being used throughout the world on a wide range of grain forage and fiber crops including alfalfa, corn, cotton, soybeans and sugarcane. In addition to drip tape, thin wall integral driplines are commonly used as well.

Common advantages of drip irrigation include yield increases, water saving, crop quality improvement and better resource use efficiency. These benefits are also typical in SDI applications, along with improved flexibility, convenience and the ability to farm in drought conditions.

Disadvantages include the high initial cost requirement, clogging and leaking problems, and potential rodent damage. In addition, the problems can't be seen since they are below the ground.

Maintenance requirements are chemical injections, an annual clean-up flush, and draining the pipes before it freezes each fall.

3) Overhead or Sprinkler Irrigation:

In this method an attempt is made to simulate natural rainfall. Irrigation water is applied to the land in the form of a spray. This method is also known as sprinkler irrigation.

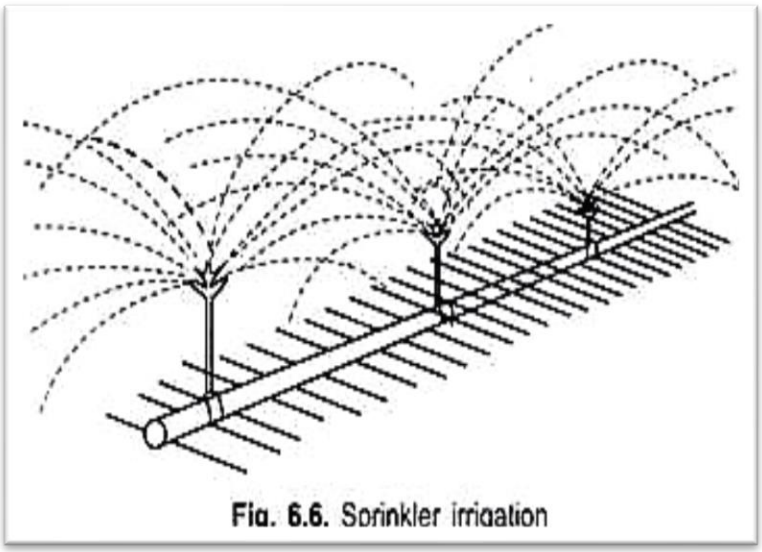


Fig. 6.6. Sprinkler irrigation

Figure 23

Sprinklers can be used on all soil types of any topography. According to the equipment and procedure used the sprinkler method may fall in fixed type or portable type.

The sprinkler irrigation system is in use since 1920 A.D. in some advanced countries. In India this method has come into use since 1950. It is mostly adopted in tea and coffee gardens. But the time has come to explore the possibilities of using this method on large scale.

By introduction of spray irrigation about 35 per cent of water can be saved which is otherwise wasted in surface methods.

Following conditions favor implementation of sprinkler irrigation:

1. When the soil is too porous for good distribution by surface irrigation.

2. When there are fields with uneven surface.

3. When soil is easily erodible.

4. When water supply is just sufficient for crop growth.

There are three general type of the sprayers. They are fixed nozzles attached to the pipe, perforated pipe and rotating sprayers.

4) Tal-Ya Plastic Trays

Tal-Ya Water Technologies in Israel developed reusable plastic trays to collect dew from the air, reducing the water needed by crops or trees by up to 50 percent.

Figure 24

The square serrated trays, made from non-PET recycled and recyclable plastic with UV filters and a limestone additive, surround each plant or tree.

With overnight temperature change, dew forms on both surfaces of the Tal-Ya tray, which funnels the dew and condensation straight to the roots. If it rains, the trays heighten the effect of each millimeter of water 27 times over.

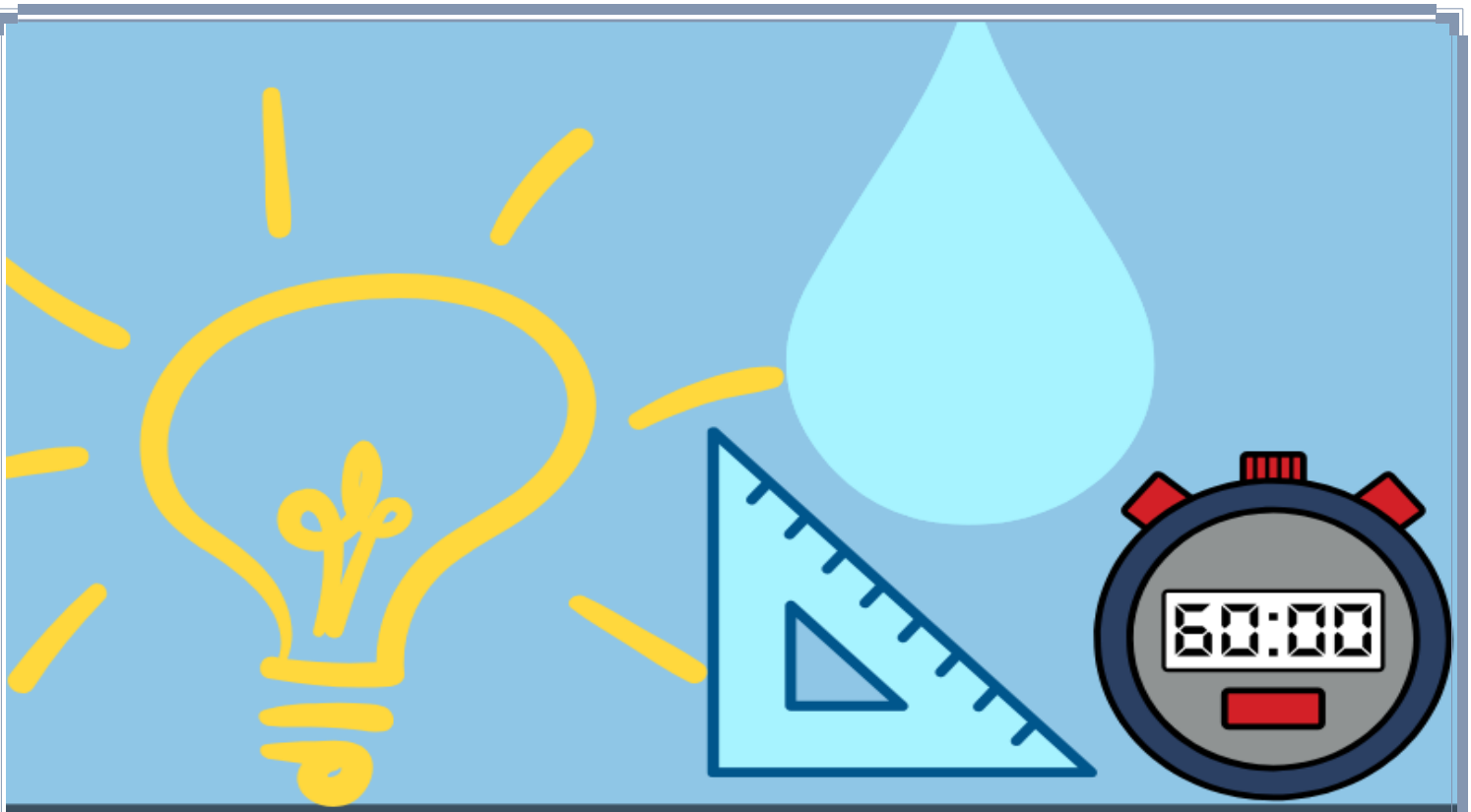
The trays also block the sun so weeds can't take root, and protect the plants from extreme temperature shifts. So, farmers need to use much less water, and in turn much less fertilizer on the crop which translates to less groundwater contamination.

