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# “New Land, New Life” Project

## West of the High Dam Lake, Aswan, Egypt

### Adaptation to Climate Change

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#### **Final Technical Report**

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## Table of Contents

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KEY WORDS .....	3
ABSTRACT .....	4
BACKGROUND AND PROBLEM STATEMENT.....	5
OBJECTIVES.....	10
METHODOLOGY.....	11
KEY STUDIES & RESEARCH ACTIVITIES UNDER OBJECTIVE 1: .....	15
KEY STUDIES & RESEARCH ACTIVITIES UNDER OBJECTIVE 2: .....	19
KEY STUDIES & RESEARCH ACTIVITIES UNDER OBJECTIVE 3: .....	35
OUTPUTS .....	42
OUTCOMES.....	46
ASSESSMENT AND RECOMMENDATIONS.....	48
ANNEXES.....	51

## **Key Words**

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Adaptation to climate change; Agricultural Research; Agro-forestry; Aswan  
Biological Research;  
Capacity building; Ecological Research; Eco-system; Egypt; EUREPGAP;  
Socio-economic assessment; Soil management;  
Vector-borne diseases; Water-borne disease; Water Quality; West Lake Nasser;

## Abstract

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This applied action research project aimed at studying the possible human and environmental effects of climate change on the new resettlement area west of the High Dam Lake in Aswan and the linkages between climate change and factors such as water and vector-borne diseases, land degradation and management methods, temperature fluctuations, agriculture, and socio-economic aspects of the settlers' community. Ultimately, the project incorporated various stakeholders, encouraging social capital formation among resettled communities and participation and cooperation from policymakers.

The first objective of the action research was to assess the impact of climate change in Lake Nasser in relation to human health particularly the existence, potential emergence, or increase in waterborne/vector-borne diseases. Results proved that the rise in temperature results mainly in water fluctuation, pollution related to bacteria, presence of algae intensification, and water-borne diseases.

The second objective of the research was to build the settlers' capacity enabling them to adopt more efficient and sustainable behavioral, environmental, institutional and technological adaptation strategies and methods/interventions that adequately mitigate the risk of disease and environmental hazards caused by climate change on human health. The project enabled the farmers to start using drip irrigation, organic fertilizers and dry active yeast; allocating water correctly, and introducing and cultivating new crops, which are heat resistant.

The third objective of the study was to derive adaptation strategies relevant to and in participation with the public health sector and other stakeholders, for the betterment of national resettlement and development schemes. The applied research team conducted capacity building and workshops for the participants and at the policy level. Conservation plans and strategies, intended to build capacity to support the conservation of the region's soil and water resources, were developed. This adaptation strategy is now incorporated in the main strategy of the High Dam Lake Development Authority.

## Background and Problem Statement

### Activity Site

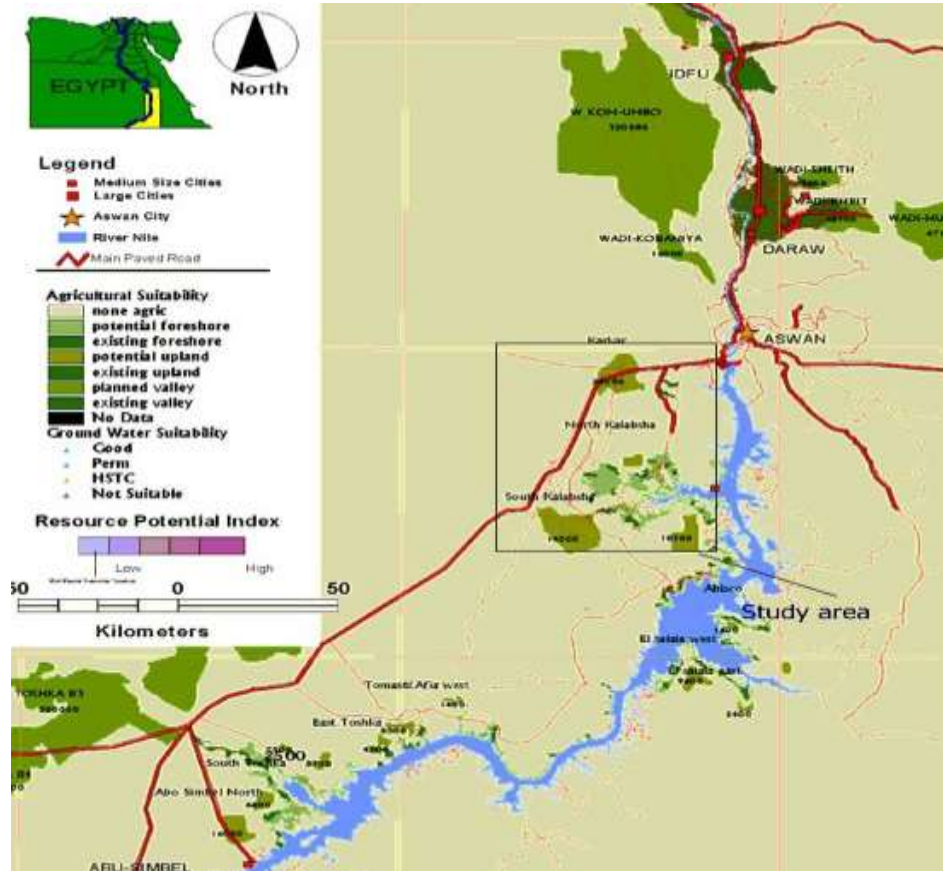


Fig. 1: The WLNA Study Area<sup>1</sup>

The site of the research, undertaken in the past few years by the Near East Foundation Egypt (NEF) and its affiliate the Center for Development Center (CDS), is located in Aswan Governorate, specifically in the New Kalabsha area, Nubia. This area is situated west of Lake Nasser, a small distance south of Aswan city. The Government of Egypt (GoE) has been implementing for the past decades a new national policy that entails moving populations from the overcrowded Nile Valley and resettling them in new communities in newly reclaimed desert lands. This policy is also meant to address the lack of employment and livelihood opportunities faced by graduates who want to reclaim lands and attain a higher overall degree of food security for themselves and for the country as a whole. The area would settle emigrant peasants and fishermen from Upper and Lower Egypt. This new society is comprised of four (4) villages, namely: New Kalabsha, Garf Hussein, and Bashayer El-Kheir, located 100, 150, and 220 km from Aswan respectively. The World Food Program (WFP) and the Egyptian Ministry of Agriculture and Land Reclamation (MoALR) have built these three villages jointly. The areas west of Lake Nasser and

<sup>1</sup> [http://www.tt.fh-koeln.de/semesterprojects\\_extern/egypt\\_08/05.Study\\_area\\_map.htm](http://www.tt.fh-koeln.de/semesterprojects_extern/egypt_08/05.Study_area_map.htm)

Toshka, more to the south, are two (2) of the most prominent resettlement areas targeted by the Government. The villages hold a population of approximately 4,500 individuals in 2006. Agriculture and fishery are the mainstays of the economy in the area. These areas are to welcome approximately one (1) million people to be resettled in twelve (12) new communities by the year 2017.

As the world's largest man-made lake, Lake Nasser is approximately 310 miles in length (1550 square miles) and, in places, can reach a depth of 600 feet. The southern third of the lake is in Sudan and is called Lake Nubia. The lake is 312 miles (480 meters) long and covers an area of 2026 square miles (5,248 km<sup>2</sup>). It has a maximum depth of 426.5 ft. (130 m) but its mean depth is 82.6 ft. (25.2 m). The Egyptian portion is 202 miles (324 km) long and has a shoreline of 4,875 miles (7,844 km).

The shoreline is a variety of desert landscapes, hilly and rugged, or flat and sandy with clean freshwater beaches. The lake is remote and thinly populated by peasant fishermen. The local residents are Bedouin camel and sheep herdsman who are occasionally seen grazing their flocks on the sparse vegetation at the edge of the lake. There are an impressive variety of birds, mammals, and reptiles. Lake Nasser is a place where a small group of anglers have literally hundreds of square miles to themselves. Thirty-two species of fish, as well as Nile River crocodiles, are found in the lake. Because it is rich in sediments and nutrients, the lake supports an abundant fish population<sup>2</sup>.

### Rationale for Selection of Research Sites

The areas west of Lake Nasser are vulnerable to economic and environmental fluctuations, particularly climate change. All of the new resettlement villages lack extension services and other advisory services on agriculture, water management, production, and marketing. New settlers take up houses and lands but receive no assistance in terms of what to cultivate, when and how. All of the new resettlement villages lack proper health and medical care services; and where they exist, they are inaccessible by settlers or helpless because they are poorly equipped and maintained.

Agriculture and fishery are the mainstays of the economy in the area. Farmers are mainly supported by WFP and to a lesser extent the High Dam Lake Development Authority (HDLDA). Each farmer is given five feddans (1 feddan = 1.038 acres) to reclaim and grow. The cost of agricultural production is very high due to the high dependency on fossil fuel (diesel) for pumping water (since there are no other alternative resources to pump water in the area), and the yield is low due to low soil fertility. Dependency on diesel causes the cost of food production to increase as the price of fuel increases. This raises the question of economic justification of the whole land reclamation strategy.

### Climate Information

This activity site lies in the region of Nubia, which has one of the harshest climates in the world. The temperatures are high throughout most of the year, and rainfall is infrequent. The prevailing winds can cause problems regarding to agricultural fields and villages. They usually blow from the north in winter and from the west and southwest in spring. The latter are called "Khamaseen" winds. These climactic conditions are probably unpleasant at times, but agricultural fields usually yield enough food to support the Nubians.

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<sup>2</sup> [www.water-alternatives.org](http://www.water-alternatives.org)

Weather information about Aswan, one of the hottest and driest regions on earth, was taken into consideration while implementing the project; and after so many years of the existence of Lake Nasser, it has proved to have no effect in improving the harshness of this climate. In Aswan, (altitude: 192 m or 630 ft.), the average temperature is 26.7 C. 10.0 C is the lowest average monthly low temperature (occurring in January) while 42.0 C is the highest average monthly high temperature which occurs in June. This gives us an average range of temperatures of 17.0 C. In general, the minimum annual temperature in Aswan is 10.0 C and the maximal annual temperature is 42.0 C. Aswan’s climate enjoys an average of 1 day per year with greater than 0.1 mm (0.0 in) of rainfall. Relative humidity in Aswan averages 31% over the year, while 20% is the lowest average monthly relative humidity, which occurs in May, and 46% is the highest average monthly relative humidity, which occurs in December.

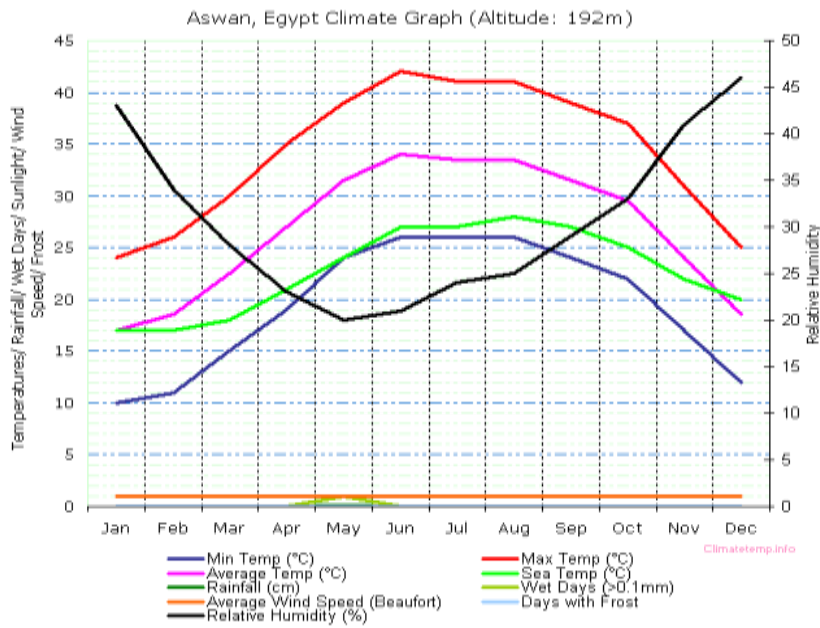


Fig. 2: Annual Climate Temperatures in Aswan

There are several environmental constraints and health threats that are associated with socio-economic and demographic factors, such as age, income, marital status, preexisting health conditions, or gender, which could increase the risk and danger of climatic change. Of particular concern are the temperatures that are often very high during summer; the low relative humidity, which presents the potential for drought; sandy soil, which, particularly when coupled with the previous two factors, means increased likelihood for sandstorms.

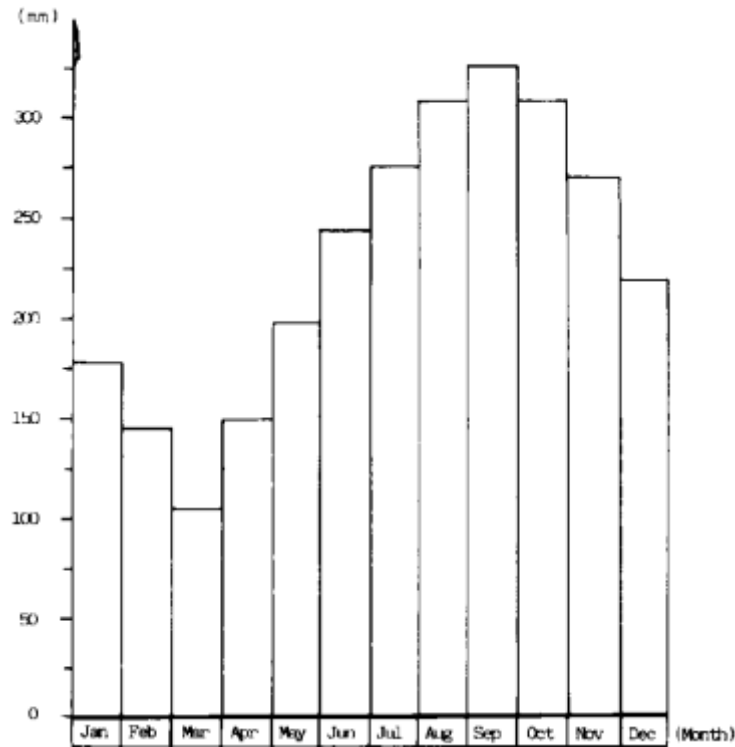


Fig. 3: Monthly Evaporation Rates for Lake Nasser<sup>3</sup>

According to previous estimates of average annual evaporation from the lake formed by the High Dam falls within the range from  $4.65 \text{ mm d}^{-1}$  to  $7.95 \text{ mm d}^{-1}$ . The difference between these limits - more than 7 billion  $\text{m}^3 \text{ yr}^{-1}$  at the highest storage level - is nearly one-eighth of Egypt's annual share of Nile waters, and more than one-third of the share of Sudan. It is also more than the estimated increase of the annual water need for Egypt between 1990 and 2000. This state of affairs renders proper management of the river flow for the sake of Egypt and Sudan quite difficult<sup>4</sup>.

The Kalabsha area is so near to Lake Nasser that it derives its needs of water by direct pumping from the Lake. But because most of the agricultural activities are on higher grounds than the Lake level, some canals have been dug from the lake to certain distances inland, and the pumps are situated at the blind end of these canals. If due to climate change, the Lake level becomes lower than the usual average, these small farms will need to rely on seepage from the Lake into nearby groundwater aquifers sandstone layers, through geological faults. The special distribution of water seepage from the Lake Nasser to its adjacent shallow Nubian sandstone aquifer - seismically active area called Khor El Ramlah-west - contains the Khor El Ramlah regional fault<sup>5</sup>. The resulted 2D inversion models revealed low

<sup>3</sup> <http://www.unu.edu/unupress/unupbooks/80858e/80858E05.htm>

<sup>4</sup> Hegazy, A. K.; Medany, M. M.; Kabieli, H. F. and Maez, M. M. (2008) Spatial and temporal projected distribution of four crop plants in Egypt. *Nat. Res. Forum*, UNU 32: 316-326.

<sup>5</sup> Khalil M. A., Monteiro Santos F. A., Moustafa S. M. and Saad U. M. (2009) Mapping water seepage from Lake Nasser, Egypt, using the VLF-EM method: a case study. *J. Geophys. Eng.* 6 :101-110.



resistivity zones that were interpreted as correlated: (1) to sandstone formation saturated with water from seepage, and (2) to a NW–SE fault that may represent a preferential path for the water flow from the Lake to the onshore aquifer. Thus water resources may still be available for irrigation and household purposes, but from the groundwater aquifer and probably direct withdrawal from the Lake may be difficult or too expensive, especially if agricultural activity is going to extend more westwards. The point is that water resources will not be so badly affected, but might be more expensive to get.

The good news about water resources in the Kalabsha area is that the Nubian aquifer, a fossil groundwater reservoir, is significantly affected by recharge from Lake Nasser and the Tushka Lakes; to date, amounting to 109 m<sup>3</sup>. After the lake reached maximum storage capacity, annual recharge decreased from 107 m<sup>3</sup>/year in 1996 to 106 m<sup>3</sup>/year in 2002. The trend of decreasing recharge is consistent with the gradual reduction of hydraulic gradient between the lake stage and the groundwater level in the Nubian aquifer. Since 1998 excess water in Lake Nasser has been routed through existing flood diversion to the Tushka Lakes. The recharge from these lakes to the Nubian aquifer has been rising (105 m<sup>3</sup>/year in 1998 to 106 m<sup>3</sup>/year in 2002)<sup>6</sup>; currently, recharge from the Tushka Lakes approximates recharge from Lake Nasser. Continuous encroachment of Lake Nasser water onto the lowlands could increase opportunities for sustainable use of fossil water of the Nubian aquifer, now being replenished by Lake Nasser.

Despite efforts to reduce any effect of degradation of the Lake Nasser reservoir, the diesel-powered water pumps are proving to be a serious source of pollution in the area. Additionally, because the Lake is used for sanitary and agricultural drainage, schistosomiasis (carried with the settlers from their previous homes) is common among fishermen, boats are painted in the water further contaminating it, and birds that may carry disease are caught for food. Water borne diseases also prevail. Other health risks include the low diversity of foods (lacking especially in proteins), poor and inaccessible medical services, small or nonexistent supplies of anti-poisoning sera to treat snake and scorpion bites, solar allergies, skin diseases, and harmful pollutants like *Ascaris*, uric acid, and oxalate, which are all common. This is in addition to facing hardships and uncertain livelihoods as a result of poor adaptation to the new living conditions and lack of prior preparedness by the settlers for their new lives in these lands. This description may paint a somber picture of the situation, but it is all that can be done by the local authorities. Additional satisfaction of basic needs of the settlers has to come from civil society.

This situation is further aggravated at the national level. Egypt is currently facing a problem of water scarcity; its water quota will have to be sufficient for the coming generations and for all forms of human and development activities. With the multiple uses of water (domestic and hygiene, drinking, irrigation) and limited underground water resources, the demand on water is expected to increase significantly. Lake Nasser holds the main strategic water storage body for the whole country with a capacity of 130 – 150 BCM, which is triple the annual water quota that Egypt is entitled to, according to the Nile Basin Agreement. The water quality is threatened by pollution because of non environmental-friendly agricultural practices by settlers, poor agricultural drainage systems, fishing activities and other human activities. Its wide-open water surface is subjected to evaporation.