What we have learned from these solutions: -

At first, we must know that many solutions in water treatment and in irrigation systems didn't achieve the efficiency it was expected to achieve it because of its high cost of money. And that any edit had been applied to any of them was to solve that problem, from these solutions was using nitrification to purify water, that it costs a lot of Money because it would need another phase of water treatment to get rid of heavy metals.

so when we were choosing our solutions we focused on specific tips that we found it was weakness points in the solutions which had been tried which are: -

1- To choose the best solution its cost must be low.
2- The materials preferred to be from nature.
3- In purifying water try to avoid chemical elements so we don't harm people or the crops.
4- In water irrigation systems, the design must be as simple as it can so it can be applied in poor cities.



DESIGN REQUIREMENTS

Design requirements

Each project cannot be executed without specific requirements that can show the success of the project.

There are a lot of design requirements that we can put to our solution like: -

Efficiency:

- Efficiency is the relationship between the output and the input.

Safety: -

safety is very important requirement in any project because the more safety the project is, the more success we will achieve.

Figure 25

To make it safety, we should use materials aren't good conductors to heat or electricity or cover the wires with plastic sheets and. we must make it safety for all ages.

Low cost: -

The cost should be suitable for the largest numbers of people to make the project more economic and successful.

We should choose materials with low cost and high efficiency and replace the expensive materials by others which have normal cost.

Figure 26

Environmental friendly:

this means that it isn't harmful to the environment or hasn't negative effect on the environment.

We can make it environmental friendly by:

1-Stop using polluter materials which affect the environment badly.

2-We should replace or remove any kind of environmentally-harmful materials.

Figure 27

Simplicity:

The design must be very simple.
Simplicity of the design make it easier to use, economical and reliable.

The product must have the least number of operations without affecting its functionality.

Our main design requirements in this project are efficiency and cost. We will choose our solution after making sure that it's the most effective way to solve our problem and it's cost will be the least possible cost.

SECTION TWO - GENERATING AND DEFENDING A SOLUTION

Selection of solution: -

After detecting the problem which we are facing this semester, have an over view on the materials available in Egypt, knowing weakness points in the systems of irrigation and the water purification ways, we have decided to work on algae water treatment.

But at first, we need to know what is algae.

Algae are generally microscopic organisms, are usually thought of as simple aquatic plants which do not have roots, stems or leaves and have primitive methods of reproduction.

They are carbon fixing and oxygenating organisms. However, some algae display primitive animal features such as motility, while blue-green algae differ markedly from plants and all other algae, in that they have a cellular structure and function that is more common to bacteria than to the plant kingdom.

Algae live in a wide range of aquatic environments and are a natural component of most aquatic ecosystems. Additionally, a great many are also terrestrial, living in soil, snow, or in association with other organisms, especially fungi (as lichens), and animals. Aquatic algae are found in both fresh and marine waters. They range in size from large kelp (meters in length) to those visible only under a microscope.

Some algae have an economic importance because they are a source of carotene, glycerol, and alginates and can be converted into a food source for aquaculture.

They can be:

Single celled

Many celled - either colonially or as filaments of cells; or

Elaborate plant bodies with differentiated cell types

Main habitat preferences:

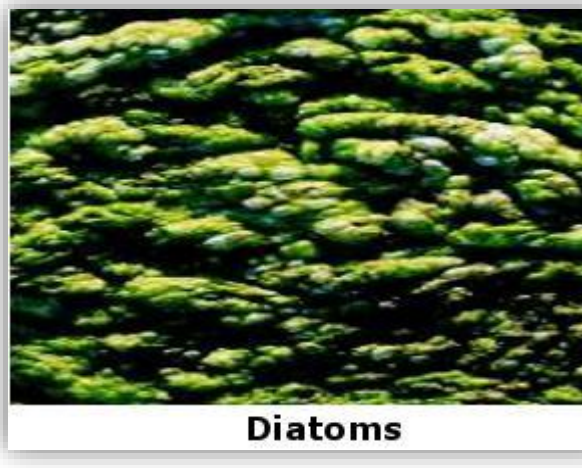
Free floating in the water column (planktonic). These comprise the microscopic unicellular algae and colonial and filamentous algae, known as "phytoplankton".

Growing as a film on rocks on the bottom (benthic) or on plants growing in the water (epiphytic). These may be single celled or small colonial and filamentous species.

Growing out into the water column but attached to a substrate at one point. These comprise the larger filamentous algae, and macro algae (e.g. seaweeds).

Types of algae

Green Algae



Diatoms

Figure 28

Figure 29

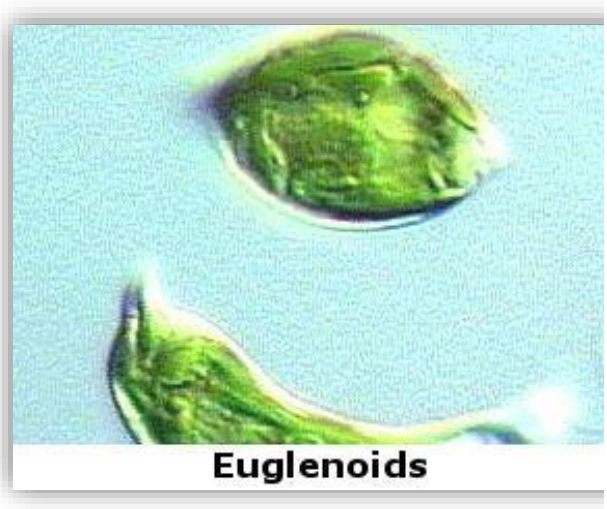


Figure 30

Figure 31

Golden Brown Algae (Chrsophyta)

Crytomonads (Cryptophyta)

Dinoflagellates (Dinophyta)

Glaucophyta

Brown Algae (Phaeophyta)

Haptophytes

Red Algae (Rhodphyta)

Yellow-Green Algae (Tribophyta)

Spirulina algae

Spirulina is a primitive form of blue-green algae called cyanobacteria, yet it has the ability to absorb sunlight and use it for energy like other types of plants. While spirulina is commonly consumed in some countries, it's primarily sold as a supplement in the United States. It's cultured for commercial use in lakes and in controlled environments such as laboratories. In warm climates it grows naturally in salty ponds and lakes.

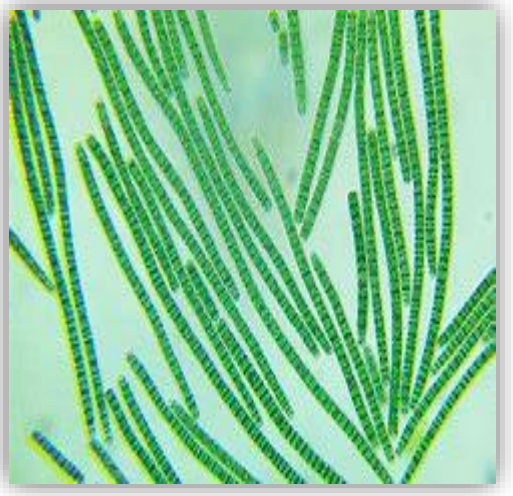


Figure 32

Advantages

When heavy metals such as lead and mercury are in the water, they're absorbed by spirulina, and you consume them along with the algae.

Spirulina also absorbs iodine, which is naturally present in water. This sounds like a benefit because you need iodine to produce thyroid hormones.

Disadvantages

During warm weather, spirulina produces blooms that contain a variety of toxins. You can be exposed to the toxins by consuming the algae, inhaling toxins or through contact with skin. Some toxins cause a skin rash or other allergic reactions.

You may experience an upset stomach, vomiting or nausea or feel extra thirsty after consuming contaminated spirulina. One type of toxin, microcystin, may damage your liver or nerves.

Getting your iodine from spirulina may cause more harm than good. Seaweeds contain very diverse amounts of iodine

Consuming too much iodine may cause an under- or overactive thyroid or increase your risk of thyroid cancer.

Euglena,

sp. Is widespread and often abundant. Euglena sp reproduce rapidly and are especially common in warm seasons.They are commonly found in freshwater streams and ponds, when they may form a green scum on the surfaces of storages,irrigation bays or drainage ditches. They are green and sometimes red. They occasionally form green or red powdery films on the surface of ponds or dams. The surface colour can change from red to green in a few hours. Euglena is free swimming in ponds and lakes and is also found in mud rich in organic matter..

Figure 33

Microcystis, (Anacystis) is probably the most common toxic algae occuring in farm dams, usually form greenish-yellow bubbly masses in still or nearly still water. The plant cells are arranged like a small hair net. A blue green algae has numerous small cells crowded within a gelatinous matrix, forming a colony which may be ovate (like an egg) or an open meshwork. Microcystis is found free floating in lakes, reservoirs and sometimes in slow flowing rivers. Colour ranges from blue-green or yellowish brown. The colonies are usually globular. A hint of red can often be seen. It is a common cause of algal blooms and can secrete chemicals that inhibit other algae. It can also produce a polypeptide which is toxic to animals after drinking contaminated water. It has also been implicated in human illnesses including necrosis of the liver (after drinking) and severe dermatitis (after contact),etc.

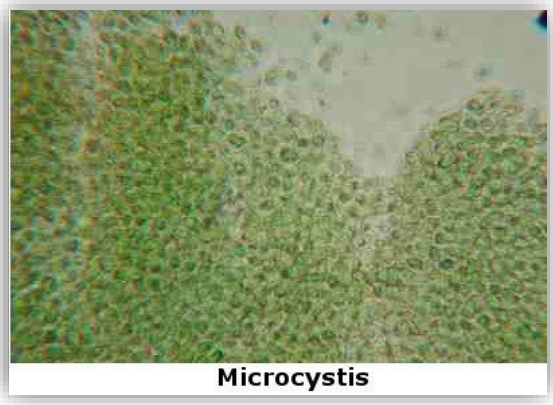


Figure 34

Dictyosphaerium Anabaena, are a blue green species which grow in spirally coiled filaments, both species often occur as water blooms which can be concentrated by wind action. It is one of the toxic blooms forming blue green alga. It is coloured grey to blue-green or even green and is free floating in slow flowing or still waters. It sometimes forms a gelatinous mass. It most often occurs throughout late spring to autumn. Some species can produce an alkaloid (similar to cocaine) which acts as a neuromuscular blocking agent causing respiratory arrest, liver and gastro intestinal damage. It may also cause cancers. Species containing this alkaloid is highly toxic and animals may die soon after drinking water containing the toxin. Some blooms also cause contact irritation leading to severe dermatitis.