Agriculture is the main human activity on which human resettlement and development plans are based; lack of irrigation water therefore is one of the major threats to settlers' livelihoods and to the development efforts in general, considering the current irrigation methods that farmers adopt. The most common irrigation method in the area is flooding or surface water irrigation. This causes up to 30%

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<sup>6</sup> [www.whrc.org/resources/publications/pdf/VanoetaIJR.06.pdf](http://www.whrc.org/resources/publications/pdf/VanoetaIJR.06.pdf)

water loss through evaporation or run-off, compared to other irrigation methods, like sprinkling or drip irrigation, where water is in covered pipes and thus protected and less subject to evaporation. Agricultural inputs/outputs are related to and dependent on the fluctuating water level in the Lake. Permanent and shore lands are both affected by the water level fluctuation but in different ways and, accordingly, making the current methods of agricultural activity unsustainable. Crops grown on the shore land are either submerged, when the water level of the Lake increases, or die because the water level has decreased causing water to be too far away to reach the plants.

## Objectives

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The general vision of the project is to reach the status where the “new resettlement communities living around Lake Nasser have the means (skills & knowledge) for improved wellbeing through long-term livelihood enhancement and health empowerment strategies put forth by the creation of informed and responsible policy. Policy makers are informed and involved in the process of resettlement. Community members are educated on local conditions and policy concerns, which will engender cooperation among themselves and the policy community, leading to more integrated resettlement policies. Marginalized and vulnerable groups living around Lake Nasser – in particular divorced and widowed women – are incorporated into the larger community, and have access to education, knowledge, and sufficient livelihood options for income generation, as well as access to health care, and options for minimizing / reducing existing and potential environmental health risks associated with climatic changes and environmental degradation.”

In other words, the overall objective of the project was to assist stakeholder in the area to conduct local-level vulnerability analysis to produce a spatially explicit assessment of the impacts of climate change on biological diversity and water and soil resources of the area, improve health conditions and sustain the rural livelihoods in its arid and semi-arid lands. In order to derive and test possible links between climatic changes, water management issues, and health conditions for the benefit of the poor & marginalized people living in new resettlement communities around Lake Nasser as well as to study the effects and propose strategies and responsible policy actions on new resettlement communities at the national level that are enlightened by accurate scientific results, specific objectives were identified under the research project, namely;

- Assess the impact of climatic changes (especially increasing temperatures combined with the change of available water resources, vulnerability of native species) in Lake Nasser in relation to the impacts on human health particularly the existence, potential for emergence, or increase in waterborne diseases; vector borne diseases. This objective was achieved. Outcomes of the applied research proved that the rise in temperature results mainly in water fluctuation, pollution related to bacteria, presence of algae intensification, water-borne diseases due to presence of bacteria (algae and fungal infection), which causes the appearance of mosquitoes and the increase in diseases such as malaria;
- Build the settlers’ capacity enabling them to adopt more efficient and sustainable behavioral, environmental, institutional and technological adaptation strategies and methods/interventions (irrigation, planting, cultivar...) that adequately lead to desired environmental and health effects and mitigate or reduce the risk of disease and environmental hazards caused by climate change on human health. The second objective was met and an indicator of this was that after conducting the applied research, the farmers began using drip irrigation and allocating water

correctly, stored water, used organic fertilizers, used dry active yeast to increase agricultural yields, cultivated crops resistant to high temperature, and introduced new crops, which are heat resistant such as the jojoba. Much of the interest in jojoba worldwide is the result of the plant's ability to survive in a harsh desert environment (semi-arid region) and its capability to be transformed into a renewable energy resource (bio- energy) and produce alternative fuel.

- Derive adaptation strategies relevant to and in participation with the public health sector and other stakeholders (regional coordination of information and action) concerned with climate change issues, for the betterment of national resettlement and development schemes. The third objective was met. The applied research team conducted capacity building and workshops for the participants and at the policy level. The strategy developed high quality data products to assist land managers and decision makers to develop conservation plans and strategies. It included a mix of actions, activities, and programs intended to have an immediate impact and to build capacity for lasting change to support the conservation of the region's soil and water resources. Accordingly, scientific information about known and potential impacts of climate change on the soil and water resources of arid lands in the region was offered on a plate to key decision makers such that it is widely incorporated into synthesized land and water management policies and practices. High Dam Lake Development Authority (HDLDA), and the Agricultural Research Center (ARC) mainly developed the adaptation strategy. This plan is already incorporated in the main strategy of the HDLDA.

## **Methodology**

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The applied research project carried out environmental, social and economic investigations using both qualitative and quantitative approaches. Through collaboration with universities and research centers namely the South Valley University (SVU), the Agricultural Research Center (ARC) and the High Dam Lake Development Authority (HDLDA) respectively.

The South Valley University (SVU) is second to none in the fact that it covers the largest area in Egypt in respect to the other Egyptian universities – it provides direct teaching services to approximately 20% of the total area of Egypt. As compared to this geographical weight, SVU is committed to a big social service role in the region of Upper Egypt. SVU has been serving the mission of a distinguished higher education institution, to comprise its cultural, educational, and service commitment for almost 15 years now. SVU played a key role in undertaking researches under objective two of this project, particularly those related to natural vegetation in the area; agro-forestry for controlling desertification and movement of sand dunes; increasing timber production; water pollutants in the lake and others. All researches undertaken by SVU were carried out on a voluntary basis as part of the University's role in supporting the local communities in its constituency.

The Agricultural Research Center (ARC) is the main research center in Egypt specialized in the study and research of plants, pesticides and all aspects related to agricultural production. The Center has numerous specialized centers specialized in agronomic practices, livestock development, maintenance of the national herds and better food processing techniques in addition to studying climate change and its impact on the agricultural sector in Egypt. The ARC's researchers contributed to the quality of the project through conducting a number of related researches and studies pertaining to crop development and introduction of new heat-resisting varieties of plants and economically viable ones such as jojoba

planting. Again, all work carried out by ARC was part of their mandate and research activities contributing to the development of the research area.

HDLDA is the main body responsible for developing the High Dam Lake area. The Authority is mandated to develop the area, utilize its resources effectively and in the meantime mitigate the negative socio-economic and environmental impacts from the lake, particularly on the local communities and new settlers. All work carried out by the project was under the auspices and in collaboration with HDLDA. HDLDA's senior management contributed to the development of the climate change adaptation strategy and incorporated in their main strategy.

The project relied mainly on networking as a technique for implementation of activities and consolidation of results. In this sense, the project has identified and formalized relationships with several key partners, including South Valley University, the Agricultural Research Center, the High Dam Lake Development Authority, and the Egyptian Environmental Affairs Agency. A network was established to attempt and build adaptive capacity through bringing together the efforts of numerous researchers and research organizations (GOs & NGOs) that are working in the area of Lake Nasser. The network had the ultimate goal of safeguarding the Lake and protecting it from pollution, and preserving its water resources. It also acted as a mean of information dissemination and knowledge/experience sharing, and coordinated the work of various stakeholders. It included periodic meetings between different research institutions, government authorities, project team, and other stakeholders to share immediate results, coordinate next steps, and resolve problematic research issues. Those institutes used to work separately and during the project lifetime, they organized monthly meetings to share feedback on field visits to the site of the project, exchange experience on problematic research issues, and plan next steps of research within the project objectives.

With regards to consolidating research activities, although there were specific teams for each research, teams were working collaboratively rather than separately. Some of the research activities overlapped and thus required teams to exchange information and discuss research results. For example, to complete their health research, the health research team needed information about water content in the area, which was analyzed by the Ecological and Biological Research Team. In order to achieve this collaboration among all teams, meetings were organized every three to six months to provide an opportunity for all teams to discuss their experiments together and exchange knowledge. Negotiations on forming the research team were conducted through several management meetings between the SVU Vice President, and researchers from Faculties of Science and Social Work, on the one hand, and the project leader on the other. The level of positive communication between both sides represented a progress over the last period of the project. This practice has led to building the capacity of participants in the field and complimented their theoretical work with field application. This is considered a product of the multi-stakeholder approach used in the project to carry out all activities. The project built the capacity of all stakeholders related to the Lake Nasser area, in order to ensure the development of a cadre of researchers, scientists, social workers, government officials, and decision makers, who can support the implementation of sustainable development strategies in the area.

To enhance relationships among different stakeholders and encourage volunteering researchers to continue their work, a team of researchers from ARC, SVU, and the Aswan Public Hospital represented Egypt in an Eco-health workshop in Lebanon with the aim of proposing eco-health projects that could be implemented in each participating country. The networking efforts had proven to be positive during the implementation of the research plans in different fields. They kept all partners posted about the work that was being carried out and thus, prevented the duplication of efforts and ensured a more organized

way for implementing the research plans collaboratively. This could be seen in using the same agriculture experiment to conduct the agricultural research as well as some aspects of the biological research. This was an opportunity for strengthening the relationship between different stakeholders, building their capacity in the different fields of the project, and ensuring the development of a cadre of researchers, scientists, social workers, government officials, and decision makers, who can support the implementation of sustainable development strategies in the area.

The project management was also trying to maintain good connections and relationships with other organizations that were not participating in project activities but were important for future endeavors. In this context, a visit was organized for Mr. Peter Paproski, the head of CIDA in Egypt, and Mr. Ramy Lotfy, coordinator of the Canada Fund for Local Initiatives, in order to follow up on the first aid kits that were donated to settlers in the area. The event was attended by the previous Canadian ambassador to Cairo, as a means to support the health-related activities offered by NEF projects in the area. Mr. Paproski also visited different project sites, and met with the community. He acknowledged the research that was being implemented within the project and the efforts offered to improve the lives of settlers in the area.

### Scope of Project

There are several environmental constraints and health threats that are associated with socio-economic factors, which could increase the risk and danger of climatic change. At the environmental level, the researchers affiliated to different partner organizations studied the trends of climate change and the impact of climate change on the quality and quantity of water in Lake Nasser and the quality of soil and crops. The researches established causal analysis related to water and soil and crop degradation and pollution to reach more effective ways of managing soil fertility and water resources and crop productivity. Research also focused on addressing the following three (3) areas:

#### 1- Water and Land Resources:

Researches undertaken attempted to reach more effective ways of managing soil fertility, water resources (irrigation and drainage), pests and improved crop varieties that have better resistance and adapt to increasing temperatures and drought. Focus was on crop protection techniques to reduce the impact of significant pests and diseases caused by increasing temperatures, as well as improving the yield and quality of crops and reducing pesticides hazards through promoting biological control methods.

#### 2- Human Health:

The research focused on the impact of climate change on human health; mainly water quality, vector-borne diseases, and common diseases between human beings and animals. It assessed the capacity of the health system, and investigated suitable preventive programs, such as mosquito control, food and water hygiene and inspection, and health care for vulnerable communities. The idea of forming community networks to spread health awareness and climate change mitigation methods were also addressed.

#### 3- Capacity Building:

The project, during the process of building knowledge & capacity relevant to the research problem, improved certain aspects of society, and hence included development-oriented

activities and solved pressing problems. It ensured the active participation of the stakeholders beyond the community itself, such as policy makers, and researchers from different disciplines. The beneficiaries/end users of this action research are new settlers in Kalabsha, Garf Hussein, and Bashayer El-Kheir villages, the cooperative established in these communities, the High Dam Lake Development Authority (HDLDA), research institutions, universities and governmental organizations, and the Mass Media. The project also focused on the learning process, facilitated the process of knowledge sharing between community members and knowledge holders, built on local and/or indigenous knowledge, and was flexible enough to allow for the redesign of some studies or activities. The project paid special attention to those vulnerable groups likely to be most adversely affected by climatic changes and variability, such as women and children, forming women's learning groups, and highlighting the relationships between gender and adaptation, and gender and vulnerability.

## **Key Studies & Research Activities under Objective 1:**

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*Assess the impact of climatic changes (especially increasing temperatures combined with the change of available water resources, vulnerability of native species) in Lake Nasser in relation to the impacts on human health particularly the existence, potential for emergence, or increase in water-borne and vector-borne diseases.*

### **A. Socio-economic Assessment:**

The project studied the settlers' perception of climate change and its impact on their livelihoods and socio-economic conditions as well as identified the adaptive capacities that the community has developed to minimize the impacts of extreme weather events (whether these adaptive capacities/options are environment-friendly and development-oriented or not).

Results from this socio-economic assessment showed that the majority of the beneficiaries in the area pertain to the young generation, within the age bracket 30-40, representing 37.7% of the total sample, and also to the age group 20-30, representing 14.3% of the total sample. It has also been recorded that beneficiaries who are immigrants from regions in Lower Egypt and the Delta outnumber all other immigrants with a percentage of 35.7% from lower rural areas, and 19% from lower urban areas. The beneficiaries' main profession in their original homelands was mostly agriculture and it remained so after moving to the new community.

Concerning the knowledge of beneficiaries about climate change, results showed that while at the beginning of the project only 20% of settlers had some knowledge regarding climate change; currently approximately 83.33% hold some knowledge about climate change. The information that beneficiaries have about climate change is focused on multiple climate phenomena such as sand storms, the rise of water levels in the Lake, and high temperatures. Analysis also revealed the fact that the source of their information regarding climate change was mostly the New Land New Life project through its project team, and the awareness programs that were implemented as part of the project activities. However, most beneficiaries think that they need more information on climate change and how to limit its constraints.

The applied research showed that there are vulnerabilities related to agriculture. Farmers use traditional ways of crop planting and irrigation. Grain has been recorded as the number one crop that is planted through seeds, followed by Sesame, Corn, Watermelon, and Zucchini. Tomatoes, on the other hand, are the number one 90% of the studied sample of farmers lacks the knowledge of drip irrigation and it also demonstrated that 90.48% do not have problems using spray and/or drip irrigation systems, while 9.52% have problems connected to those irrigation systems. The study confirmed that these problems related to the use of new irrigation systems can mainly be solved through increasing the knowledge of these farmers on these methods of irrigation through training them on how to use and maintain spray and drip irrigation methods. The findings also showed that many settlers have traditional accumulative agricultural knowledge but no new one.

Based on the socio-economic assessments and the capacity building plan that was developed accordingly, the project implemented a number of training programs such as the use of fertilizers under different temperatures, and different times of the year - specifically in relation to economic crops in the

area - EUREPGAP, and post harvest practices. Other capacity building needs were fulfilled during the latter period of the project, especially needs that were related to health and nutrition, and animal husbandry.

## **B. Ecological & Biological Research:**

The ecological and biological research complemented and built on the results of the socio-economic assessment. The study included the investigation of the wildlife; vegetation, animals, and water quality, as well as safe drinking water on the household level, the effect of polluted water and algae blooms on the spread of waterborne diseases, and malnutrition diseases. The investigation helped in determining the health risks and the presence of water and vector-borne diseases and other possible disease-carriers. The research shows the possible linkages between the different patterns of land use and water management, climate change, and health risks in Lake Nasser; and identifies vulnerable groups, determination of diseases' transmission sources and prevention methods.

Data review from previous eco-health studies was compiled (See Annex 1). Findings from the Eco-health Assessment were related to three main areas of work; namely, 1) water quality and water borne diseases, 2) algae intensiveness, and 3) distribution of vegetation and its relation with the distribution of vector borne diseases. Research topics were identified in order to study the relationship between *rising temperatures* and *fluctuating water levels*, on the one hand, and the presence and prevalence of *bacteria, protozoa, algae, and vector-borne diseases*, on the other. The plan addresses stakeholders from different ranking, starting from policy makers and ending with executive staff, as well as the community - as beneficiaries and partners - at the heart of the strategy.

The implemented researches proved that the rise in temperature results mainly in fluctuation in water level, decrease in the quality of water, rapid distribution of water contamination, pollution related to bacteria, presence of heavy metals and algae intensification, water-borne diseases due to presence of bacteria (algae and fungal infection), which causes the appearance of mosquitoes (specially during the months of November and December) and the increase in diseases such as malaria. The analysis of the water samples recorded new pollution indicators such as total yeasts, *Candida Albicans*, *Aeromonas Hydrophila* and total staphylococci; pathogenic bacteria included salmonellae, shigella, total vibrios and listeria group. Results confirmed that there is a positive relationship between the rise in water temperature and the quality of water (See Annex 6).

The research also built the settlers' capacity enabling them to adopt more efficient and sustainable behavioral, environmental, institutional and technological adaptation strategies and methods/interventions. The farmers began using drip irrigation and allocating water correctly, stored water, used organic fertilizers, cultivated crops resistant to high temperature, introduced new crops, which are heat resistant such as the jojoba, and used dry active yeast to increase agricultural yields. Orientation by researchers from the South Valley University (SVU) and the Agriculture Research Center (ARC) was made to the project team and five (5) farmers on plant diseases that might infect crops in this area, especially under high temperatures.

The applied research team also conducted capacity building and a series of workshops for the participants and at the policy level concerned with climate change issues, for the betterment of national resettlement and development schemes.

## **C. Integrated Human Health Monitoring System:**



This system enables regular and periodic medical check-ups for settlers, monitoring of health problems and status, lab analysis, when necessary, and door-to-door mobile health care and medical treatment vehicles. This system was within a framework of coordination and collaboration with local health authorities and research institutions (e.g. Directorate of Health in Aswan, Education Hospital, and the South Valley University).

**Medical Convoy:** The seven (7) medical convoys provided health services to 3,469 beneficiaries including medical checkups, laboratory tests, and provision of medicine. For the research purposes, the research team recorded data on the symptoms and diagnosis of all examined cases. According to the data analyzed, the most common diseases present in the area are upper and lower digestive system diseases such as intestinal worms, diarrhea, heartburns, and colic and this is mainly due to water pollution. As far as pediatrics is concerned, the most common recorded diseases are flu (during winter only), bronchitis, anemia, and pinworms. In addition, women commonly suffer from anemia during pregnancy. Allergic rhinitis, flu and sore throat are the most common Otolaryngology diseases. In the area of Dermatology, allergic contact dermatitis, allergic contact dermatitis, cases of extreme skin dryness, freckles, change of skin color, and hair loss are mainly due to sun exposure and high temperature related directly to climate change. Also, fungal infections and individual dental and surgical cases were recorded.

There were two main causes of the identified diseases; 1) the settlers' unhealthy nutrition system; because their nutrition mainly depends on dried and reserved food, as well as highly salted food (such as salted fish and salted cheese); and 2) the poor hygiene. Researchers have pointed out that diseases found in the area of the project can be found in any other Egyptian community. The link that has been recorded with climate change is the prevalence of eye allergy, which can be connected with the active movement of wind in the area. In addition, the presence of flies might also be affecting the number of occurrences of Muco purulent conjunctivitis. In addition, there are concerns that drinking water might be highly mineralized, with high oxalate and urea contents which increase the chance of kidney diseases and failures due to water pollution and high temperature. Until this point of the research, no common diseases between humans and animals were recorded.