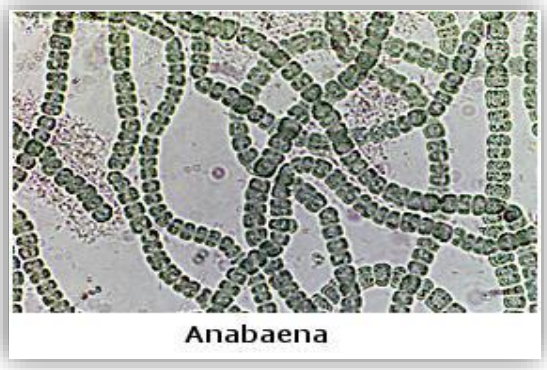


Figure 35

Nodularia is part of the Blue Green Algae (Cyanobacteria) family and is widespread. Blue greenish in colour. Usually found free floating in salt, brackish and freshwater lakes, dams and ponds. It is frequently intermingled with other algae forming extensive blooms. These blooms can cause death of stock or native animals. Nodularia produces hepatoxins that can kill liver cells, causing liver damage and gastro enteritis in humans. There are 12 known species one reported in Australia

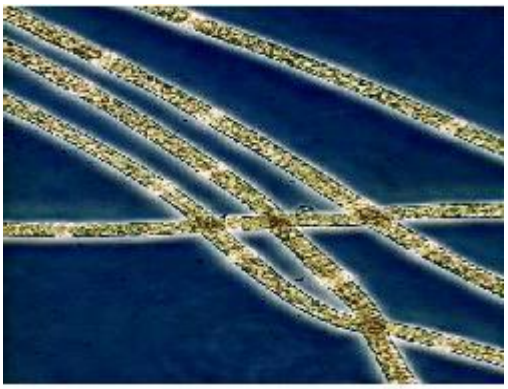


Figure 36

Oscillatoria, is part of the Blue Green Algae (Cyanobacteria) family. It is blue greenish in colour, usually free floating, cylindrical or sometimes slightly tapering, unbranched filaments in aquatic environments. Some are tolerant of high levels of organic pollution and some are shade-tolerant and able to survive in water below blooms of green algae. It is implicated in irritation of skin and mucous membranes suffered by people swimming. It is widespread and common in a variety of habitats.

Figure 37

Filamentous also known as "pond moss" or "pond scum" these threadlike algae often occur in huge greenish masses floating upon the waters' surface.T

hey can form dense mats in static water or long, rope-like strands in flowing water. Its filaments consist of series of cells being joined end to end giving a thread-like appearance.

This form begins growing on the bottom or substrate and then lifts to the surface as

Figure 38

buoyancy grows due to its production of oxygen. This form of algae may seem cottony, slimy, or coarse in texture.

Figure 39

Spirogyra, very common green algae which feel like wet, soapy hair, bright green in colour often found free floating in static water near the surface or in masses in the sediment. Sometimes forms extensive mats in rivers, dams, ponds and often blocks channels.

Figure 40

Chlorella, a small grass-green plant which usually stores starch.

Chara

They dark grey-green with orange or green pinpoints on the branches. Chara often grows at the bottom of lakes in fresh and also some brackish waters one to six metres deep. Chara is common in freshwater areas with silty or sandy beds. It is usually more noticed in droughts when the water level drops.

.

Figure 41

Oedognium - A free floating green filament usually attached to rocks in still or moving water. Also found on wood and some aquatic plants..

Figure 42

Phormidium - Is widespread. It is blue greenish in colour usually attached to rocks, debris or sediment in fresh and salt water.

Sometimes found on damp soil. The filaments form a consistent mass.

Figure 43

Green Algae

Green algae range in size from microscopic to large plants, and canbe single celled, colonial, or filamentous. Some of the single celled and colonial green algae have small tails or "flagella" attached to each cell, which they use to swim. However many green algae are non-motile. Green algae may be either planktonic or attached. They show the greatest diversity of shapes, sizes and species of any group of freshwater algae. Green chloroplasts are frequently observable within the cells of green algae when looked at under a microscope.

Blue Green algae

Blue-green algae or **Cyanobacteria** are microscopic cells that grow naturally in Australian fresh and salt waters. They are a type of bacteria, but in some ways act like plants by using sunlight to manufacture carbohydrates from carbon dioxide and water, a process know as photosynthesis. In doing so, they release oxygen. They grow in dams, rivers, creeks, reservoirs, lakes and even hot springs.

Figure 44

When blue-green algae bloom, that is, grow to large numbers, they can form thick accumulations on the surface of the water. These accumulations are commonly known as scums. Blue-green algal scums form when large numbers of the algae float to the water surface using vesicles within their cells that they inflate with gas. Coming close to the surface enables them to gain maximum sunlight.

Problems associated with blue-green algae: -

1- Unpleasant Odours & Tastes.
2- Filters on pumps and machinery clog.
3- Large fluctuations in pH.
4- De-oxygenation due to decomposition endangers fish.
5- Increased costs of operating water treatment plants.
6- Poor aesthetics spoil recreation and tourism.
7- Poisoning of humans & **livestock**.
8- Skin irritation in humans.