Under the current circumstances of the area, researchers raised a number of concerns that might face settlers in the future, especially with the expected rise in temperatures, as follows:



Fig. 4: Vaccinating children during



Fig. 5-6: Women above & men below during seminar



- Constant exposure to the sun, especially during summer, when temperatures hit their maximum, might cause skin to develop cancer, and increase the occurrences of Photophobia, skin dryness, and Eczema;
- Very high temperatures, especially during summer, lead to excessive sweating, which causes minerals to be highly concentrated inside the human body leading to kidney diseases, and high blood pressure;
- Constant exposure to parasitic and worm diseases might affect liver and spleen functions on the long term, eventually leading to liver failure;
- Existence of mosquitoes, and white flies, especially under high temperatures, might increase the possibility of transmitting disease between humans and animals, and among humans; and
- Possibility of polluted drinking water due to poor water reservation systems in the area.

Initial solutions for health problems that were found in the community include; 1) raising the awareness of settlers on healthy nutrition and good hygiene, under severe living conditions; 2) developing a healthy sewage system inside homes and garbage dumping and collection in a healthy way; 3) improving the ability of settlers to deal with drinking water and store it in a healthy manner; and 4) providing healthy meals for school children. These solutions will eventually help combating the negative effects of climate change while dealing with water pollution and specially polluted drinking water, high temperature and sun exposure.

The following table shows the breakdown of beneficiaries who benefit from CDS mobile clinics, by sex and age group:

Medical Service	Men		Women		Children		Total		Total
	Kalabsha	Jarf H.	Kalabsha	Jarf H.	Kalabsha	Jarf H.	Kalabsha	Jarf H.	
Dermatology	11	11	20	12	21	10	52	33	85
Ophthalmology	13	0	28	0	29	0	70	0	70

**Veterinary Convoy:** The three (3) veterinary convoys provided vaccination, diagnosis, and on-site treatment for livestock of beneficiaries. 596, 984, and 930 settlers received free medical treatment for their livestock during the first, second, and third mobile units respectively. Results indicate that diseases among livestock in project areas include external parasites (48% of examined cases) and internal parasites (30% of examined cases). Other diseases include ovarian inactivity (2%), Pneumonia (1%), uterus inflammation (1%), and blood parasites (1%). Researchers identified several reasons for the external and internal parasites being the most common among livestock including:



Fig. 7 Veterinary Convoy

- Rising temperatures in the area cause the rapid growth of these diseases;
- Intermediate hosts of parasites are commonly found in homes;

- Unhealthy system for caring for livestock at homes (barns are not regularly disinfected using suitable pesticides and insecticides); and
- Poor nutrition system, which affects the immunity of animals.

Researchers also identified external parasites as a disease that can be transferred to humans through direct and indirect contact with animals. Some of the diseases are also transferred through water, which again is affected by the increasing temperatures in the area. Further in-depth studies are needed to assess the frequency of these health issues and their relationship to climate change. SVU researchers are interested in pursuing this research.

## **Key Studies & Research Activities under Objective 2:**

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*Build the settlers' capacity and enabling them to adopt more efficient and sustainable behavioral, environmental, institutional and technological adaptation strategies and methods/interventions (irrigation, planting, cultivar...) that adequately lead to desired environmental and health effects and mitigate or reduce the risk of disease and environmental hazards caused by climate change on human health;*

### A Capacity Building Plan for Local Community and Stakeholders

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The initial step under this objective was carrying out a capacity building plan for the local communities and stakeholders.

From an ecological and socio-economic perspective, west Lake Nasser area is more vulnerable to climate change and more likely to suffer heavier losses. It is thus imperative that effective and timely measures are taken to adapt to climate change impacts and put the adaptation strategy into action. This however requires knowledge, technical expertise, and the political will to make informed decisions.

In the context of Lake Nasser, in order to implement the objective of capacity building mentioned above, we must to develop a capacity building plan for the involved stakeholders including governmental, civil society organizations, academic institutions, private sector, and local communities. The stakeholders need to further develop knowledge and technical expertise to adapt to the impacts of climate change. Capacity building programs on climate change, particularly those that adopt a "learning-by-doing" approach and engage stakeholders, are needed.

The project's capacity building philosophy is based on the following three key principles:

- Institutional strengthening and human resources development;
- Research driven; and
- Local priorities and needs satisfaction.

The three main pillars of capacity building are:

1. Creating an Institutional Framework for Action: Revising plans and polices in order to incorporate climate change issues;

2. Raising Awareness: Educating local communities about climate change and increasing awareness through outreach programs; and
3. Dissemination of Information: Strengthening and enhancing communication between stakeholders.

**Methodology:**

Stakeholders in Lake Nasser were classified into seven (7) groups based on local and regional assessment carried out using both quantitative and qualitative methodologies including structured questionnaires, focus group discussions, interviews and workshops. To develop this capacity building plan, interviews and discussions were held with these seven (7) groups. The following table shows the classification and the groups and the number of individuals interviewed in each group:

<b><u>Group</u></b>	<b><u>Number of Individuals</u></b>
Community Members	72
Academics	10
Agriculture Directorate in Aswan	5
Veterinary Department	4
Aswan Fever Teaching Hospital	8
EEAA Office in Aswan	11
High Dam Lake Development Authority	25
<b><u>Total</u></b>	135

A needs assessment was conducted to identify the current status of the stakeholders' knowledge and experience as well as the proposed line of action. The following table portrays the results of this needs assessment:

Stakeholder	Current Status (level of knowledge and experience)	Proposed Line of Action
Community Members	<ul style="list-style-type: none"> <li>• Knowledge of general climate change phenomena: sea level rise, high temperatures, sandstorms, etc.</li> <li>• Basic knowledge on how to cope with the impacts of climate change specifically high temperatures and water fluctuation (i.e. changing daily routine, dealing with sunstrokes, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• Increase the capacity of adaptation to climate change impacts.</li> <li>• Increase awareness about advocacy tools that enable the implementation and monitoring of adaptation actions.</li> <li>• Increase the resilience to climate change risks.</li> </ul>
Academics (South Valley University- Aswan Branch)	<ul style="list-style-type: none"> <li>• Knowledge of climate change impacts such as fluctuations in temperature that affect biodiversity.</li> <li>• Socio-economic research related to climate change.</li> <li>• Research on the impact of climate change on water quality, quantity and their effects on biodiversity.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop modules that address issues of climate change impacts.</li> <li>• Enhance the ability to implement multi-disciplinary projects.</li> <li>• Develop communication, negotiation and advocacy skills.</li> <li>• Continue curricula review programs in the university that include: assessment, integration of climate change science into existing curricula, and development of new courses.</li> <li>• Improve access to journals and others scientific materials.</li> </ul>
Agriculture Directorate	<ul style="list-style-type: none"> <li>• Knowledge of the effects of climate change on vegetation and planting time of some crops.</li> </ul>	<ul style="list-style-type: none"> <li>• Extension services and tools.</li> <li>• Increase the level of knowledge with regards to climate change impacts on planting time, crop species and livestock.</li> </ul>
Veterinary Directorate	<ul style="list-style-type: none"> <li>• Knowledge of general climate change phenomena: sea level rise, high temperatures, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Enhance the ability to assess animal diseases related to climate change (causes and methods of control).</li> <li>• Raise awareness about common animal and human diseases related to the impacts of climate change.</li> </ul>
Health Directorate and Aswan Fever Teaching Hospital	<ul style="list-style-type: none"> <li>• Knowledge of general climate change phenomena: sea level rise, high temperatures, as well as some water borne and vector borne diseases.</li> </ul>	<ul style="list-style-type: none"> <li>• Increase technical skills so as to enable the control of climate change related diseases such as: water borne and vector borne diseases.</li> </ul>

Stakeholder	Current Status (level of knowledge and experience)	Proposed Line of Action
		<ul style="list-style-type: none"> <li>• Increase preparedness and enhance response systems to climate change risks.</li> </ul>
EEAA Aswan Office	Knowledge of: <ul style="list-style-type: none"> <li>• General climate change phenomena: sea level rise, high temperatures, etc.</li> <li>• Effects of climate change on biodiversity.</li> </ul>	<ul style="list-style-type: none"> <li>• Increase the capacity of the staff, enabling them to design and monitor projects related to climate change risks.</li> <li>• Enhance the early warning systems that address climate change issues.</li> </ul>
High Dam Lake Development Authority	Knowledge of: <ul style="list-style-type: none"> <li>• Effects of temperature on fish growth and reproduction.</li> <li>• Impacts of temperature and water fluctuations on the planting time for various crop species.</li> <li>• Climate change impacts on animal husbandry.</li> <li>• Impacts of high temperatures on infrastructure and the implementation and monitoring of projects.</li> <li>• Impacts of temperature on water quality and quantity.</li> <li>• Day length and its effect on planting time.</li> <li>• Effects of low humidity and sandstorms on agriculture.</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct intensive trainings on topics such as: water resources management, agriculture, fish production, and fisheries management.</li> </ul>

Based on the socio-economic assessments and the capacity building plan that was developed accordingly, the project implemented a number of training programs such as the use of fertilizers under different temperatures, and different times of the year - specifically in relation with economic crops in the area - EUREPGAP, and post harvest practices. In 1997, EUREPGAP (Euro-Retailer Produce Good Agricultural Practices) was established as an initiative by retailers belonging to the European retailer working group. They responded to rising consumers' concerns regarding environmental and labor standards, products' safety and developed harmonized standards and procedures for the development of Good Agricultural Practices in conventional agriculture with focus on Integrated Crop Management and workers' welfare<sup>7</sup>. Other capacity building needs were fulfilled during the latter period of the project, especially needs that were related to health and nutrition, and animal husbandry. Based on the results of the second socio-economic assessment, additional capacity building topics were incorporated within the capacity building plan and training programs were implemented to address the lack of knowledge of the beneficiaries related to plant diseases and ways to avoid infection, double and triple cropping, crop reservation and storing, recycling agricultural waste, and maintenance of modern irrigation systems for instance. It was noted that several agricultural practices have been changed, as farmers started adopting modern techniques in planting and irrigation of their products. New varieties have been introduced that can bear the increasing temperatures such as jojoba and some varieties of cucurbits.

One of the products of the multi-stakeholder approach that is used to implement all project activities is building long-term relationships between different scientific institutions, governmental authorities, project team, and beneficiaries in the area. Those relationships are utilized in order to make the best use of resources and ensure that there is no duplication of work or effort. As a fruit of this cooperation, the same agriculture experiments that was designed and implemented under EUREPGAP, later on described in details in this report, was used to conduct part of the ecological and biological research

Capacity building of farmers and the project team was also built on how to detect any plant infections, the symptoms of different diseases and ways of protection and treatment. The project team was also trained on how to take samples from soil and plants in order to send them to the laboratory for testing in ARC and analyze the risks of disease infections in relation to different temperatures; which were daily monitored during the experiment (See Annex 5, 6, 7 and 8). This was implemented both in the HDLDA land devoted to the experiment and the land of the five (5) participant farmers. The HDLDA will incorporate the results in their research programs and will follow-up on the application of these results in the field.

Through awareness raising use of organic fertilizers, introduction of new crops resistant to climate change, crop intensification, and use and storage of water (use of drip and spray irrigation) introducing new crops like jojoba, increase productivity through dry active yeast.

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<sup>7</sup> [www.globalgap.org](http://www.globalgap.org)

## **A. EUREP GAP on-farm trials:**

Under EUREPGAP activities, the project staff met with board members of agricultural cooperatives in Kalabsha (four meetings) and Bashayer el Kheir (six meetings) to introduce the project's concept and activities, as well as climate change and its importance. The board members discussed various potential interventions and strategies for lessening the risks posed to the environment and to settlers' health. An effort was made to identify crop varieties that are suitable to the area's environmental conditions on the long term, particularly in terms of withstanding higher temperatures and requiring less water. The land that was used to plant the agriculture experiment, thus, was granted by the HDLDA, and was handed over to them again by the end of the project as a reclaimed and cultivated piece of land.

Vegetables are the most common crops planted in the area west of Lake Nasser. However, not all vegetables' varieties are heat-tolerant and almost all of them are planted under flood irrigation. Agricultural experiments were then designed in order to test the effect of different climates as well as different agricultural practices on the growth of cash crops. Agro-ecological practices were introduced to 343 farmers, and these practices were applied on some of the common crops in the region. The team researched on varieties of vegetables crops (tomato, cucumber, cantaloupe, eggplant, and watermelon) using on-farm trials and on-farm management with participating farmers. Different trial plots were established using different fertilization and irrigation treatments, different planting dates, crop rotations, and intercropping. Farmers applied different practices and treatments in terms of fertilization, irrigation, post harvesting, and bio pest control. Experiments also aimed at examining the best, which can support the soil to regenerate and thus resist climactic changes, especially increased temperatures. For each of the chosen crops (two varieties of tomatoes and two varieties of watermelon), five levels of fertilization were applied (F1 to F5) with two irrigation systems (70% and 100%), under the same climate conditions as follows:

- 1- F1: 100% organic fertilizers – 0% chemical fertilizers
- 2- F2: 75% organic fertilizers – 25% chemical fertilizers
- 3- F3: 50% organic fertilizers – 50% chemical fertilizers
- 4- F4: 25% organic fertilizers – 75% chemical fertilizers
- 5- F5: 0% organic fertilizers – 100% chemical fertilizers

The same crops were also planted in the lands of three (3) farmers using their own irrigation systems (dripping irrigation) and their own fertilizations (after the orientation on EUREPGAP) in order to reach conclusions on the best practices that would lead to the highest rates of land production with the highest quality under the temperatures in the area. The project site team followed up the experiments on a daily basis as well as took soil samples and sent them to ARC researchers for laboratory tests. They also recorded daily data on the crops, with details on the height of plants, the total vegetative growth, the number of nodes on the stem, the number of leaves, the time of the first flower appearance on plants, the number of early fruits, the total number of fruits, the fruit diameter, height and weight. This agriculture experiment was designed in cooperation with different institutes affiliated to the Agriculture Research Center (ARC), the resident project team in Aswan, and farmers. Farmers contributed with their knowledge on agro-ecology and also pointed out the problems that were facing them in the area, especially as related to levels of irrigation and fertilization under different temperatures during different seasons of the year. One of the benefits of the strong relationship that was built with the HDLDA is the strong cooperation and commitment from HDLDA to provide the project team with all needed facilities that would enable them to implement project activities.



Results from the study have shown that some of the chemical components of the soil before use showed that N, P, K and organic matter content were of low value, which revealed that the soil is low in fertility. The soil pH was slightly acidic to alkaline. Land suitability for several crops was moderately to marginally suitable with constraints of nutrient retention, soil drainage, soil texture, and water availability. The soil had a good potential for agricultural development, with the main fertility constraints of low organic matter. It is worth to mention that organic and inorganic fertilizers improved the physicochemical properties of the studied soil. The higher values in physicochemical properties observed in treated plots relative to the control could be due to higher levels of organic matter. It can be concluded that the combination of organic and inorganic fertilizer seems to be more practical than the use of organic fertilizer alone. The results showed that the highest CaCO<sub>3</sub> content is noticed in F5 treatment which received the highest portion of its nutrient demand as organic forms had the lowest value of CaCO<sub>3</sub> due to the action of the applied organic matter in lowering pH values and consequently, increasing solubility of calcium carbonate content. Also, higher organic matter levels were observed in FYM amended soils rather than in the control. This could be attributed to the fact that organic materials had a major impact on the mineralization rate and increase the soil organic carbon directly; whereas the effect of mineral fertilizer was less pronounced since it increased Soil carbon input only indirectly by improving plant growth (Antill et. al., 2001).

There are also significant relations between the quantities of applied organic matter and soil organic matter contents. Results also revealed that as the pH values decreased as the quantity of organic amendment increased. These results may be attributed to the effect of organic amending, which contains organic acids. Moreover, the results showed encouraging improvements in the physical properties of the studied soils with application of organic and inorganic fertilizers. It demonstrated the relative abilities of the amendments to improve the soil retention capacity. A trend of higher soil retention capacity was observed with the addition of (FYM). It is obvious from the results that, application of organic fertilizer combined with mineral fertilizer was more effective than the application of them separately. It is worth to mention here that the rate of increase in soil moisture content at (FC) was higher than at wilting point. Results also showed that, the best improvement in (AW) was adjacent with the combination of organic and mineral fertilizers with the rate of (F3) application. This is due to the positive effect of using organic materials, which improves some physical properties of coarse soil texture.



**Figs. 8-10: EUREPGAP experiment for 3 crops at the beginning of germination**



Sandy soils have much less surface area than clayey soils and, thus, retain much less water at higher tension. However, with the addition of organic matter, specific surface area increases resulting in increased moisture at higher tension (Gupta et. al., 1979). Similar conclusions were also obtained by amending soil with organic materials; it was not only effective in increasing water-holding capacity, but also in the pore size distribution. Fine capillary pores were increased on the expense of quickly and slowly drainable pores due to use of organic materials. Organic matter increased the moisture retention capacity in the soil, which was due to the reduction of soil bulk density, and the increase of soil porosity and the specific surface area of the treated soil. Such conclusions helped shape final recommendations concerning the best treatments, which can support the soil to regenerate and thus resist climactic changes, especially increased temperatures.

During the design and the beginning of the implementation of this experiment, the capacity building process was a hand-on and a three-way process among all participants. The ARC researchers built the capacity of the project team on how to follow up the experiment, how to monitor the growth of crops, how to register this progress under different temperatures, and how to take samples of the soil. While researchers from the ARC participated with their scientific experience in adding to the knowledge of both the project team and farmers, the project team also added to the knowledge of the ARC team about the nature of the area and what would work and what would not work, especially that the project team and farmers have accumulative experience as a result of their participation in the first phase of the project. Farmers also contributed with their knowledge on agro-ecology and also pointed out the problems that are facing them in the area, especially as related to levels of irrigation and fertilization under different temperatures during different seasons of the year. This experiment was repeated during the project's lifetime in order to determine times of the year that are best for growing those crops.

Experimentations and research on crop varieties were accompanied by training and technical assistance to farmer groups; including training on the goals of EUREPGAP, the scope and benefits of EUREPGAP, costs, registration and certification requirements and on-farm management. One of the objectives of this training was to assist farmers to design and implement their own experimentations in their own land. Trials were monitored and followed up on a regular basis by researchers and EUREPGAP experts. Experimentations were assessed through farmer discussion groups and disseminating information, and sharing knowledge through farmer field schools. The project also conducted linkages to farms, export companies and agribusinesses that were registered under EUREPGAP to be better familiarized with the process. Trained farmers were disseminators of information, worked as advisors to other farmers, and advocates of the practices of EUREPGAP; this in turn would help the area transform into an exporting area towards different countries of the world.

## **B. Capacity building of Cooperatives:**

Three (3) cooperatives were recently established in each of the communities around Lake Nasser. The project worked with these cooperatives, providing them with capacity building and technical assistance programs to improve their members' skills and knowledge, enable them to work closely with the farmers, and follow up their agricultural activities and on-farm experimentation, under the supervision of the project officers. One of the major aspects of capacity building was marketing extension and the vegetables' nursery management. The project trained the cooperatives' members on establishing and managing nurseries under the weather conditions of Lake Nasser; this would eventually contribute to solving the problem of the lack of extension services and build the capacity of local people to perform this role.

A capacity needs-assessment for cooperatives was conducted during the first year of the project and results revealed that most beneficiaries lack the knowledge about ways for safely immunizing their plants from disease, combating infection if it occurs, healthy crop storage, inter-cropping, and recycling agricultural waste. Consequently, a capacity building plan was developed in order to cover the identified needs and a number of different programs that cover agriculture topics were implemented such as the use of fertilizers under different temperatures, and different times of the year, specifically in relation with economic crops in the area, EUREPGAP, and post harvest practices. On the management level, a training package was delivered to the cooperatives' managerial staff including strategic planning, communication skills, persuasion and negotiation skills, and leadership skills. Beneficiaries also participated in agriculture trainings. 40 trainers from 9 ARC affiliated institutes implemented the capacity building activities on fifteen (15) different programs; such as but not limited to:



**Fig. 11: Capacity building for cooperatives**

- 1- Diseases of the Cucurbit family;
- 2- Best ways for planting tomatoes and watermelon;
- 3- Uses of medicinal and ornamental plants, especially related to treating illnesses and improving general health;
- 4- Comprehensive treatment and reservation of the Solanaceae family against diseases;
- 5- Healthy nutrition in the area, especially the importance of water and how to keep it clean in the Lake Nasser area using easy techniques;
- 6- Healthy nutrition, especially as related to vitamins and how to prepare meals rich with vitamins using ingredients found in the area, with the least cost possible;
- 7- Soil problems in the area and how to deal with them, using different fertilization techniques;
- 8- Production of non-traditional vegetable crops such as Broccoli, colored Lettuce, Fennel, Chinese cabbage and Sweet corn;
- 9- Hibiscus and Sesame diseases and how to treat them;
- 10- Vegetable, medicinal and ornamental plant diseases and ways of treatment; and
- 11- Planting without soil to overcome problems of scarce water and fertilization, as Aswan was one of the first cities in Egypt to employ this technique during building the High Dam.

The number of beneficiaries participating in those capacity building events reached 412 men and women, from Kalabsha, Garf Hussein, Bashayer El Kheir, and stakeholder organizations. In their evaluation of the capacity building programs, beneficiaries pointed out that they have acquired a very large amount of new information; which was needed before the beginning of the new planting season, specifically information related to:

- 1- Employing different treatment techniques of diseases for different plant families already planted in the area, and sometimes vulnerable to infection;
- 2- Employing ingredients found in the area to compose healthy meals, especially for the nutrition of children; and

- 3- Non-traditional planting, and planting without soil, which have been found as the most interesting topics to beneficiaries.

ARC, through 6 researchers from the Central Laboratory for Agricultural Climate (CLAC), implemented a training program on irrigation management under difficult environmental circumstances for 10 farmers and 5 cooperative members, 1 HDLDA staff member, and 2 project staff members. The training program aimed at improving the knowledge and skills of cooperatives and farmers to run and manage modern irrigation systems (drip and spray irrigation) currently used in the area. The importance of this training lies in the fact that in order for the new resettlement areas west of Lake Nasser to be able to face the challenge of climate changes, especially rising temperatures, they need to employ irrigation systems which allow their lands to be more resistant to those changes.

The training also aimed at raising the awareness of beneficiaries on the requirements of installing an effective irrigation network; the direct effect of this training was the raise of awareness of beneficiaries and the fact that they were able to identify deficiencies in the irrigation systems that were installed in their lands and asked for modifications before they take responsibility for running and managing them. This shows that the project beneficiaries have reached a level of awareness where they could understand issues, judge their importance, and act upon their judgment. It also shows that they were willing to take the initiative if they have the basic knowledge about certain issues.

A very important part of the capacity building plan of beneficiaries, especially cooperatives, was link visits. They were seen as a mean for cooperatives to gain real life experiences, which encourage them to adopt best practices and pass them on to the rest of the farmers in the project area. In that matter, a two-day link visit to EUREPGAP certified farms in Misr-Ismailia Road, and Misr-Alexandria Road were organized and implemented for 27 beneficiaries from Kalabsha, Garf Hussein and Bashayer El Kheir, in addition to 2 project staff members. In their evaluation of the visits, participants acknowledged the importance of application after theoretical training. The visits aimed at introducing EUREPGAP practices to beneficiaries and explaining benefits of applying this system in their fields. Through those visits, beneficiaries also learned about the steps of becoming EUREPGAP certified.

The capacity building activities also focused on improving the abilities of farmers to evaluate agricultural experiments and be able to select the best practices which most apply to their circumstances and environmental conditions. This was achieved through the participation of farmers in the evaluation of the agricultural experiments applied by ARC researchers in the trial land of the project as well as in farmers' lands. The project site team organized several visits for farmers to evaluate different agricultural experiments and discuss their own points of view on the adaptation practices that they think most relevant to their situation.

### **C. Research on Best Practices of Agro-forestry:**

Agro-forestry's link to climate change particularly in the area of research is established through a number of factors. Planting multipurpose trees increases vegetation in the area and windbreaks help resist sand storms known to occur in this region. Trees can also be used as a mean of erosion control by holding soil in place that might otherwise be swept away by water or wind. In addition, some trees provide a source of fodder for domestic animals. Trees, planted around each set of five feddans, define land borders for each farmer.

The project team members and HDLDA members who have attended the Desert Development Center (DDC) training established the agro-forestry nursery (60mX9m). In consultation with professors who

have conducted the training, needs for running and efficiently using the nursery for germination, propagation and growth of tree seedlings were identified. All needs have been purchased and the nursery was prepared for use through installing the irrigation system, building a concrete walker through the nursery, and establishing planting basins.

In order to test the effect of different temperatures on the germination and growth of seedlings, the highest germination percentage was recorded for Volca Mariana (84%), while the lowest percentage was recorded for Citrus (9.7%) that was planted without Poly Ethylene coverage. Those same Citrus seedlings recorded a (46.9%) germination percentage under one layer of Poly Ethylene, and a (75.4%) percentage under 2 layers of Poly Ethylene. It can be concluded that higher temperatures actually help the growth of Lime seedlings, which means that they can grow with high quality in the west of Lake Nasser area and can be used to surround farmers' lands and serve as windbreaks. The project team and ARC researchers monitored the effects of different temperatures on the growth of plants, reaching conclusions about the best time and temperature for starting the planting cycle of those trees.



Fig. 12: Lime & Guava trees already planted in farmers' lands

The project team and ARC researchers monitored the effects of different temperatures on the growth of plants, reaching conclusions about the best time and temperature for starting the planting cycle of those trees.

In order for the project team to be able to establish and manage the agro-forestry nursery, it was necessary to build their capacity in this area. A training program was designed and implemented by the DDC – American University in Cairo with the participation of 2 project team members, and 1 HDLDA engineer. The training covered topics related to establishing and running an agro-forestry nursery, as well as types of trees that can be planted in the West of Lake Nasser area, how to plant them inside the nursery, how to monitor their germination and growth, planting and nurturing tree seedlings, irrigation systems, propagation, and harvesting. Prior to that, the project team, in consultation with experts from ARC and DDC, identified the community needs related to agro-forestry trees.

The agro-forestry nursery continues to produce seedlings from different types of trees such as Volca Mariana, Lime, palm, Mango, Kaya, Neem, Guava, and Buckthorn trees. Researchers from ARC and the Kom Ombo Agriculture Research Station in Aswan provided follow up to the seedlings and gave advice on the treatments to be given to different types to achieve the best growth rates and best plant characteristics. Researchers also visited the experiments applied by farmers to evaluate their success and gave them advice on the best future practices they should apply for successful land protection using trees as windbreaks.

Agro-forestry is expected to be an effective indirect adaptation strategy to climate change; where the ensuing interactions present multiple benefits, including broad sources of income, increasing biological yields, opportunities for diversification of agricultural systems, better water quality (mitigating the effects of water pollution), improving efficiency of use of soil (soil fertility), water and climatic resources, reducing carbon emissions (mitigating the effect of pollution) and better habitat for both man and wildlife.

#### **D. Other Related Applied Research Projects:**

Several researches were conducted during the lifetime of the project in different fields related to agriculture, ecology and biology as well as health. A summary of these researches is as follows:

### **Bio-Energy Plantation of Jojoba** (See Annex 4)

Jojoba is an environment friendly plant that can supply water and minerals from far below the soil surface. Its deep root system makes it a soil Stabilizer. Jojoba (*Simmondsia chinensis*) provides a renewable source of unique high-quality oil, requiring little water and maintenance and yields a crop of seeds that have many uses. Jojoba seed-oil is used in lubricants, cosmetics, pharmaceuticals and as a replacement for sperm oil in manufacturing of inks, varnishes, waxes, detergents, resins and plastics. Jojoba will grow well in days of full sun. Temperatures are critical but only in the low range. Jojoba handles heat very well. The research resulted in:

- 1- The plantation of an area of Lake Nasser;
- 2- Production of high-quality oils from industrial crops;
- 3- Saving the soil and water resources since jojoba does not consume water;
- 4- Introducing a new industry in Lake Nasser Area for people, scientists, and workers.

### **Agro-Climate Change** (See Annex 5)

The major role of on-farm irrigation management is to maximize crop yield per each unit of applied water. Projected future temperature rises under climate change conditions are likely to reduce the productivity of the major crops, and increase their water requirements thereby directly decreasing crop water use efficiency. Water share for agriculture in this region is subject to reduction, as a national policy to protect Lake Nasser. Moreover, the irrigation duration for each village is limited by certain hours per day, as the pumping energy is offered to the farmers as a type of social encouragement, which is limiting the irrigation practices beyond the actual irrigation requirements. The evaluation of the current farmers' irrigation strategies in terms of water productivity and irrigation-water use resulted in:

- A confident deficit in irrigation at both early and late stages of crop development; this could have a negative impact on canopy expansion and early senescence;
- Less irrigation has a favorable effect on irrigation energy consumption and total production cost;
- The reduction in energy cost unit is more pronounced to the farmers than the increase in crop yield unit.

### **Physicochemical Characteristics of Lake Nasser, Drinking Water & Wastewaters as related to Climate Change** (See Annex 6)

Houses drinking water in the three villages are supposed to be safe according to WHO and the Egyptian standards for drinking water. The high water pollution index (WPI) for irrigation canals from the lake to the agriculture site, fish cultures (both concrete and earth pond systems) at Garf Hussein and Kalabsha areas, and drainage canal from fishponds must be treated before they are charged to the lake or reused after treatment for agricultural purpose or cycled again to the fish cultures. The study assessed the relationship between the rising temperature in Lake Water and its water quality. The water quality has been examined from the Lake main stream at Kalabsha and Garf Hussein, as well as several purification units, water tanks, pipes, and water reservoirs in houses. The assessment showed a poor water quality for drinking. It also showed a tight relationship between the fluctuation of water level in the lake and the distribution of water contamination. A water pollution index of the lake was also extracted.

### **Impact of the Climatic Changes on the Accumulation of Trace Metals in Terrestrial and Aquatic Environments** (See Annex 7)

The study established a baseline concentration of environmentally sensitive metals (As, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, V and Zn) in top cultivated and uncultivated soils. It also delineated the areas of trace metals deficiency or excess that may affect plant and animal nutrition as well as human health. The research resulted in the following conclusions:

- The variability of the metals is due to sediment-water interaction and the biological productivity as well;
- The flow velocity as well as water level fluctuation is the basic factor for the distribution of heavy metals in bottom sediments;
- The distribution of these metals in soils depends strongly on the soil moisture conditions and soil to soil solution equilibrium;
- Geochemical maps showing the distribution of trace metals in the terrestrial and aquatic environments; and
- The impact of this metal distribution on both human health and plant and animal nutrition could be detected.

### **Assessing Ecosystem Qualities in Lake Nasser under Climate Change** (See Annex 8)

The study assessed the impact of climatic change on flora, aquatic creation and natural vegetation using the interpretation and uses of the data gathered by previous researches (soil, sediment and water). The study resulted in:

- The evaluation of the impact of human activities in the area on environmental quality;
- The assessment of the effects of climatic change on environmental quality; and
- The stakeholders' help regarding decision in putting the appropriate policies for the conservation of the ecosystem.

### **Seasonal periodicity of algae in the aquatic habitats at Kalabsha-Garf Hussein region, west of Lake Nasser** (See Annex 9)

The irregular hydrological events due to the fluctuations in water level may influence the life conditions in Lake Nasser. The objective of the study was to emphasize that the monitoring of the biological aspects of Lake Nasser are important for detecting the alterations that might take place due to the irregular hydrological events particularly flood and the concomitant fluctuations in water turbidity. Also, this investigation was carried out to provide information on the seasonal periodicity of the characteristics of the algal assemblages in a trial to understand how far the water habitats in this region can be altered in response to the climate change and differ from time to time. The development project at Kalabsha - Garf Hussein region is regarded as an example site for the sustainable development projects that were initiated since the early 1980's on the west shore of Lake Nasser. The study drew the following conclusions:

- The dense populations of phytoplankton in drainage water of aquaculture can positively affect the development of agricultural crops;
- Irrigation of the cultivated soil in this region with water rich in planktonic algae from the drainage water of aquaculture may improve the biological state;

- Maintenance of high-quality water should be among the principal priorities in management plans;
- For drinking water, problems may arise, when mass development of planktonic algae takes place and the technology of drinking water production is not adapted;
- Clogging of filters by bulky and/or slimy algae is another serious problem; and
- *Microcystis aeruginosa* is recorded in this investigation as a rare taxon in aquaculture. However, its over growth should be avoided to protect the area from the toxic water blooms.

### **Bacteriological Evaluation of Drinking Water** (See Annex 10)

The current study was carried out to evaluate the chemical and microbiological characteristics of drinking water used for human consumption and to what extent the people in west of lake Nasser suffer from community health problems. The study aimed to reveal the failure of the treatment system of the investigated water in removing the classical indicators of pollution. With the development of a variety of multiple test kits for specialization of many waterborne aerobic and anaerobic organisms, more attention is being given to selected species of microorganisms for use as indicators of water pollution. The obtained results indicated that:

- The produced water, supposed to be for domestic use, contained bacteria (all the tested organisms);
- The ill performance and poor drinking water quality of the purification systems of the investigated water samples.

### **Natural vegetation in Kalabsha & Garf Hussein in Egypt** (See Annex 11)

Changes in the environmental conditions result in a continuous change of the native plant cover. The study reported the changes in the weed flora along the shores of Lake Nasser (Kalabsha and Garf Hussein) as a result of the new land use systems, particularly those related to land reclamation. The shores of Lake Nasser at Garf Hussein and Kalabsha were surveyed for weeds and natural vegetation during four seasons. Voucher specimens were prepared for each species and deposited at Botany Department; Faculty of Science at Aswan. The research had the following conclusions:

- A list of the species at Shores of Lake Nasser at Kalabsha and Garf Hussein including 110 species belonging to 89 genera and 35 families from which 36 species are monocotyledonous and 74 are dicotyledonous;
- These species represent about 23.5% of the total weeds of Egypt; and
- The largest families in the study are Graminae (27 species, 25%) Leguminosae (10 species, 9.1%) Composite (10 species, 9.1%) and Herophytes (66 annuals) are the most common life form in the present study (66 species 60%).

### **Effects of Soil Moisture Regime and Nutrition on some Vegetable Crops under Heat Stress** (Annex 12)

The study consisted of evaluating some promising varieties of vegetable crops under heat stress, and minimizing the uses of chemical fertilizers as well as following the pathogenic diseases and pests under the experiment conditions. The study outputs consisted of the development of a data base of the tested environment to be utilized by decision makers. The study also concluded that minimizing the uses of chemical fertilizers, consequently reduces pollution. Also, the introduction of new vegetable varieties suiting the environment of Lake Nasser would raise the standards of living of the poor living in the area.



This research study also helped develop human resources in the horticulture field and optimize the use of irrigated water.

**Insects Carrying Vector-Borne Diseases in Lake Nasser Area and Their Impacts on Climate Change** (Annex 13)

The study conducted a survey regarding the dynamics of the insects' seasonal activities in Lake Nasser area and gathered data related to insects carrying vector-borne diseases in the area. The research concluded that there is a significant presence of mosquito in Lake Nasser area especially of Exuvia of pupae (big and small ones) especially during winter (October & November 2009). The study also concluded the presence of Larvae, small mosquitoes, and backswimmer bug, especially during summer. It was also noticed that the volume of water in Lake Nasser decreases during summer where plants appear in the middle of the Lake.

### **Ideal Crop Composition in the Area West of Lake Nasser** (Annex 14)

The study conducted a survey regarding the different type of crops that are suitable to be cultivated in Lake Nasser area, and studied the dynamics of the ideal seasonal crops in the area. The research concluded that:

- During the summer season (1<sup>st</sup> year), the crops to be cultivated are Alfalfa “bersim” and lobby fodder and during the second year, soya beans are the best crop to be cultivated;
- During the winter season (1<sup>st</sup> year), the crop to be cultivated is Alfalfa “bersim” and during the second year, beet is the best crop to be cultivated;
- Crop Composition 1 for Animal husbandry: Fodder Crops (60%); Field Crops (10%); Oil Crops (10%); Vegetable Crops (10%) and Fruit Crops (10%).
- Crop Composition 2 for Export: Medicinal Plants (30%); Oil Crops (30%); Vegetables (20%); and Fruits (20%).
- Crop Composition 3 for Agricultural Industry: Oil Crops (25%); Fruit trees (20%); Vegetables (20%); Fiber Crops (20%) and Medicinal Plants (15%).

### **The Effects of the Different Agricultural Seasons and Sprinkling Dry Active Yeast on the Growth of Vegetables, Dates, Nigela Sativa & Coriander** (Annex 15)

The study aimed to reach the ideal timing for agricultural cultivation under climate change conditions; and increase the production of crops. The study concluded that:

- Regarding the Nigela Sativa and the coriander: the height of each plant sprinkled and the number of its branches is superior than the plants that were not sprinkled by dry active yeast; and
- The average productivity of each feddan is higher while sprinkled with dry active yeast and the highest productivity is witnessed in October.

### **Bacterial, Physiological, Fungal & Viral Infections in some Crops in the Area West of Lake Nasser under Climate Change** (Annex 16)

The study aimed at assessing the potential impacts of climate change on diseases affecting crops as well as study the negative impacts caused by crops holding bacterial, fungal, physiological and viral infections on human health and decrease the use of pesticides and direct the farmers to safer alternatives. The study concluded that:

- Regarding tomatoes, they witness a 30% rate of infection.
- Regarding potatoes, they witness an approximate 25% rate of infection (varying from 60% to 10% according to the type of potatoes).
- Regarding green pepper, eggplant, cucumber and eggplant, they witness a “Blank Farinae” infection and viral infections.
- Regarding strawberries, they witness a 10% rate of infection mainly due to “Blank Farinae”.