Blue-green algae produce highly potent toxins

The main cause of concern about blue-green algae is the ability of some to produce highly potent toxins. There are four different forms of toxins that can be produced:

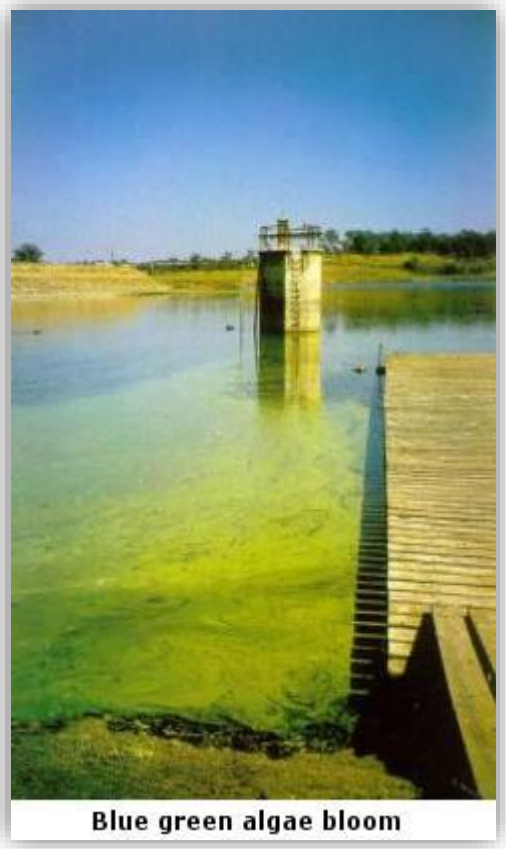

Blue green algae bloom

Figure 45

Hepatotoxins: These attack the liver and other internal organs of the poisoned victim. Some have also been identified as cancer promoting substances.

Neurotoxins: These act as neuromuscular blocking agents, leading to respiratory arrest.

Endotoxins : These are contact irritants, and can cause severe dermatitis and conjunctivitis in people coming into contact with the algae through swimming or showering. They may also cause stomach cramps, nausea, fever and headaches if consumed. Their presence in airborne droplets can cause asthma. Some are also thought to be possible tumour promoters, although this has yet to be shown.

Non-specific toxins: These are relatively slow acting general toxins which progressively damage most organs, including the liver.

Toxic blue-green algae

The five main toxic blue-green algae are: *Anabaena, Microcystis, Cylindrospermopsis, Oscillatoriaand Nodularia.*


Blue green algae

Figure 46

Anabaena, and Microcystis are the two main bloom-forming genera in waters. Anabaena forms long chains of cells, called a trichome,(hair like structure) which sometimes grow in a spiral, depending on the species.

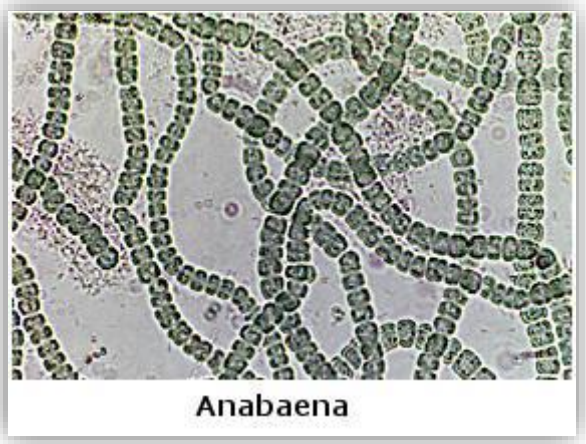


Figure 47

Microcystis aeruginosa is most common in lakes and reservoirs. It forms irregularly shaped colonies of cells up to 1 to 2 mm wide that can be visible to the naked eye. Microsystis blooms can be quite persistent lasting for months, or even years in some cases.

Nodularia often forms thinner scums than those of Anabaena and Microcystis blooms. Nodularia, like Anabaena, forms chains of cells or trichomes. Although it occurs in fresh waters, it is more common in brackish waters.

Cylindrospermopsis is commonly thought of as subtropical blue-green algae, but it also occurs in more temperate regions during the summer, including parts of Australia. It has very tiny cells that form chains or trichomes. It is a freshwater species, and causes problems in town water supply systems due to its highly potent toxins.

Figure 48

Oscillatoria is blue greenish in colour, usually free floating or entwined with other algae. It is widespread. There are approximately 150 known species of which 47 are known to occur in Australia. Some species causes contact irritation leading to severe dermatitis.

Figure 49

After searching we have decided to work on chlorella algae, Chlorella is a small grass-green plant which usually stores starch and it's very common in nature along the rivers.

Algae water treatment is a very efficient way to purify water.

The whole process is about the asexual reproduction of algae in a suitable media which contains all the nutrients which can be needed for its growth and reproduction.

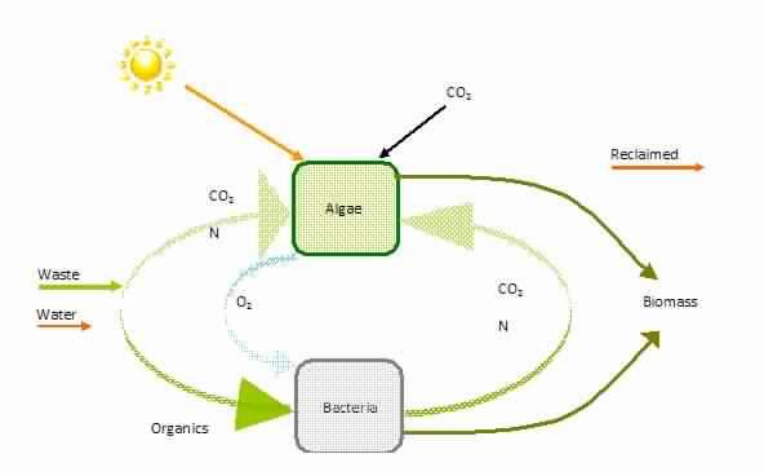


Figure 50

Photosynthesis begins and algae start to reproduce feeding on ammonia, heavy metals and simple elements in water resulting for us pure and clean water.

After that the solid particles "algae" is separated from water by the centrifugal machine and the biomass product can be used in many fields of life.

In our project which suppose to help also improving agricultural methods we have decided to use the bioproduct as a fertilizer, which is rich in many elements and it

can fix any type of soil.

Our solution meets all our design requirements and especially our main 2 design requirements which are efficiency and cost.

That it’s:
1- chlorella algae can get rid of ammonia, heavy metals and simple elements we won’t need any more phases to reduce any ratio of any of them.

It doesn’t hurt the environment so it’s and eco-friendly solution.

It’s safe for human, animal and agricultural uses.

It won’t be expensive as I mentioned that it reduces all the harmful components in water and it’s very common in nature.

The bioproduct which can be used in many things increases this solution’s efficiency.

and it’s a very simple solution which all of its materials and methods are simple and easy to be made.

Selection of prototype: -

For our prototype, there were more than one necessary design requirements which we were careful to apply in our prototype. The most important two were efficiency and cost.

We also chose other design requirements which are: -

1- Simplicity
2- Safety
3- Eco-friendly

We had applied all of them in our prototype.

Our prototype can be tested by analyzing the water. That can be done by pH meter, and simple elements and heavy metals analyzing tests in labs.

Its design requirements also can be tested through the following methods: -

1- Cost can be calculated from the used materials prices.
2- Efficiency can be calculated by comparing the water analysis before treatment and after treatment and if there is additional uses of any wastes in the solution.
3- Simplicity appear in the prototype's design.
4- Safety will be recognized in the analysis of water after treatment, that it must be in the allowed range in the fixed standard of irrigation water.

5- It will be recognized also if the water is harmful or not to the environment through the water analysis after treatment.

SECTION THREE:
-

CONSTRUCTING AND TESTING A PROTOTYPE

Materials and Methods

Materials	picture	cost
Chlorella algae (~ 100 gm)		31 L. E
Air pump		From lab
Centrifugal machine		From lab
2 Plastic bottle (1L)		Recycled bottles

Sand soil		***Wasted soil***
Glass box		***--- From Fab lab***

Our safety precautions weren't too much, that we have just to wear gloves during dealing with algae.

Test plan

Our design requirements are:

1- Efficiency.
2- Simplicity
3- Cost
4- Eco-friendly.
5- Safety

Steps of the test plan

1. At first, we searched for places where we can get agricultural irrigation wastewater and then we brought 2 L from El-Qanater agricultural water bank.

2. We then applied the first primary treatment process that involves the settling process which is the process of removing large pieces of debris and any other large solids.

3. Then, we sent one liter of them to be analyzed in the laboratory so as to be able to compare our results after treatment with it and we then started to work on the other liter of water.

Figure 51

4. We then started to apply our main treatment process using the Chlorella algae. We used 100g of algae to treat 1 liter of water and it was a very suitable scale which is 1: 10 (100 gram of algae per 1 liter of water).

5. We put the water with the algae in a plastic bottle. Then, we expose the bottle to a source of light (light bulb) so as to provide the algae with a suitable medium to start the photosynthesis process and therefore reproduce quickly.

6. We then used the air pump and put it in the bottle so as to quickly

stir the water with the algae and therefore rapid its reproduction.

We also closed the bottle with a piece of cotton so as not to be affected

with any external environmental factor.

7. We then left it for 4 days and in the forth day we used the centrifugal machine to detach liquid water from the solid algae.

8. Then a sample of our treated water was sent to be analyzed.

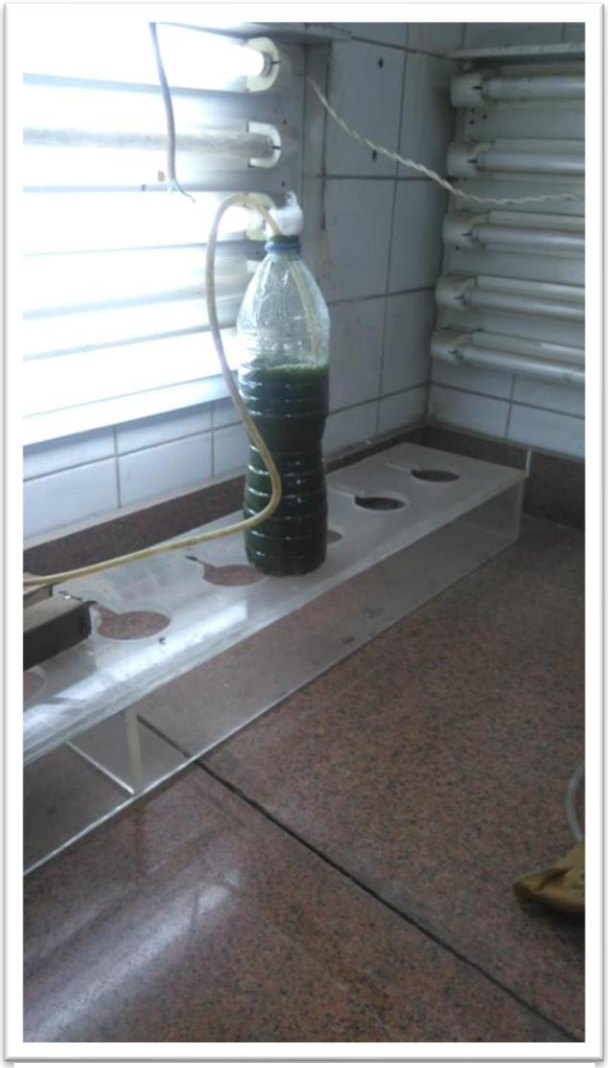


Figure 52

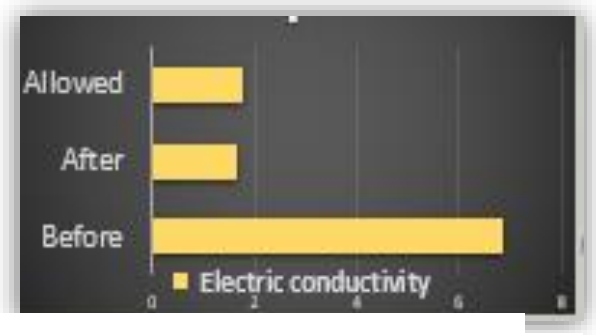
- At last, we were able to compare the results of the first analysis with

the second one to make sure that we have achieved our first design

requirement which is the efficiency (water quality).