### **Medical Health Care & the Relation between Humans, Animals and the Environment** (Annex 17)

The study conducted a survey regarding livestock diseases in the area and especially the venereal diseases. The study also raised the awareness of the population in Lake Nasser regarding the spread of

diseases and vaccinations through different programs. The researchers conducted several medical seminars to raise the awareness of farmers regarding the common diseases between humans, livestock and the environment. The survey showed a high percentage of venereal diseases in cows specifically in the area; a high percentage of anemia in the population related to mal-nutrition and under-nutrition; and a low rate of awareness regarding livestock diseases. Seven (7) medical convoys and 10 awareness campaigns regarding common diseases between humans, livestock and environment (cholera, RVF, Tuberculosis, etc.) were conducted.

### **Key Studies & Research Activities under Objective 3:**

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*Derive adaptation strategies relevant to and in participation with the public health sector and other stakeholders (regional coordination of information and action) concerned with climate change issues, for the betterment of national resettlement and development schemes*

#### Development of Climate Change Adaptation Strategy

To address the global and regional concerns regarding the potential impact of climate change on natural resources, the project provided approaches for adapting to the potential impacts of climate on soil and water resources not only in the New Kalabsha area, but also on the local level. Moreover, the project contributed to and strengthened local monitoring, reporting and assessment of soil and water resources. The strategy developed high quality data products to assist land managers and decision makers to develop conservation plans and strategies. It included a mix of actions, activities, and programs intended to have an immediate impact and to build capacity for lasting change to support the conservation of the region soil and water resources. Accordingly, the strategy helped to give decision makers, both public and private, the capacity, tools, and understanding to make sound decisions about their soil and water resources and how to better conserve them. Scientific information about known and potential impacts of climate change on the soil and water resources of arid lands in the region was offered to key decision makers such that it is widely incorporated into synthesized land and water management policies and practices. The adaptation strategy was mainly developed by High Dam Lake Development Authority (HDLDA), and ARC. This plan has already been incorporated in the main strategy of the HDLDA.

The adaptation strategy started with identifying and assessing the vulnerabilities of various sectors to potential climate change impacts. It then involved determining and assessing available options to deal with the effects of expected climate change through a shift in public policies.

A recently developed climate change adaptation strategy was presented to resettled farmers in the area of west of Lake Nasser in order to develop strategies to reduce community vulnerability and build resilience in dealing with the impacts of climate change. The strategy emphasized the health and agricultural sectors, priority areas for the local communities. It was crucial to involve the settlers at this stage in order to ensure that their needs were met, their vulnerability reduced, and alternatives to climate change were willingly introduced. Through dialogue with various groups of stakeholders, the strategy was adapted to reflect community concerns and priorities.

The integrated, cross-sectoral strategy was threefold. First, it sought to build strong understanding, knowledge, and information systems to help public decision makers and other stakeholders, including settlers, plan and implement adaptation strategies. Second, it proposed the establishment of a

framework to promote collaboration within and among different local stakeholders to incorporate strategies for adaptation to climate change impacts into sector planning. Finally, the adaptation strategy recommended assessing and identifying current and expected vulnerability in order to implement priority adaptation actions and risk reduction measures in key climate sensitive areas such as agriculture, water management, and public health.

### Methodology for Developing the Adaptation Strategy

The methodology included a series of meetings and focus group discussions with project stakeholders to reflect on the proposed adaptation strategy and discuss various stakeholders' perceptions. These meetings and discussions were conducted in each of the three resettlement areas of Garf Hussein, Kalabsha and Bashayer El Kheir – the project's target areas. Additionally, a one-day workshop was held with representatives from the South Valley University (SVU), Egyptian Environmental Affairs Agency (EEAA), High Dam Lake Development Authority (HDLDA), Department of Veterinary Affairs, and Department of Health. These core deliverables included building a strong understanding and knowledge base of climate change impacts among decision makers and community members, establishing a cross-governmental framework of collaboration among different sectors, and assessing and identifying current and expected vulnerability in key climate sensitive areas, such as agriculture, water management and public health. Participants were asked to rank the approaches based on effectiveness, cost, ease of implementation, replicability, and time required. The criteria were ranked from 1 to 5, with the highest rankings indicating:

1. Effectiveness: Most effective
2. Cost: Least cost
3. Ease of Implementation: Most easy to implement
4. Replicability: Easy to replicate in other areas
5. Time Required: Least amount of time

Through in-depth discussions with the stakeholders, the proposed adaptation strategies were revised based on their priorities. Here are some points that state the vision of the Lake Nasser climate change adaptation strategies in order to reduce vulnerability and hence build resilience in dealing with the impacts of climate change; this plan is already incorporated in the HDLDA main strategy as follows:

1. Building strong understanding, knowledge, and information systems including potential funding opportunities to help public decision makers and other stakeholders, including local communities, plan and implement adaptation strategies;
  - Empower decision makers and community members to take actions that aim to reduce individual and collective vulnerability to climate change impacts through continuous capacity building activities, workshops and deliberations;
  - Introduce alternative options, information knowledge, and technical support that improve and increase the capacity of decision makers and community members to adapt to climate change impacts through scientific modeling and deliberations of the best adaptation models;
  - Develop indicators and tools for decision makers at all levels to assess the technical effectiveness, economic, social and environmental impacts of adaptation options;
  - Develop extension services and mechanisms that support other stakeholders' work with decision makers to help them prepare for climate change;

- Build stronger relations with donors and funding agencies to influence their decisions regarding funding initiatives and services to support the implementation of the adaptation strategy;
  - Develop and maintain long-term climate related programs and networks for data collection on climate change in various selected vulnerable sectors; and
  - Disseminate information about climate change impacts to different target groups with various degrees of specialization and sophistication (i.e. for decision-makers, local community members, etc.), whenever possible.
2. Establishing a framework to promote collaboration within and among different local stakeholders to incorporate strategies for adaptation to climate change impacts into sector planning;
    - Establish and develop collaboration among agriculture, fisheries, and engineering and industrial sectors, which are most vulnerable to climate change in the Aswan Governorate;
    - Support policy makers to advocate for reduction of vulnerability to climate change;
    - Strengthen inter-agency coordination and exchange a flow of information to ensure that decision-makers have access to the same information and work towards common goals.
  3. Assessing and identifying current and expected vulnerability in order to implement priority adaptation actions and risk reduction measures in key climate sensitive areas (agriculture, water management, and public health)
    - Improve agriculture, water, fisheries and health research that targeted adaptation decision making and expand public outreach of research to policy makers and the public sector such as form working groups including decision makers, executives and community leaders to identify where vulnerabilities are greatest in sectors most likely to be vulnerable to climate change; and
    - Identify gaps in knowledge and technical skills of policy makers, executives and community members and identify options and actions to fill in these gaps.

### **Sector-Specific Strategies**

The relation between health, water and agriculture sectors is widely recognized. For example, water management (irrigation and dams, for example), water supply and water quality change the epidemiology of water-borne diseases (such as diarrheas, hepatitis A and E, and schistosomiasis). Agriculture is essential for nutrition (quality of food, availability of micronutrients) and food safety (contamination), as well as control of zoonoses (such as avian and swine flu). Food reduction will not only lead poor households deeper into poverty, but may force a change in diet, resulting in long-term nutrition deficiencies, especially among children. The following highlights key stakeholder perceptions on the adaptation strategy as well as observations from the CDS team.

#### **(1) Health Sector Strategies:**

In terms of sector-specific strategies, the vision of the health sector is to promote community resilience to reduce vulnerability to climate change impacts, most notably water and vector-borne diseases and

extreme temperature-related diseases. The first approach under this strategy is to identify sources of vulnerability and groups at highest risk and provide alternatives to reduce vulnerability; as follows:

- Assess the health status of the community and the groups most vulnerable to the impacts of climate change;
- Provide health services to reduce conditions related to health vulnerabilities for use by the local health department and community members;
- Assess the change and distribution of microbial pollution of food and water-borne diseases;
- Assess the change and distribution of vectors and vector-borne diseases;
- Identify and promote adaptation options with public health officials and other stakeholders; and
- Establish health services and mechanisms to monitor climate-related illnesses, especially water and vector-borne diseases (some agencies have shown interest in the area and are willing to invest in promoting health).

The three local communities identified the assessment of the health status and change in vectors as priority areas. While there have been no noticeable changes in the types of illnesses present, they have seen an increase in the number of illnesses. They noted that every year, the water becomes more and more polluted and the number of insects and snakes has increased. Having technical information from professionals specialized in these areas would be of great benefit to the settlers, as many members are conscious of the changes to their environment but are unaware of the proper coping mechanisms. For example, in Bashayer El Kheir, one settler noted an increase in dizziness and eye problems in the community – two symptoms associated with increased extreme temperatures. However, the absence of any health care services has left the community unprepared to deal with these occurrences. Water quality in the three areas is also of major concern to settlers. While some areas have acceptable drinking water, there is either no water purification station at all, or it is poorly managed.

## 2. Empower and engage stakeholders to reduce community health vulnerability to climate changes

- Organize educational outreach campaigns on climate change-related diseases;
- Introduce best practices for reducing risks associated with climate change; and
- Identify simple networking and outreach strategies for local vulnerable populations

It is imperative to note here that the settlers who have moved to the area west of Lake Nasser have all come from various areas across Egypt. The mountainous terrain of Aswan requires different coping strategies than people are used to, and any educational information that can be relayed to the community will be beneficial. In addition, while settlers of the three areas have a basic understanding of climate change, more awareness, and adaptation actions are needed. Settlers of the three areas noted that networking and outreach strategies were the least of their priorities, as the communities are already well connected with each other and have an informal network of relations.

## 3. Improve public health preparedness and emergency responses

- Conduct mobile and fixed health care campaigns for most vulnerable groups;
- Develop emergency preparedness plans for events likely to increase with climate change (vector and water-borne diseases);
- Maintain commitments to healthy food and nutrition programs; and

- Ensure provision of safe and reliable public drinking water resources

Settlers in each of the three areas noted the importance of health care campaigns, especially fixed units. The community felt that the presence of an ambulance, as well as a doctor or doctor's assistant was a top priority. Because the communities in these areas are geographically distanced from the city, emergency responses are often delayed. In terms of healthy food and nutrition programs, settlers noted their inability to prepare nutritious meals, as they are limited by their income and lack of electricity, which would assist in storing food in refrigerators, and limited knowledge on the issue. Furthermore the provision of safe and reliable public drinking water resources is crucial to the local communities. Specialized technicians with skills and experience are required to monitor and manage water quality, as those previously regulated to this task are not always available in the area. Settlers in each of the three areas noted their willingness to receive training on how to monitor the water purification stations and take effective control of these water sources.

## **(2) Agriculture Sector Strategies:**

The vision of the agriculture sector is to increase productivity and support income generation; as follows:

1. Improve soil usages and water management;
  - Improve soil usages and water management practices;
  - Establish demand-responsive water management for agriculture; and
  - Improve efficiency of water management systems

This deliverable was of utmost importance to settlers. As water management techniques have either already been mastered or are limited by the current supply of water in the area; settlers feel that these techniques cannot be further improved. Farmers in Bashayer El Kheir expressed frustration from the fact that the World Food Program – which manages services in the village, determined water supply and they had no say in altering the management system. Settlers have received very little training or awareness on soil management practices. While many members of the three communities highlighted the need for further training on soil practices, Garf Hussein settlers noted the need for monetary investment in the local agricultural organizations in order to scale up their farming. These settlers also stressed the importance of loans to help them grow their businesses.

2. Plant the most suitable crops for the area, taking into consideration expected climate changes
  - Strengthen the production system through diversification of cultivars;
  - Identify drought-tolerant, saline-tolerant, and water resistant varieties; and
  - Introduce management practices such as early or late plant varieties

While the introduction of drought and water-tolerant crop varieties was important to the settlers of Garf Hussein and Kalabsha, farmers in Bashayer El Kheir were unconvinced that climate changes will ever result in the decrease of water availability. They see no need in altering the types, or varieties of crops that they currently plant and have experience in farming. Also, the introduction of different management practices, such as early or late plant varieties, was an unwelcome adaptation strategy from farmers in Garf Hussein since they noted that they have already altered their management practices. The settlers in the other two areas expressed their willingness to alter their farming practices based on

recommendations from individuals specialized in agriculture and familiar with the conditions in the area west of Lake Nasser.

### 3. Strengthen household and farmers' capacity to use and implement new best practices

- Enable farmers to take on management of local irrigation systems;
- Generate and disseminate relevant information on water quality, soil moisture, and cropping practices to help farmers choose the most appropriate adaptation techniques;
- Provide farmers with access to information on marketing and production input prices;
- Apply scientific data which improve and predict the impact of climate change;
- Establish and develop a local system to link small producers to markets;
- Provide microfinance alternatives for poor farmers; and
- Identify key climate change risks that farmers face and investigate adaptation options that address these risks and the needs of decision makers

In the past, farmers in the three areas received information on farming best practices, but these training sessions were basic. The willingness to learn is high among all settlers, and they have the drive to scale up their practices and ensure sustainability. The three communities are also willing to work together to create networks linked to the market, but want to ensure that these networks are done right. For example, settlers in Kalabsha highlighted their most recent experience with a tomato seed supplier. The supplier passed the seeds on to the community after the prime farming period had passed, and therefore the tomato crops were ruined. The supplier refused to take the crops from the farmers and did not reimburse them for the ruined crops. This example further reinforces the strategy of developing microfinance alternatives for farmers in the area, as they have no insurance system for climate change related to crop failures.

#### Participatory Workshops:

After developing the adaptation strategy, the project held a number of workshops and events to discuss the implementation of this adaptation strategy. Participatory workshops were implemented to serve different purposes, which brought together government officials, researchers and community members to discuss implementation of the adaptation strategy, while strengthening existing policies relevant to adaptation options, minimizing potential impacts, expressing their points of view about climate change, and how they perceive its impacts on their lives. Local and national media were involved in most of the workshops, as a tool to practice pressure on policy and decision makers to adopt policies that adapt to the impacts of climate change.

As foreseen in the milestones, participatory workshops were planned to take place within the first six months of the project. Thus, a participatory workshop that marked the official inauguration of the project was held in Aswan for the project's stakeholders. An action plan that laid out the work of different stakeholders was produced. On the other hand, contacts were established with major media sources. Journalists from Al Ahram, Al Ahram Weekly, and Channel Eight (Aswan's television channel) attended and covered the events of the workshop.

In addition to the workshop that marked the inauguration of the project, a series of meetings were held with Community Development Associations in Kalabsha (six meetings), Garf Hussein (eight meetings), and Bashayer el Kheir (seven meetings) to introduce concepts of climate change and its impact on water, agriculture, and human health as well as monitor progress of project activities, share immediate



results of research with different stakeholders, and resolve problematic research issues. Each association's capacity to undertake various roles and implement certain activities with their respective communities was discussed, negotiated and agreed upon. Also, follow up meetings (one day workshops) were held between different stakeholders to share experiences and results, discuss challenges, and find solutions for research problems in light of the developed adaptation strategy.

### Publicity Materials:

The team developed an Arabic volume that documents the project's experience in Lake Nasser area. The project produced simplified guides as handouts for beneficiaries on farming, animal husbandry, healthy nutrition, and safe water use. Those handouts rely on the content, which was introduced during the capacity building programs and implemented through the lifetime of the project. The guides take into consideration the level of education of beneficiaries and use self-explanatory pictures to reach out to the largest number of beneficiaries. The project site team is responsible for the dissemination of publications through their regular door-to-door visits.

As for the final results of the project, they were disseminated through the project's website ([www.lakenasser.org](http://www.lakenasser.org)) and several other news papers' articles (see Annex 13) and activities. The final conference of the project was one of the main dissemination tools especially with officials representing the High Dam Lake Development Authority, and the Governor of Aswan. The MAP EGYPT half annual bulletin offered to dedicate an issue for publishing the final results of all researches implemented under the project in simple Arabic, which represented another opportunity for the dissemination of results and for starting a wider discussion about the development horizons in the area west of the High Dam Lake.

The project team also conducted a capacity assessment in order to determine the capability of both the beneficiaries and the High Dam Lake Development Authority to adopt the recommendations on the adaptation options in the area of the project and to cooperate in disseminating the recommended practices on a wider scale inside the community of settlers.

### Challenges

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As project activities developed, and roles crystallized, challenges appeared during the implementation process. One of the main challenges that faced the project was the change of management officials in both the High Dam Lake Development Authority, and the Agriculture Research Center. This change brought about the possibility of stalling project activities due to the fact that new officials might not have a clear understanding about the project objectives in the area in particular, and Near East Foundation in general. To overcome this challenge, the project management conducted a series of communications with the highest levels of authority in Aswan governorate represented in the Governor, the governorate's Secretary General, and the Director of the governorate's Technical Office. Based on those communications, the management team met with both the governorate's Secretary General and the Director of the governorate's Technical Office to explain the idea behind the project, discuss future steps, and agree on the support needed from the governorate. The project management also communicated with the new Head of the High Dam Lake Development Authority and the Head of the Agriculture Research Center in order to agree on steps for cooperation during the period of the project. The memoranda of understanding negotiated and signed with both entities at the beginning of the project helped make the communication process easier. The final six months of the project witnessed intensified cooperation between all stakeholders achieving the intended project outcomes.

Also, it is of note that the implementation of some project activities was faced by some challenges that made the completion of some of those activities take a longer time than expected. The delay of starting some project activities set out for the first six months of the project meant that activities set out for the second half of the first year of the project were also delayed. A major challenge was faced regarding the negotiations with different organizations that were identified as key stakeholders and the relationship by signing cooperation agreements. This was due to the fact that it was difficult to organize meetings with key persons and leaders of partner and stakeholder organizations because of their busy schedules in both SVU and ARC (See Annex 2 for detailed information).

However, taking the time to conclude those negotiations and sign the agreements with key partners was seen as imperative for the implementation of the rest of project activities in the most professional and efficient way possible. Those organizations represent a large number of very specialized researchers and scientists who, with their contributions, ensured the accuracy of project results and thus guided the process of designing strategies for responding to climate change issues. This has been clear in the socio-economic assessment, the agro-forestry activities, the EUREPGAP activities, and training activities that were mainly implemented in cooperation with ARC, HDLDA, and the Faculty of Social Sciences – SVU.

The project was also faced financial constraints due to the budget being set before recent inflation spikes, which have resulted in an unexpected raise in plane ticket rates - that jumped from CAD 100 to CAD 150 and sometimes even more according to the season - fuel costs, and accommodation prices. Due to recent decisions by the Egyptian Ministry of Transportation, the prices of train tickets have also reached unprecedented levels; they went from CAD 80 to CAD 164, which did not make the train a substitute for planes. This represented a clear burden on the project budget especially that many researchers from ARC who actively participated in project activities were Cairo residents and needed to travel constantly to the project site to follow up the activities that were being implemented.

This type of challenges might not be research-oriented; however it affected the flow of research activities during the project. The team management was convinced that taking the time to resolve such issues would have its return on the longer term. Working towards changing the attitudes and behavioral patterns of researchers in different institutions did eventually affect the frequency and quality of research conducted in the new resettlement areas west of Lake Nasser. The main results learned from these challenges are that for any future project a better time management, a financial forecasting, and a contingency line item in order to cover for fluctuation of currency rates, have to be present.