Also, as an addition, we brought a glass box and we put in it sand soil (that reassembles dessert soil). We then add the algae biomass which is the byproduct of our treatment process to it. This is because it works very well as a fertilizer and can be used to fix any soil the thing that made our solution more efficient especially in the agricultural field.

Data collection



After comparing the final water analysis results by

the first one, we found that our efficiency in

Table 1

	Before	After	Efficiency
Total N	42 ppm	28 ppm	33.3%
K	60 ppm	11.5 ppm	80.8%
Ca	160 ppm	50 ppm	68.75%
Mg	141 ppm	26.5 ppm	81.21%
Na	500 ppm	128 ppm	74.4%
Average	-	-	67.69%

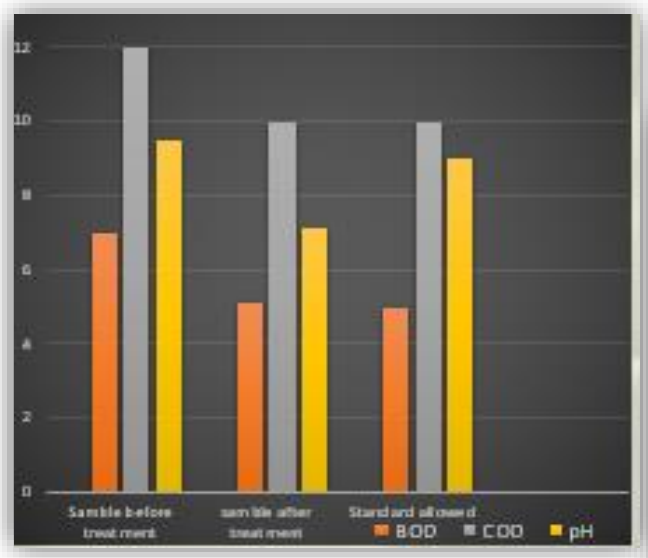
reducing

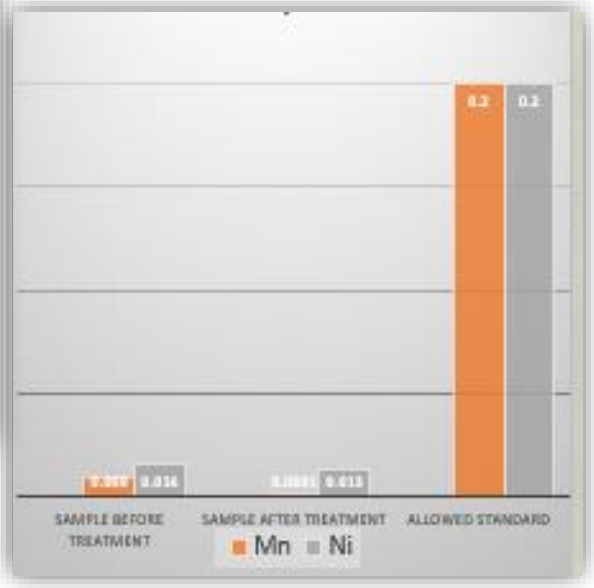
heavy metals and simple elements was 63.5%.

The water conductivity after treating became 1.633.

And about heavy metals by its own we have reduced it by 58.8% and simple elements by 67.69% .

graph 8 *graph 7*





From previous mentions, we found that our results are suitable to be used as irrigation water according to the standards of the irrigation water in Egypt.
As the pH of water after purification is 7.1, and the COD is 10 ppm, the BOD is 5 ppm, which are perfect results for the irrigation water.

To collect these data, we used pH meter from chemistry lab, we also analyzed water (simple elements and heavy metals analysis) in Agriculture Research Center.

SECTION FOUR: - EVALUATION, REFLECTION, RECOMMENDATIONS

Discussion: -

In conclusion, the water crisis in Egypt requires our hard work in order to be able to maintain sustainability for the coming generations. Our project will make a difference and limit the impacts of this problem, by providing a new renewable source of water that we have produced from treating agricultural wastewater using chlorella algae that it is naturally grown in fresh water. We concluded that algae can greatly remove heavy metals, carbons and ammonia from water with efficiency of 58.8% with heavy metals and 67.69% with simple elements, and in general it reduced both of them by 63.5%, and it also gives a normal ratio of BOD, COD and pH. In addition to the biomass produced from the treatment process that can be then used as a fertilizer to improve the agricultural soil and also used in many other fields. In fact, our project has achieved all of our determined design requirements and more as:

- Its efficiency: as depending on the water analysis, the water quality after treatment, compared to the determined standards, is very suitable to be used in the irrigation process.
- Its low cost: that it can be afforded by anyone and by Egypt on the large scale.
- It is a safe, simple, and an eco-friendly one that it does not produce any harmful gases or toxins.

Not only that, but also by comparing our solution to the prior solutions which we searched before, we would find that algae are the most effective way to treat water as it doesn't need many phases to be applied in the treatment process treat. On the other hand, most of the prior solutions need many more phases of treatment that makes it much more expensive to be applied on the large scale and as a result it isn't so effective to be applied, so our solution is a really perfect way to solve our problem.

Figure 53 water analysis after treatment

And finally, all our measurements were accurate in collecting all the data and the water analysis was supported by Agriculture research center.

Recommendations: -

There are many other things that could be applied in the future in our project, so we recommend anyone that aims to improve our project to:

· Make use of the biomass produced from the purification process and reuse it to perform another function such as following: -

1.Using it as an animal feeding after triturates it, if the ratio of heavy metals in algae is small.