Due to the delayed start of project activities, the project was not able to conclude all its research activities at the end of the two-year project lifetime (See Annex 3 for Research summary). Thus, the project management applied for a six-month extension to IDRC in order to be able to conclude the research activities and reach reliable results. After a process of negotiations about the activities, which still needed to be completed and the redeployment of budget available for the project, IDRC approved a six-month no-cost extension, which ended on September 2010.

## **Outputs**

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As an action research project, New Land New Life implemented research activities accompanied by the provision of direct services to the community in the targeted area. Thus, during the planning of research, researchers, project site team, and the project management designed their activities around the role of the community in the implementation of activities and the benefits offered throughout the

lifecycle of the project. To make sure that the research serves the community members and has direct influence on their livelihoods, beneficiaries themselves were part of the design and implementation of all project activities. The **socio-economic assessment** carried out at the beginning of the project indicated vulnerabilities related to agricultural practices. This initiated a number of agricultural research activities in participation with the beneficiary farmers. Dialogue with beneficiaries during community meetings and focus group discussions, on the one hand, and deliberations during workshops with research teams, on the other, led to the achievement of the following outputs:

### **Agricultural Research Activities**

- All agricultural experiments were designed by researchers from the Agriculture Research Center (ARC) in cooperation with project site team and farmers. Together with the implementation of scientific research agricultural experiments such as “Bio-Energy Plantation of Jojoba”, “Effects of Soil Moisture Regime and Nutrition on some Vegetable Crops under Heat Stress”, “Ideal Crop Composition in the Area West Lake Nasser” and, “The Effects of the Different Agricultural Seasons and Sprinkling Dry Active Yeast on the Growth of Vegetables, Dates, Nigela Sativa & Coriander”; researchers offered extension services to farmers in their land and provided them with timely information about their cultivation techniques to improve their current practices.
- Researchers also offered capacity building programs based on the needs identified by farmers themselves. At the same time, the project site team was responsible for daily follow ups of the experiments and data recording processes during the lifetime of the project, and worked as a link between researchers and beneficiaries. Towards the end of the agricultural experiments, farmers contributed to the assessment of experiments, and researchers concluded on best techniques and practices based on the final data analysis.
- As a result of the agricultural research activities, 80% of farmers started using organic fertilizers and their return on crops rose by 20%.
- 65% of the farmers started using crops resistant to high temperatures, such as jojoba all year, Alfalfa “bersim” and lobby fodder to be cultivated during summer session (1<sup>st</sup> year) and during the second year; soya beans and beet root have also proved to be the best crop to be cultivated. These crops would ultimately increase productivity per feddan to 21-40 tons.
- 20% of the farmers have also started using agricultural intensification, which would increase production by 10 to 25% per feddan; 15% of farmers are to use crops that give shadow to original crops, which will increase production by 5 to 8%.
- Also, through veterinary guidance and nutrition courses, animal husbandry would double the number of cattle and lead 20% of farmers to raise livestock. In this respect, it should be noted that the project carried out 3 veterinary convoys to check the health of livestock in the area.

### **Ecological and Biological Research**

- The ecological and biological researches complemented the results of the socio-economic assessment through focusing on water quality and water-borne diseases, algae intensiveness, and distribution of vegetation and its relationship with vector-borne diseases.

- All water and soil research activities were designed by researchers from the South Valley University (SVU) in cooperation with the project site team and ARC researchers when necessary. The first data review from previous eco-health studies was compiled and used at the beginning of the project to identify important research topics that should be included and used as a way to guide the research activities, avoid repetition, and compare results. This is why the data review process was considered an ongoing process rather than a step taking place once at the beginning of the project. According to the results of the data review, research plans were developed to cover the selected research topics. Although the community did not have a direct role in the implementation of this research as it was mostly related to collecting samples and laboratory testing and analysis, researchers offered the community capacity building programs on the use and storage of water. Based on the results of the data analysis, researchers offered conclusions to both the community and policy makers on water use and management, and protection against water borne diseases (See Annexes 6, 7, 8, 9 11).

### **Health Research and Integrated Human Health Monitoring System**

- The health research activities were implemented by researchers from the Aswan Educational Hospital, the Aswan Health Directorate, and the Animal Reproduction Research Institute – ARC through medical and veterinary convoys. Convoys provided direct health services to the community and at the same time collected data on the diseases found in the area and their possible relation to climate changes, disease vectors, and the quality of water in the area.
- The seven (7) medical convoys provided health services to 3,469 beneficiaries including medical checkups, laboratory tests, and provision of medicine.
- The link that has been recorded with climate change is the prevalence of eye allergy, which can be connected with the active movement of wind in the area. In addition, the presence of flies might also be affecting the number of occurrences of Muco purulent conjunctivitis. In addition, there are concerns that drinking water might be highly mineralized, with high oxalate and urea contents which increase the chance of kidney diseases and failures due to water pollution and high temperature. Until this point of the research, no common diseases between humans and animals were recorded.
- Researchers also offered beneficiaries capacity building programs on healthy nutrition, protection against disease, animal health and safe animal husbandry activities. A total of 1,225 beneficiaries both women and men participated in these training sessions and seminars.

### **Capacity Building**

- The capacity building component of the project worked on three main aspects: creating an institutional framework for incorporating climate change issues; raising awareness of local communities on climate change through outreach programs; and disseminating information to stakeholders, while strengthening the network between them.
- Throughout the project's duration, a series of training workshops and seminars were delivered by agriculture practitioners, botanists, pest control specialists, physicians, nutritionists and veterinary doctors from the South Valley University and the Agriculture Research Center.

- The number of beneficiaries participating in those training events reached 412 men and women, from Kalabsha, Garf Hussein, Bashayer El Kheir, and stakeholder organizations.
- The following is a list of the main agriculture extension workshops and delivered by the project:
  - Methods of planting orange seedlings (sour orange, Volkameriana, & Macrophylla)
  - Citrus production in arid and semi-arid lands
  - Mango production in arid and semi-arid lands
  - Asparagus production for export
  - Growing non-traditional crops in green houses (cabbage, broccoli, collard, Chinese mustard, Chinese cabbage, Brussels Sprouts)
  - Seedling production
  - Managing and growing crops in green houses
  - Compost production
  - Compost usage for growing vegetables
  - Manure usage for fruit trees
  - Pest control in cash crops in the area such as sesame and hibiscus
  - Production of cucurbits.
- Other seminars included:
  - Nutrition basics and types of food suitable for arid and semi-arid lands;
  - Vitamins and minerals necessary for living in hot climate areas;
  - Common diseases between human beings and animals;
  - Treatment of snakes and scorpion bites.
- All these training activities were carried out in relation with the Euro-Retailer Produce Good Agricultural Practices (EUREPGAP) and post harvest practices.
- Based on the results of the second socio-economic assessment, additional capacity building topics were incorporated within the capacity building plan and training programs were implemented to address the lack of knowledge of the beneficiaries related to plant diseases and ways to avoid infection, double and triple cropping, crop reservation and storing, recycling agricultural waste, and maintenance of modern irrigation systems.
- In addition, the project collaborated with the Desert Development Center (DDC), affiliated to the American University in Cairo, for establishing and running an agro-forestry nursery, and provided training on the best types of trees that can be planted in the West of Lake Nasser area, how to plant them inside the nursery, how to monitor their germination and growth, planting and nurturing tree seedlings, irrigation systems, propagation, and harvesting.

### **Adaptation Strategy to Climate change**

- The researches undertaken supported the design a comprehensive adaptation strategy to climate change in the targeted area, in participation with the community and policy makers. This strategy addressed both the community and decision-makers in order to improve the life conditions of beneficiaries and increase their capacity and resilience towards expected climate changes.

- For each stakeholder, a number of issues/topics were raised during the participatory workshops, deliberation meetings and convenings as follows:
  - a. **For policy makers (HDLDA and other public authorities):**
    - a. Strengths and weaknesses of managing newly established communities;
    - b. The impact of climate change on resettlement policies, linking to results from cultivation and water research under the project.
  - b. **For the Health directorate:**
    - a. Designing geographically specific health care systems, that could be applied to the health needs of the project area.
    - b. Methods of predicting future diseases based on current and expected future climate changes that could be applied to the project area.
  - c. **For beneficiaries:**
    - a. Simplified guides for modern and non-traditional planting techniques in the area west of Lake Nasser, especially related to EUREPGAP and modern irrigation and fertilization systems;
    - b. Possible effects of climate change on living conditions in the area;
    - c. Best adaptation options for settlers to maintain quality livelihoods in the area including:
      - i. Water use and management
      - ii. Nutrition
      - iii. Health care
    - d. Women’s role in supporting sustainable livelihoods for their families in the area including:
      - i. Supporting men in agricultural activities
      - ii. Raising healthy children
      - iii. Starting projects in agriculture-related industries
      - iv. Increasing the resilience and adaptability of family members against climate changes.

## **Outcomes**

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- The multi-stakeholder approach of this project supported building long-term relationships between different scientific institutions, governmental authorities, the project team, and beneficiaries in the area. Those relationships had been utilized in order to make the best use of resources and ensure that there was no duplication of work or effort. As a fruit of this

cooperation, the same agriculture experiments that were designed and implemented under the EUREPGAP were used to conduct part of the Ecological and Biological research.

- A key outcome is advancing the scientific understanding of climate change and the necessary adaptations through enhancing the scientific technical capacity of researchers, as exemplified in the results of all the research activities undertaken under Objective 2.
- The applied researches conducted, under Objective 2, have built the settlers' capacity to adopt more efficient and sustainable behavioral, environmental, institutional and technological adaptation strategies and methods/interventions (irrigation, planting, cultivar...) that adequately lead to desired environmental and health effects and mitigate or reduce the risk of disease and environmental hazards caused by climate change on human health.
- Furthermore, the Capacity Building and training events targeting farmers focused on increasing knowledge and information on climate change adaptation models thus enabling them to detect plant infections, realize the symptoms of different diseases and ways of protection and treatment.
- Through the trainings and awareness raising sessions that complemented the applied researches, farmers have learned methods of using of organic fertilizers and the introduction of new crops resistant to climate change such as jojoba and some types of cucurbits and tomatoes, crop intensification, use and storage of water (use of drip and spray irrigation), and increasing productivity through dry active yeast.
- The study of the Effects of Soil Moisture Regime and Nutrition on some Vegetable Crops under Heat Stress was of particular importance as it concluded that minimizing the usage of chemical fertilizers, consequently reduces pollution. Also, the introduction of new vegetable varieties suiting the environment of Lake Nasser would raise the standards of living of the poor living in the area.
- The Ecological and Biological research findings also showed the incidence of possible linkages between the different patterns of land use and water management, climate change, and health risks in Lake Nasser area. This research study also helped develop human resources in the horticulture field and optimize the use of irrigated water.
- The rising temperature in the area results mainly in fluctuations in the water level, decrease in the quality of water, rapid distribution of water contamination, pollution related to bacteria, presence of heavy metals and algae intensification, water-borne diseases due to presence of bacteria (algae and fungal infection), which causes the appearance of mosquitoes (specially during the months of November and December) and the increase in diseases such as malaria.
- The existence of mosquitoes, and white flies, especially under high temperatures, might increase the possibility of transmitting disease between humans and animals, and among humans.
- The analysis of the water samples recorded new pollution indicators such as total yeasts, *Candida Albicans*, *Aeromonas Hydrophila* and total staphylococci; pathogenic bacteria included

salmonellae, shigella, total vibrios and listeria group. Results confirmed that there is a positive relationship between the rise in water temperature and the quality of water (See Annex 6).

- With regards to human health, researchers concluded that under the current circumstances, the settlers in the area might possibly face a number of health issues such as developing cancer and increase in the occurrences of photophobia, skin dryness, and eczema. Furthermore, excessive exposure to the sun, particularly in summer lead to excessive sweating, which causes minerals to be highly concentrated inside the human body leading to kidney diseases, and high blood pressure.
- Initial possible solutions for such health problems include raising the awareness of settlers on healthy nutrition and good hygiene, under severe living conditions; developing a sanitation system inside homes and garbage dumping and collection; improving the ability of settlers to deal with drinking water and store it in a hygienic manner; and 4) providing healthy meals for school children. These solutions will eventually help combating the negative effects of climate change, while dealing with water pollution and specially polluted drinking water.
- The HDLDA incorporated the results of the analysis of risks of disease infections in relation to different temperatures, which were daily monitored during the experimentation phase, in their research programs and will follow-up on the application of these results in the field.
- Furthermore, HDLDA incorporated the adaptation strategy developed under objective 3 of this project in their main strategy during the strategic planning exercise conducted after HDLDA was transformed into an economic profit-making entity.
- The Governor of Aswan has also expressed his willingness to widen the scope of this adaptation strategy on Aswan level so that the Governorate becomes pioneering in this field. The ARC is to provide the technical support and know-how for the strategy.

## **Assessment and Recommendations**

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Social, economic, and environmental systems in arid regions are vulnerable to climate change disruptions. Integrated policy, planning, and management of water and energy resources can provide multiple economic, environmental, and climate benefits. Climate change resilience needs to be built systematically into new projects and policies. To date, climate change is almost never used as a template and/or considered as an option. Yet, whether the issues at hand are the design of river basin management, new irrigation systems, and/or urban planning, impacts, implications related to climate change need to be at the forefront.

Higher temperatures, increased drought, and more intense sandstorms will very likely increase erosion. River and riparian ecosystems in arid lands will be impacted negatively by decreased stream flow and increased water removal. Although some changes may be somewhat slow and gradual, many changes may be rapid and dramatic.

The research built the settlers' capacity to adopt more efficient and sustainable behavioral, environmental, institutional and technological adaptation strategies and methods/interventions (irrigation, planting, cultivar...) that adequately lead to desired environmental and health effects and



mitigate or reduce the risk of disease and environmental hazards caused by climate change on human health. As a result of the applied research, the farmers began using drip irrigation and allocating water correctly, stored water, used organic fertilizers, used dry active yeast to increase agricultural yields, cultivated crops resistant to high temperature, and introduced new crops, which are heat resistant.

The study also derived adaptation strategies relevant to and in participation with the public health sector and other stakeholders (regional coordination of information and action) concerned with climate change issues, for the betterment of national resettlement and development schemes. The applied research team conducted capacity building and workshops for the participants and at the policy level.

The design of adaptation strategy adopted by HLDA in Lake Nasser area has become an integral part of their overall strategic planning. The governor of Aswan wishes to widen the scope of this adaptation strategy on Aswan level so that the governorate becomes its pioneer. The ARC is to provide the technical support and know-how for the strategy.

Thus, the adaptation to climate change will require radically different paradigms in ecosystem management in order to:

- Cope with climate change and variability in resource and ecosystem management;
- Engineer the products of succession to prevent regional synchronicities and inhibit undesirable species invasions following large-scale disturbances; and
- Anticipate and direct migrations in ways that hedge our bets, mitigate adverse effects, and enhance ecological goods and services.

Strengthening local land rights and encouraging investment in sustainable management will eventually help farmers adapt to change. In many cases, this means improving local technologies for soils management. Governments also need to provide incentives for collective management of common resources – water, grazing, woodlands – through joint management, legislation and local by-laws as well as investing in the design of new and better energy systems, through decentralized power generation, the use of bio-fuels, and improvements in solar technology. Support for such technical innovation needs to be considered a high priority challenge, rather than an orphan topic.

Adaptation needs to be fully understood and the local community needs to be strengthened in order to cope in ways that bring positive rewards. It is vital to recognize much of what is already being done by local people and organizations, rather than thinking that government should make such changes happen by itself. It is a good sign that NEF is not the only goodwill actor in the area. It shows that there are other actors who felt that the area is unique in its physical as well as social features (See Annex 19 for other development projects in the area). Climate change is one of many problems that require policymakers to think in terms of adapting to changing environmental conditions. Yet traditional institutions of government, such as the Ministries of Irrigation or Agriculture, were constructed for continuity, not adaptation. Hence, it was difficult for them and other centralized agencies to incorporate adaptive management. Most natural resource management agencies at the national level were built as centralized bureaucracies in the climatically stable of the early 20th Century. Managers of natural resources face a wide range of uncertainties when attempting to manage specific areas in a time of global climate change. The issues they face are fraught with complexities about the fundamental dynamics of ecological systems and possible trajectories of these systems, some of which are known, but many are likely to be new. NGOs and other civil society groups can play a major role to support local action. Also, new institutions should be developed to help navigate through largely uncharted waters.

These new institutions should be designed to conduct experiments that are structured to learn and understand. We learn as much by failures as we do by successes, so we need to focus on actions that are safe to fail, for people and ecosystems. Safe to fail policies provide room for mistakes, and the ability to learn from our mistakes; such policies require institutions that build trust and social capital, and focus on participatory learning by individuals and groups.

# **Annexes**

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Annex 1: Eco-Biological Summary of Findings and Research Plan

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**Eco-Biological Summary of Findings and Research Plan**

The following table demonstrates a summary of Eco-biological findings related to each research topic and the researches that were conducted to further investigate the relationship between climate change and research findings.

Eco-Biological Summary of Findings and Research Plan

Research area	Previous findings	Climate change related concern	Research topics	Outcomes
1- Water quality and water borne diseases	<ul style="list-style-type: none"> <li>In the first assessment, all water samples collected were found highly contaminated, with Bacterial and Protozoan content. Further studies, especially for Giardia, Entamoeba histolytica, and Cryptosporidium, need to be conducted.</li> <li>In the second assessment, water samples taken from the purification units, water tanks and pipes, and water reservoirs in houses were all found polluted with Chlychia Ecolay.</li> </ul>	<ul style="list-style-type: none"> <li>Rising temperatures</li> <li>Fluctuating levels of water in Lake Nasser</li> </ul>	<ul style="list-style-type: none"> <li>Study the impact of rising temperature on the distribution and prevalence of bacteria and protozoa.</li> <li>Study the impact of the fluctuation of water level in the Lake on the distribution of water contamination.</li> </ul>	<ul style="list-style-type: none"> <li>Conclusions about the relationship between rising temperatures and bacterial content reached.</li> <li>A strategy for the best use of water resources in the area designed</li> <li>Future effects on water and health related issues in case of rising temperatures and decreased water levels projected.</li> <li>Adaptation strategy for reducing the effect of rising temperature on contamination developed</li> <li>Biotechnological methods for reducing water contamination introduced</li> <li>Awareness campaigns for the community on how to adapt to water contamination organized and implemented</li> </ul>
2- Algae intensiveness	<ul style="list-style-type: none"> <li>Algal growth was found to be relatively high in investigated sites, particularly in the sites of fish culture ponds. The dominating types of algae differed from one sites to another. In general, data indicated that different water areas acquired specific</li> </ul>	<ul style="list-style-type: none"> <li>Rising temperatures</li> <li>Movement of wind</li> <li>Relationship between algae and aqua-life</li> </ul>	<ul style="list-style-type: none"> <li>Study the impact of rising temperature on algal growth, and possible effects on human health</li> <li>Study the effect of intensive algal growth on water quality</li> </ul>	<ul style="list-style-type: none"> <li>Methods for the reduction of harmful algae growth introduced</li> <li>Strategy for algae control developed</li> <li>Adaptation methods in case of rising temperature and decreased water levels introduced</li> </ul>

Research area	Previous findings	Climate change related concern	Research topics	Outcomes
	environmental conditions and man-made effects, although the sampling sites are located in the same district.			
3- Distribution of vegetation and its relation with the distribution of water borne diseases	<ul style="list-style-type: none"> <li>The area is dominated by the submerged plant <i>Myriophyllum spicatum</i>.</li> <li>Four main natural vegetation zones are found in the shoreline of Lake Nasser; 1) Zone, A frequently inundated, 2) Zone B, periodically inundated, 3) Zone C, rarely inundated, and 4) Dry zone, never inundated.</li> </ul>	<ul style="list-style-type: none"> <li>Rising temperatures</li> <li>Fluctuating levels of water in Lake Nasser</li> </ul>	<ul style="list-style-type: none"> <li>Study the relationship between the existing distribution of vegetation and disease vectors such as mosquitoes</li> <li>Study the effect of fluctuating water levels on the growth and distribution of vegetation, especially in less frequently inundated areas</li> <li>Study the effect of rising temperature on the prevalence of vector borne diseases</li> <li>Identify current and possible vector borne disease species</li> </ul>	<ul style="list-style-type: none"> <li>Strategy for vector borne disease reduction developed</li> <li>Threat assessment in case of future rising temperature conducted</li> <li>Capacity of the community to contribute to vector borne disease reduction built</li> </ul>

## Annex 2: Challenges

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### Challenges

The implementation of some project activities was faced by challenges that delayed the completion of some of those activities. A major challenge was to complete the negotiations with different key stakeholders and to formalize the relationship by signing cooperation agreements.

Regarding the ARC, one of the obstacles was to set dates for meetings with top officials who were responsible for formalizing the agreements. The negotiations on the articles of the agreement were very smooth, and cooperation was very much welcomed. Putting this agreement into action was also very quick since 7 institutions affiliated to ARC showed their interest to offer their contributions to the project without expecting any financial returns. Regarding SVU, the case was different to some extent; although top officials (represented in the vice-president of the university) were very cooperative in formalizing the agreement without putting an article for financial compensation, this agreement was not received well by the Faculty of Science – SVU, which is the main actor in the ecological-biological research. It was challenging to convince them that participating in project activities would in turn yield scientific returns to the Faculty and make it a leading institution in the area. In the end, the progress in the biological research did not reaching the levels hoped for.

In addition, in the ARC case, the take off was very smooth with a lot of enthusiasm by the deputy director of the center. He had the main role in encouraging and mobilizing researchers in different institutes affiliated to ARC to be part of the project. He visited researchers to distant sites, west of Lake Nasser. He followed up researchers' activities, solved internal problems at ARC, which sometimes hindered researchers from travelling to the project site, and he made sure that there is solid documentation to all activities implemented by his researchers. Although this has been very important for launching our work and making sure that all efforts were coordinated, it started creating a challenge in the flow of communication between researchers on the one hand and the project management on the other. The deputy director wanted to keep his role as the main channel for communication. With the increase in the number of activities that were being implemented simultaneously, and thus the increased number of reports, and with the deputy director being a busy senior official who was not always free to check researchers' reports immediately, reports in many occasions were delayed.

To the project management, his desire to play this role was understandable, being the owner of the initiative, and knowing how to mobilize his staff and motivate them. However, the project management wanted the communication flow to be faster and smoother with the researchers in order to move towards next research steps in an easier manner. The project management discussed this issue openly with him and the following decisions were agreed upon:

- 1- ARC reports were to be sent to both ARC deputy director and project management at the same time.
- 2- If there is an internal problem in ARC it should be communicated to the deputy director; however if the problem is technical, it should be communicated directly to the project management, and reported later on to the deputy director.

For SVU, the challenge was different. The memorandum of understanding was signed with the president of the university. At that time, there was no vice president for the Aswan Branch Affaires, who should have been responsible for enforcing the MOU in the Aswan Faculties. As a result, the enforcement of the agreement was delegated to the deputy dean of the Faculty of Science in Aswan, as the project is

research based. Instead of communicating the MOU to all concerned faculties in the Aswan Branch, the deputy dean only involved the Faculty of Science. This placed a burden on the project management to communicate the message of the project to other faculties, separately, and encourage them to participate in project activities, which on the contrary to the case of ARC, made the process of mobilizing various researchers from different backgrounds lengthy.

The situation became even more complicated when the deputy dean entirely delegated the enforcement of the MOU to the Unit of Environmental Studies and Development, which is financially independent from the faculty, and thus carries out most of its researches through external funding. Based on their nature, members of the unit negotiated financial benefits before expressing their willingness to contribute to project research. The majority of them were not convinced by the value of volunteer work, the return of scientific research results from the project to their unit, and/or the importance of involving other faculties in the process. The project management held several meetings with the unit during the first year of the project in order to resolve those issues; however, they still held their position of not participating unless accommodation, per diems, transportation, and equipment were granted to them.

During this negotiation process, a vice president for the Aswan Branch Affaires was appointed. He was aware of the previous NEF project in the area west of Lake Nasser, and he also attended the opening workshop of the NLNL project in November, 2008. He had a very positive perspective and thus was encouraged to be involved in the process of enforcing the MOU, once the project management communicated the issues hindering this process. The vice-president held a collective meeting with members of the unit and the attendance of the project management, in order to listen to their viewpoint and agree on means for their participation in the project. The vice-president pointed out the importance of voluntary work, the fact that not all returns are according to cash money. However, they still insisted on their previous opinion. To overcome that, the vice-president took a decision, with the project management, to form a team which includes researchers from different faculties, who are willing to participate voluntarily in the project, and to take the responsibility of following up the role of this team in implementing SVU's part of the signed MOU.



## Annex 3: Research Program Description

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### Research Program Description

Research activities undertaken under the project have found out that the water quality used for drinking and irrigation is poor and highly contaminated with algae, bacterial and protozoan contents. Residues of heavy metals were also found. Such findings raise concern about the impact of rising temperatures in the area and the fluctuating levels of water in Lake Nasser. The impact of rising temperature on the distribution and prevalence of bacteria, algae and fungi; and the impact of fluctuation of water level in the Lake on the distribution of water contamination is clear. Extreme temperatures and fluctuating levels of water in the Lake are also affecting the natural vegetation in the area and resulting in the appearance of new diseases and vectors such as mosquitoes and white flies. Rising temperatures and contamination of water in the lake is also affecting its aquatic life resulting in infection of aquatic animal species with diseases and variability in fisheries production. Developing techniques for the management of these diseases, as well as developing methods for reducing variability in fisheries production to enhance the livelihoods of the fishing community in the region need to be further studied. The research program developed and promoted sound health interventions and practices to control such ailments and diseases among vulnerable community members.

It is imperative to highlight that all the above research areas were covered through support from local participation of the local people both settlers and the indigenous population. The research program focused on the process of knowledge generation and interaction between the researchers and the researched. Knowledge was generated and transmitted through interaction with specific social, ecological and economical contexts.

#### ***A. Important Targets for the Research Program:***

##### **Water**

- Water quality in Lake Nasser
- Surface\water quality
- Groundwater quality
- Drinking water quality
- Water use efficiency

##### **Soils**

- Biological Soil fertility and soil organic matter
- Alkalinity and salinity
- Irrigation and soil salinity
- Organic vs. inorganic fertilizers
- Composting
- Soil erosion
- Sand drift

##### **Flora and crops**

- a. Continued monitoring of flora with a view of climate change (e.g., invasive species)
- b. Selection of useful wild species for utilization as crops
- c. Continued monitoring of pathogenic micro-organisms

d. Windbreaks

**Fauna and domestic animals**

1. Continued monitoring of fish, birds, reptiles, insects and other arthropods (e.g., scorpions), pests (e.g., white fly), natural enemies, pollinators, disease vectors (e.g., mosquitoes, etc.), soil animals (herbivores, predators, and detritivores), threatened species, etc.

**Environment**

- e. Continued environmental monitoring
- f. Indicators of environmental quality
- g. Indicators of sustainable development
- h. Indicators of climate change adaptation

**Economics**

- 1. Transport and marketing
- 2. Income and job generation
- 3. Purchasing power
- 4. Investment and savings

**Social Aspects**

- 1. Relations with high level decision makers
- 2. Relations within the community
- 3. Cooperatives and civil society
- 4. Training program adequacy
- 5.

***B. Team Composition and Competence:***

A multidisciplinary team of researchers from the Near East Foundation (NEF) and its affiliate the Center for Development Services (CDS), the Agricultural Research Center (ARC) in Cairo and the South Valley University (SVU) in Aswan, jointly implement this ambitious research program. Although the research program was focused on a local level to respond to specific requirements in the Lake Nasser area, it offered the potential for a much wider application. The research activities undertaken in the different areas provided the basis on which long-term partnerships were built.

## Annex 4: Bio-Energy Plantation of Jojoba

### Researches implemented under the New Land New Life Project Lake Nasser, Aswan

#### Bio-energy Plantation of Jojoba

#### Research Institution:

Research institution:	Department of Physics, Faculty of Science
Institution address:	Department of Physics, Faculty of Science, Aswan 81528, Egypt
Institution Telephone:	002 097 3480447
Institution website:	
Researcher:	Dr. Ramadan M. Salem, Lecturer Department of Physics 0181951767
E-mail:	<a href="mailto:ramose2000@gmail.com">ramose2000@gmail.com</a> <a href="mailto:ramose1964@yahoo.com">ramose1964@yahoo.com</a>

#### Research Data

Research title:	Bio-energy plantation of Jojoba in the Eastern Desert, Lake Nasser Area, Aswan, Egypt
Research objectives:	<p>Jojoba is a woody evergreen shrub or small multi-stemmed tree that typically grows to 1–2 m tall, with a broad, dense crown. The leaves are opposite, oval in shape, 2–4 cm long and 1.5-3 cm broad, thick waxy glucose gray-green in color. The flowers are small, greenish- yellow, with 5–6 sepals and no petals. The plant develops one or a few long tap roots (up to 40 ft.) that can supply water and minerals from far below the soil surface. Jojoba is eco-friendly or environment friendly. Deep root system makes it as soil Stabilizer. It can be planted to beautify the landscape or on highway and roadside in green belts around the desert towns. Jojoba (<i>Simmondsia chinensis</i>) is a perennial woody shrub. It provides a renewable source of unique high-quality oil. Much of the interest in jojoba worldwide is the result of the plant's ability to survive in a harsh desert environment. Accordingly the objectives are:</p> <ol style="list-style-type: none"> <li>1- Plantation of jojoba as a renewable energy resource (bio- energy).</li> <li>2- Production of alternative fuel</li> </ol> <p>Uses of the available lands in Lake Nasser to produce of a high-quality oils used for medicine and energy applications</p>
Linkage between the research and project research questions	<p>The linkage between the research and project research question appears from the achievement of the third question, where the jojoba shrubs are environmentally friend and it is highly industrial crop. The linkage can be shown in the following:</p> <ol style="list-style-type: none"> <li>1- Jojoba is a plant that can grow in many semi-arid regions of the world, requires little water and maintenance and yields a crop of seeds that have many uses.</li> </ol>

	<p>2- Jojoba seed-oil was used in lubricants, cosmetics, pharmaceuticals and as a replacement for sperm oil in manufacturing of inks, varnishes, waxes, detergents, resins and plastics. In this era of dwindling natural resources and increased concern for the environment,</p> <p>3- Jojoba will grow well wherever avocados do well and the days of full sun are greatest. Temperatures are critical but only in the low range. Jojoba handles heat very well.</p> <p>Soil texture is important as jojoba grows best in sandy or decomposed granite or rocky soils and slowest in heavy clay soils such as adobe. Even if the fertility of the soil is marginal, jojoba is still able to produce well without the use of fertilizers. However, jojoba plants kept in containers seem to do better with some fertilization.</p>
<p>Research approach:</p>	<p>Jojoba, [<i>Simmondsia chinensis</i> family: Simmondsiaceae] is a new oil-producing industrial crop that has attracted much attention in recent years. Jojoba oil, which is commonly known as liquid wax, is colorless and odorless with unique physical and chemical properties. Unlike most other vegetable seed oils, which are triglycerides, jojoba oil is made of long-chain fatty acids and fatty alcohols with no side branching. This unique chemical configuration accords jojoba special characteristics unparalleled in the plant kingdom. It is similar to sperm whale oil and can be substituted for it in many applications. The most important uses are in the cosmetic industry, as a high-temperature high-pressure lubricant, and as a potential low-calorie edible oil. Other possible uses are as an anti-foaming agent in the fermentation industry and as a magnetic memory media lubricant. Jojoba oil can easily be hydrogenated into a soft wax and can be used in candle wax, various kinds of polishes, coating material for fruits and pills, and insulation for batteries and electrical wires.</p> <p>Jojoba is a perennial, dioecious, evergreen shrub or small tree that lives under diverse environmental conditions. It has an extensive and deep root system and requires little care if maximum seed production is not desired. Jojoba is valuable as a soil conservation and landscape plant for highway shoulders, city parks, and other places that cannot afford much care.</p> <p>The main objective of the jojoba research program is to introduce the jojoba shrubs in Lake Nasser Area for energy production. The research contains two stages: the first is the plantation of jojoba shrubs in Lake Nasser Area, and the second is extraction of Jojoba oil, developing new products and applications, plus opening new markets through an integrated system (agricultural, researchable, industrial, productive and marketing). These two stages can be achieved under supervision of the Egyptian Natural Oil Company (4 Al About Building Salah Salem Road Nasr City, Cairo, Egypt Phone/Fax: 202 262 3949 - 202 261 7167 - 202 262 4719 Email: natoileg@link.com.eg)</p>
<p>Resources used:</p>	<p>1- Jojoba seeds 2- Agricultural tools</p>
<p>Date of implementation:</p>	<p>August 2009</p>
<p>Duration and frequency of implementation:</p>	<p>5 years for plantation and oil production 5 years for studying and production of jojoba oils</p>

Results:	<ul style="list-style-type: none"><li>5- plantation of the large area of Lake Nasser</li><li>6- production of high-quality oils from industrial crop</li><li>7- save the soil and water resources due to the jobba do not consumes water</li><li>8- introduce a new industry in Lake Nasser Area for people, scientists, workers</li></ul>
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Annex 5: Agro-Climate Change

Researches implemented under the New land New Life project Lake Nasser, Aswan

**Agro-Climate Change**

**Research Institution:**

Research institution:	Central Laboratory for Agriculture Climate (CLAC) - Agriculture Research Center
Institution address:	6, Michel Bakhoum St. Dokki –P.O.Box 296 Imbaba12411 Giza, Egypt.
Institution Telephone:	202-33367274
Institution website:	<a href="http://www.clac.edu.eg">www.clac.edu.eg</a>
Researcher	Samar M. Attaher
E-mail:	<a href="mailto:Sattaher2001@yahoo.com">Sattaher2001@yahoo.com</a>

**Research Data:**

Research title:	Adaptation measures of on-farm irrigation system to overcome the negative impacts of climate change in the western bank of Lake Nasser.
Research objectives:	<p>The overall objective of effective on–farm irrigation management is to maximize crop yield per each unit of applied water. Projected future temperature rises under climate change conditions are likely to reduce the productivity of the major crops, and increase their water requirements thereby directly decreasing crop water use efficiency. Under the current national water management strategy, water share for agriculture in this region is subject to reduction, as a national policy to protect Lake Nasser. Moreover, the irrigation duration for each village is limited by certain hours per day, as the pumping energy is offered to the farmers as a type of social encouragement, which is limiting the irrigation practices beyond the actual irrigation requirements.</p> <p>Specific objective of this study are:</p> <ul style="list-style-type: none"> <li>- Evaluate the current farmers’ irrigation strategies in terms of water productivity and irrigation-water use;</li> <li>- Examine some possible irrigation strategies in order to improve</li> </ul>

	<p>water productivity with minimum irrigation requirement, and to coop with projected water shortage and temperature increase related climate change; and</p> <ul style="list-style-type: none"> <li>- Assess the adaptation capacity of the farmers' community to coop with the projected climate change, and tackle the proposed adaptation options to on-farm irrigation system.</li> </ul>
<p>Linkage between the research and project research questions</p>	<p>The projected global warming and climate change is projected to add more pressures over the Egyptian on-farm irrigation system. While, the vulnerability of on-farm irrigation in Egyptian agricultural regions and the acceptable adaptation measures varies according to the local conditions of each region, the agricultural region in the western bank of Lake Nasser is one of the new promising and remote agricultural settlements. Despite the remote location of this area, it has the advantage of early season production for several cash crops, with high quality. The agriculture production in this region is fully-irrigated, and constrained by high temperature levels and arid conditions, low fertility soil, labor unavailability, marketing inaccessibility and limitations, and high cost of production inputs. Agriculture production in this region could be very risky from the environmental prospective that the agriculture activates is very close to Lake Nasser; the strategic national water reservoir of Egypt. The farmers are tending to increase the irrigation-water, including chemicals, as practices to overcome sever environmental conditions, which is projected to increase in the future.</p>
<p>Research approach</p>	<p>In order to achieve the study objectives, the following implementation steps were taken:</p> <ul style="list-style-type: none"> <li>- Review of literature</li> <li>- Define the baselines of the case study:             <ul style="list-style-type: none"> <li>o Current and future climate</li> <li>o Soil (soil samples)</li> <li>o Agriculture system</li> <li>o Socioeconomics [Energy, management, maintenance, policy ...]</li> </ul> </li> <li>- Conduct modeling study (Agriculture model):             <ul style="list-style-type: none"> <li>o Model verification</li> <li>o Input data sets preparation</li> <li>o Define scenarios</li> <li>o Define adaptation measures</li> <li>o Examine the defined adaptation measures within the scenarios</li> </ul> </li> <li>- Adaptive capacity analysis:             <ul style="list-style-type: none"> <li>o Current adaptive capacity</li> <li>o Define constrains, gaps and opportunities</li> </ul> </li> </ul> <p>The study is based on modeling approach using the FAO crop model "AquaCrop" on drip irrigated tomatoes as important element of the crop pattern of western bank of Lake Nasser. This was performed through three steps:</p>

	<ul style="list-style-type: none"> <li>○ Primary calibration of the default tomato file in AquaCrop;</li> <li>○ Observation and evaluation of the current farmers' irrigation strategies; and</li> <li>○ Evaluation of some possible irrigation strategies under current and future climate conditions.</li> </ul>
Resources used:	<ul style="list-style-type: none"> <li>- Two field trials were conducted for two seasons at two reclamation villages of Kalabsha and Garf Hussein. For all trials, tomato crop (<i>Lycopersicon esculentum</i>, Adora cultivar) was transplanted.</li> <li>- Drip irrigation system was used.</li> <li>- This study had been achieved through community-based pilot assessment, performed by using a preset questionnaire.</li> </ul>
Date of implementation:	2008/2009 and 2009/2010
Duration and frequency of implementation:	Twice in two years: In the default crop file of tomato in AquaCrop the length of the crop life was 110 days, whereas, 150-180 days are the observed length of the winter tomatoes.
Results:	<p>Two irrigation strategies are usually applied by the farmers in western bank of Lake Nasser. Generally, the farmers use the application time instead of application volume or depth in all irrigation strategies, with 4 L/h drippers, which gave about 9 mm/h. The first farmers' irrigation strategy (P1) is starting the season with long application time, up to 45 minutes per day after the transplanting, then the application time start to decrease gradually, to reach about 15 minutes per day by the end of season. The average winter tomato observed yield under P1 10 ton/ha, with total irrigation of about 550 mm, and water productivity (WP) of about 2.2 kg/m<sup>3</sup>.</p> <p>The second farmers' irrigation strategy (P2) starts the season by small application time of about 10-15 minutes per day, with gradual increase in application to reach 30 minute per day at the flowering and fruit development phases, and tends to decrease once more at the maturity and late season phase to reach about 20-15 minute per day by the end of the season. The average observed yield under P1 is about 9 ton/ha, with total irrigation of about 420 mm, and WP of about 2 kg/m<sup>3</sup>. Reference to the model evaluation, both P1 and P2 induce biomass and yield reduction due to stomata closure and early senescence, reducing harvest index (HI), and reduce water productivity (WP).</p> <p>Indeed, applying deficit irrigation at both early and late stages of crop development could have a negative impact on canopy expansion and early senescence. While this practice could generate the required balance between the required irrigation application and WP, with lower levels of crop reduction compared to full season deficit practice. This could be observed through OP4 60 and 80% strategies. Additionally, this practice could allow applying higher deficit levels, as OP4 60% and OP4 80% almost have the same WP, with high irrigation application for</p>



	<p>OP4 80%. Furthermore, it's clear that obtaining high WP could not only achieved by applying net irrigation application, different combinations between net irrigation application and deficit practices could obtain the same levels of WP with less water.</p> <p>Generally, applying less irrigation has a favorable negative effect on irrigation energy consumption and total production cost. Under western Lake Nasser, the reduction in energy cost unit is more pronounced to the farmers than the increase in crop yield unit.</p>
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## Adaptation of on-farm irrigation system to climate change over western bank of Lake Nasser

By: **Samar M. Attaher, PhD**

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### 1. Introduction

#### 1.1 Climate change impact and vulnerability

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In the high level conference of FAO held on Rome at June 2008, the delegates asserted that "Agriculture" is not only a fundamental human activity at risk from climate change, it is a major driver of environmental and climate change itself. It has the largest human impact on land and water resources (FAO, 2008).