2.Using it to produce bio fuel- that will help solving the energy crisis in Egypt.

· Combine the treatment process with a complete closed irrigation system that can save our new produced source of water. This irrigation system could be the drip-irrigation system as it saves about 70% of water used in the irrigation process by reducing the rate of the vaporization process. To increase the system's efficiency we can use mulch" which can be rice straw" and put it on the soil to efficiently decrease the rate of vaporization. We can also use DHL sensor to detect the humidity of the soil so as to start the irrigation process only when it is needed.

Search for chemicals that could be used in the BG medium of the chlorella algae in order to increase its rate of reproduction.

About the Bg media : - Broth is a universal medium for the cultivation and maintenance of algae.

Composition

Ingredients gm / liter Sodium nitrate 1.500 Dipotassium hydrogen phosphate

0.0314 Magnesium sulphate 0.036 Calcium chloride dihydrate 0.0367 Sodium carbonate 0.020 Disodium magnesium EDTA 0.001 Citric acid 0.0056 Ferric ammonium citrate 0.006 Final pH after sterilization (at 25°C) 7.1 **Formula adjusted, standardized to suit performance parameters.

Principle and Interpretation

This medium supports growth of algae. They require light as source of energy. Synthetic nitrogen and carbon sources and other inorganic salts comprise this medium. Exposure to light intensity of 2,000 to 3,000 lux is optimal for cultivation of algae. Neon light source is found to be sufficient to provide this illumination. For maintenance of algae exposure for period of 24 hours a day is optimal .Often the flasks kept for incubation may be covered with grease proof paper. They grow optimally at room temperature between range of 20-25°C. Similar medium with added trace metals is cited in ATCC as Medium 616 for maintenance of Synechocystis species (3).

Learning transfer

1. In Biology :-

- We have learned a lot of genetic modification which is a process of manipulating genes and extracting them from specific species with desirable traits and then inserting them in another specific species that we want them to show these desirable traits. We have also learned about the selective breeding process which is a process of selecting for example crops with desirable traits and let the grow and reproduce more and more crops that show these desirable traits. Genetic modification can help a lot in saving water for agricultural foe example :

1- We could inserting specific genes to specific plants in order to let them grow with sea water instead of fresh water.

2- We could also inserting specific genes to the plants that enables them to grow consuming less water than they normally consume.

- There are many genetic modifications that can be applied to the plants or the soil that will help in saving water in the agricultural process, but in fact the genetic modification process requires relatively high cost and requires mush time to be tested , so we did not use this method in our capstone project.

- We were able to explain the intended and unintended consequences of the use of GMO’s and Describe the trade-offs of the use of genetically modified food.

- It also helps us to know much information about the advantages and disadvantages of the GMO. Also the description and how to do it well.

- We used it as a base information to provide the probability of the choice of using this idea in our capstone or not.
- It helps us to know the methods of making practical GMO or Selective breeding We used it during searching about the idea of the project to know more about these methods.

2. In Earth science :-

- We have first learned about the unusual properties of water as the polarity, the high specific heat, the hydrogen bonding between its molecules, adhesion and cohesion , high heat capacity and many others. Some of these unusual properties of water contribute to its pathways through earth's system as:

- The adhesion and cohesion properties of water and also through surface tension make it flow from the roots of the plant through the stems and leaves and then into the atmosphere which results in changing the pathway of water from underground to the atmosphere.

- The high heat capacity of water that help in moderating the earths temperature, but with climate changes and very high temperatures the water changes its pathway from oceans ,seas and lakes into the atmosphere through the evaporation process.

This topic was very helpful for us in searching the learn more about water and to collect information about the best source and situation for water to be used.

- We have also learned about the water cycle and the aquifers of water whether it is underground or surface water. In addition to the processes involved in the water cycle such as the condensation process, the precipitation process and also the surface run off and the infiltration process.

- It helps us to know information about the basic methods of treatment of water. We used it to know about the primary and the secondary phases of treatment of water which we used as a main part before applying our main treatment process using the algea.

3. In Chemistry :-

- It helps us to know more about the quantitative analysis like knowing the TDS (Total Dissolved Solids) and PH (measuring the rate of acidity or basicity of the water).

- We used it to measure the TDS (Total dissolved Solids), PH (measuring the rate of acidity or basicity of the water) and also know how to reach to the rate of having irrigation water.

- We have learned about some of the ways that we could apply to our treatment system such as : the use of resins, the alum (Aluminum sulphate), the simple and fractional distillation processes. In addition to the basic filtration process.

- It also greatly helps us with the use of some devices as the pH meter and the TDS which we used to analyze the water samples.

4. In Mathematics :-

- It helps us to know more about the polynomial and rational functions and how to use and interpret them on the graphs.
- We mainly used them during the analysis of our obtained results as we have first recorded them and then designed graphs for them using these functions.
- We also have learned about the rules of probability to solve problems and predict results and behavior.
- We used it to predict the results of our project through the data which we have to know how it could be approximately.
- We have also learned about the absolute value functions which It helped us to get the absolute values of many real numbers.

5. In English :-

- We have been learning about factual presentations that present information, finding and supporting evidence clearly that helped us a lot to justify the problem we are solving with our capstone project.
- We have also learned about mind mapping strategies which are strategies that we can follow to generate different ideas, organize them to choose their best in order to solve a specific problem or achieve a particular task.

- Mind mapping helps us a lot with our capstone project as we used it a lot during our capstone meetings to first searching the problem as we used a mind map to generate all of the causes we could think about that are related to the water scarcity problem in general and the problem of the huge water loss in the field of agricultural specifically in Egypt. It was also very helpful for us during selecting our solution after searching a lot of prior solutions
- In addition, we have learned a lot about the use of the English language in the presentation skills that really improved and developed our skills that we need during the exhibition and the evaluation.