The fact of "climate change" still face a lot of suspensions, although recent high confidence studies concluded that warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level (IPCC, 2007b).

IPCC (2001b) identified "Climate change" as a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of *human activity*. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC, 1992), where climate change refers to a change of climate that is attributed directly or indirectly to *human activity* that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods. In the same sequence, IPCC (2001b) cleared the definition of the term "climate variability" as variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).

The scientific evidences attributed climate change to "energy imbalance" occurring in the global energy cycle, which so called "greenhouse effect" phenomena (IPCC, 2007c). This imbalance is referred to the fast increase in the concentrations of greenhouse gases (GHGs) and aerosols in earth atmosphere. GHGs and aerosols affect climate by altering incoming solar radiation and out-going infrared (thermal) radiation that are part of Earth's energy balance (IPCC, 2007c). GHGs concentrations increased dramatically since the start of the industrial era (about 1750) as a result to the fast human development based on fossil fuels energy and the extensive change in land use patterns. The human impact on climate during this era greatly exceeds that due to known changes in natural processes, such as solar changes and volcanic eruptions.

The direct observations of recent climate change (IPCC, 2007c) concluded that global surface air temperature increased by 0.76 °C from year 1850 to year 2005. Moreover, the linear warming trend over the last 50 years is recorded by 0.13 °C per decade. Rising sea level is consistent with warming. Global average sea level has risen since 1961 at an average rate of 1.8 [1.3 to 2.3] mm/yr and since 1993 at 3.1 [2.4 to 3.8] mm/yr, with contributions from thermal expansion, melting glaciers and ice caps, and the polar ice sheets. Additionally, an increase in the frequency and the intensity of the extreme weather events of tropical cyclones and storms, heat and cold waves, floods and droughts, is strongly observed.

Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.

Khalil et al. (2008) concluded that there are a general trend of warming occurred in Egypt in the last 30 years. This conclusion based on a comparison between air temperature parameters of years 1975-2004 and the average historical normals up to 1975 revealed a general trend of gradual increase in mean temperature by 0.46 °C. Furthermore, they found that the average trends of minimum, maximum and mean temperature at 1990-2004 were higher than the observed at 1975-1989.

The most likely trend of future global change indicated in the fourth assessment report of IPCC (IPCC, 2007c) for the next two decades a warming of about 0.2°C per decade is projected for a range of SRES emission scenarios. The projected warming will associated with a precipitation increases very likely in high latitudes, and decreases likely in most subtropical land regions. As well as, the indicated climatic changes included a very likely increase in the frequency and the intensity of the extreme events, a likely more expansion of the areas affected by drought and floods, and a likely increase the incidence of extreme high sea level.

The historical climate record for Africa shows warming of approximately 0.7°C over most of the continent during the twentieth century (Desanker, 2002). More over, all of Africa is very likely to warm during this century, and the warming is very likely to be larger than the global (IPCC, 2007a). Additionally, climate data gathered in North Africa region during the 20<sup>th</sup> century indicated heating by more than 1 °C, with pronounced trend in the last 40 years (Agoumi, 2001).

### *1.2 Adaptation development concept and mechanism.*

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In 2001, IPCC identified “Adaptation” as any adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. This term refers to changes in processes, practices, or structures to moderate or offset potential damages or to take advantage of opportunities associated with changes in climate. It involves adjustments to reduce the vulnerability of communities, regions, or activities to climatic change and variability (IPCC, 2001a).

The scientific research is increasingly taking the role of adaptation to climate change seriously. The scientific community is aiming to recognizing the significance of adaptation in national and international policies. Based on that aim, a dual co-operation relationship is established between climate change researchers and policy makers, to set adaptation plans (IPCC, 2001). In the setting of this relationship, the researchers are playing the role of adaptation planners, and policy makers are considered as the public executers of the plans.

The adaptation science agenda should have two primary goals. One is to generate and provide scientific knowledge, working in partnership with decision-makers and other stakeholders that can be used to decide and implement vulnerability reducing adaptations. A second goal is to build capacity and partnerships for generating, evaluating, integrating, communicating and applying knowledge for adaptation.

Adaptation plans are mainly focusing on increasing the adaptive capacity of the different systems, by changes in processes, practices, or structures to reduce climate risks (IPCC, 2001b). In developing countries, the priority of these plans is the high vulnerable systems to climate change. Therefore, the high vulnerability of agricultural sector put it in the top of priority list of adaptation plans. Most of plans are taking the form of long term national strategies, governmental actions and managerial rules. This limited role of stakeholders may leads to, in many cases, a separation between the designed adaptation plans attributes and perceptions, and current situations in agricultural sectors, which creates a

difficulties in plans application and increase the adaptation costs. Also, the stakeholders feel a minimal degree of responsibility towards climate change adaptation strategies, and they always think that "climate change problem is the government problem" and "they can not do any thing, by them selves, to face it".

This reality gives arise of a very important questions "What is the real role of stakeholders in adaptation planning process?"

Setting a definition of future agenda and needs for increasing the adaptive capacity of agricultural sector, is one of the problems that face the agriculture scientific community. The climate change adaptation of the crop production system in Egypt could be studied and analyzed according to scientific bases, statistics, models, and policies. Whereas, encouraging the involvement of the agricultural stakeholders in adaptation option planning, analyzing, and evaluating could improve the criteria of the resulted options, and orient it in the directions of the actual local conditions.

Medany et al. (2007) concluded that, in order to enhance the role of stakeholders' involvement in adaptation planning and, to improve the adaptive capacity of the agricultural sector, there is a need to increase awareness and improve the concept of climate and its relation to crop productivity. They added that, the scientific community still needs to simplify the scientific bases of climate and the main driving climatic forces that affect the plant growth and crop yields, and the facts related to climate change impacts.

### *1.3 The national situation and requirements*

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The most projected global impacts over agriculture system could be summarized in a serious changes in crops-productivity, change in cropping patterns and cultivation seasons, increase in irrigation requirements, the increase in the intensity and the severity of pests and diseases, agriculture land loss due to SLR, and agricultural soil degradation (Bazzaz and Sombroek, 1996, IPCC, 2007a). The magnitude of these impacts will differ regarding to the vulnerability level of the region and the adaptation capacity of the local agricultural systems. The agriculture sectors in Med-latitude region and in arid and semi-arid regions are exposed to be highly vulnerable to the projected impacts of climate change.

Füssel and Klein (2006) identified the "vulnerability" of the systems to climate change as the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, the adverse impacts of climate change. Generally, Egypt is located in the arid region that can be affected greatly by the adverse effects of climate change (IPCC, 2007a).

"Agriculture" represents one of the most important human activities in Egypt. Agriculture is key sector for the socio-economic development in Egypt, and it plays a significant role in the Egyptian national economy. The important role of agriculture in Egyptian economy, and the increased environmental pressures are the reasons that motivate the agriculture community to conclude that "agriculture is vulnerable to climate change", as an extra environmental pressure.

Crop-water requirement is one of the important agriculture production essential items that take place in impact studies at the national level. The future warming seems to lead to increase  $ET_o$  over Egypt. This increase will be uneven between regions and seasons. Potential irrigation-demands are projected to be increased by 6.4-16.0% at 2100s (Attaher, et al. 2006). Under the projected changes in the potential evapotranspiration ( $ET_o$ ) in Egypt, the crop-water demands is projected to face significant changes that may vary according to the crop type and the cultivation season (Attaher et al., 2006).

On the other hand, Agriculture water-demand is one of the serious pressures to water sector. This is mainly due to several factors; (i) 85% from total available water is consumed in agriculture, (ii) 95% of

the cultivated area is under fixed irrigation system, water use efficacy of agricultural activities are mainly low compared to the other water consumption sectors, and (iii) about 80% of cultivated land have surface on-farm irrigation systems, which are low efficient irrigation systems (less than 60%) coupled with poor irrigation management (Abou Zeid, 2002). The overall national policy for Egypt's development in the period 1997 -2017, aims to add 3.5 million feddan be irrigated by 2017. Whereas, under current water situation, reclamation projects face a lot of problems due to water shortage, soil quality and lack of investments. The ongoing expansion of irrigated areas will reduce the headroom of Egypt to cope with future fluctuation in flow (Conway, 2005). Moreover, the profitability of the new lands is predicted to decrease under climate change, due to water shortage problems, high production cost, and soil degradation (Eid et al., 2001). Also the increased competition between water demands for domestic sector and agriculture sector is predicted to intensify due to population increase and climate change pressures on water resources that will produce more stresses on standard of living (Conway, 2005).

## 2. Adaptation of the on-farm irrigation system in the western Bank of Lake Nasser (Case study).

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### 2.1 Case study justifications

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The overall objective of effective on-farm irrigation management is to maximize crop yield per each unit of applied water. Projected future temperature rises under climate change conditions are likely to reduce the productivity of the major crops, and increase its water requirements thereby directly decreasing crop water use efficiency. The projected global warming and climate change is projected to add more pressures over the Egyptian on-farm irrigation system (Attaher et al., 2006). Under this critical situation, figuring out adaptation strategies for on-farm irrigation system in Egypt, become one of the high national priorities. While, the vulnerability of on-farm irrigation in Egyptian agricultural regions and the acceptable adaptation measures varies according to the local conditions of each region.

The agricultural region in the western bank of Lake Nasser, in the southern part of the Nile River in Egypt, is one of the new promising and remote agricultural settlements. The region is characterized by hyper aridity and extreme hot climate. The government of Egypt is planning to resettle one million farmers around Lake Nasser by 2017. Despite the remote location of this area, it has the advantage of early season production for several cash crops, with high quality. The agriculture production in this region is fully-irrigated, and constrained by high temperature levels and arid conditions, low fertility soil, labor unavailability, marketing inaccessibility and limitations, and high cost of production inputs. Agriculture production in this region could be very risky from the environmental prospective that the agriculture activates is very close to Lake Nasser; the strategic national water reservoir of Egypt. The farmers are tending to increase the irrigation-water, including chemicals, as practices to overcome sever environmental conditions, which is projected to increase in the future. Under the current national water management strategy, water share for agriculture in this region is subject to reduction, as a national policy to protect Lake Nasser. Moreover, the irrigation duration for each village is limited by certain hours per day, as the pumping energy is offered to the farmers as a type of social encouragement, which is limiting the irrigation practices beyond the actual irrigation requirements.

### 2.2 Objective of the researcher

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The objective of this study is the following:

- 1- Evaluate the current farmers' irrigation strategies in terms of water productivity and irrigation-water use.

- 2- Examine some possible irrigation strategies in order to improve water productivity with minimum irrigation requirement, and to coop with projected water shortage and temperature increase related climate change.
- 3- Assess the adaptation capacity of the farmers' community to coop with the projected climate change, and tackle the proposed adaptation options to on-farm irrigation system.

### 2.3 Methodology

In order to achieve the study objectives, the following implementation steps were taken:

- Review of literature
- Define the baselines of the case study:
  - Current and future climate
  - Soil (soil samples)
  - Agriculture system
  - Socioeconomics [Energy, management, maintenance, policy ...]
- Conduct modeling study (Agriculture model):
  - Model verification
  - Input data sets preparation
  - Define scenarios
  - Define adaptation measures
  - Examine the defined adaptation measures within the scenarios
- Adaptive capacity analysis:
  - Current adaptive capacity
  - Define constrains, gaps and opportunities

#### **2.3.1 Modeling study**

The study is based on modeling approach using the FAO crop model "AquaCrop" (Steduto et al., 2008) on *drip irrigated tomatoes* as important element of the crop pattern of western bank of Lake Nasser. This was performed through three steps:

- (i) primary calibration of the default tomato file in AquaCrop,
- (ii) observation and evaluation of the current farmers' irrigation strategies,
- (iii) evaluate some possible irrigation strategies under current and future climate conditions.

To start with calibration, two field trials were conducted for two seasons of 2008/2009 and 2009/2010, at two reclamation villages of *Kalabsha* and *Garf Hussein*, located at western bank of Lake Nasser. For all trials, tomato crop (*Lycopersicon esculentum*, *Adora* cultivar) was transplanted at the middle of November 2009, with 0.30 m between plants inter-row and 1.20 m between plant rows.

The soil texture was sand, which had 13.3 vol. % field capacity (FC) and 6 vol. % wilting point (PWP).

Drip irrigation system was used of line-source emitter of 0.3 m spacing and 4 L/h discharge. Irrigation water requirements and scheduling were calculated by using "CropWat" FAO model (Smith, 1992), according to the daily weather data collected from Aswan weather station located at 23.97° N latitude, 32.78° E longitude and 199 m altitude. The crop daily management practices were set in order to avoid water and fertility stress and limitations, while the initial water conditions of the fields was at about FC.

The development of crop canopy expansion was observed during the trails, while the total tomato yield per unit area, fresh and dry matter of the fruits and the plant was determined at the end of the season. At the same time, Irrigation applications, irrigation time and total tomato yield were the main observed parameters, for about 13 farmers from the same villages, in order to determine the farmers' irrigation strategies.

Based on the calibration procedure, AquaCrop was used to evaluate sex irrigation strategies under current and future conditions, as listed in table (1)

**Table (1): The suggested on-farm irrigation strategies**

P1	First farmers' actual irrigation practices
P2	Second farmers' actual irrigation practices
OP1	Irrigation schedule based on net irrigation requirement at depletion 50% of readily available water (RAW),
OP2	irrigation schedule based on 75% depletion of RAW at initial stage, 50% depletion of RAW at development and mid season stages, and 75% depletion of RAW at maturity stage,
OP3	Two deficit irrigation levels of 80% and 60% of actual water-requirements, at all crop development stages,
OP4	Two deficit irrigation levels of 80% and 60% of actual water-requirements, at initial and maturity stages only.

Five years average of daily weather data of Aswan weather station (Table 2) was used to represent the current climate. Air temperature raise was the climatic factor used in the evaluation procedure referring to future climate change, where CO<sub>2</sub> response is not yet finalized in AquaCrop, and adjustments are still needed. The Maximum and the minimum monthly values of air temperature change of Aswan governorate were determined from a downscaled implication of IPCC SRES scenarios using HadCM3 GCM climate model up to year 2050 (Attaher et al., 2006). The current and the future ET<sub>o</sub> values were determined by using FAO ET<sub>o</sub>Calc software (Raes, 2009)

In climate change simulations, the impact of air temperature increase was assessed basically on the net irrigation requirements, where the impact on the crop biomass production and the harvest index is not yet well-calibrated under the local conditions of the current study.

### 2.3.2 Adaptive capacity analysis

The aim of this part of the assessment is to identify the current keys of vulnerability of the on-farm irrigation system in the western bank of Lake Nasser, and identify the needs and gaps of the farmers' community to improve their adaptation capacity.

**Table(2): The current trend of climatic factors of Aswan station, and the factors of future change in temperature from Attaher et al. (2006)**

Month	Current climate trends					Climate change	
	Temp [°C]		RH %	Wind Speed [m/s]	ETo [mm/day]	Temp change factor [°C]	
	Max	Min				Max	Min
1	22	9	35	3.7	5.4	4.7	1.2
2	25	10	26	3.9	6.7	4.2	1.1
3	30	14	18	4.2	8.6	5.2	0.9
4	34	19	14	4.3	10.4	4.7	0.7
5	41	23	13	4.1	11.2	5.6	0.9
6	45	25	13	4.2	12.2	5.8	1.1
7	45	26	16	3.8	11.4	6.1	1.1
8	43	26	18	3.8	11.1	6.1	1.1
9	39	24	20	3.9	10.5	6.2	1.3
10	35	21	22	3.8	9.0	6.0	1.4
11	28	15	33	3.7	6.9	5.4	1.5
12	24	11	37	3.6	5.6	4.7	1.0
annual	34	19	22	3.9	9.1	5.4	1.1
DJF	27	13	28	3.8	7.1	4.2	1.0
MAM	35	19	15	4.2	10.1	5.2	0.8
JJA	44	26	16	3.9	11.6	6.0	1.1
SON	34	20	25	3.8	8.8	5.9	1.4

This objective had been achieved through community-based pilot assessment, performed by using a preset questionnaire. The survey questionnaire covered five topics of (i) general specifications of the questioned farmers and the dominated on-farm irrigation systems, (ii) farmers’ background about concept, design, structure, management and the maintenance of modern irrigation systems, (iii) limitations and opportunities of using modern irrigation systems, (iv) sustainability of the current on-farm irrigation systems, and (v) farmers’ perceptions about on-farm irrigation development.

The questions types varied from the Yes/No questions, multi-choice selection, and unguided questions to freely give reasons and suggestions. The questionnaire form was fill out through person- to- person meetings.

The surveys were conducted in three settlement villages of the western bank of Lake Nasser, of Kalabsha, Gurf Hussen and Bashayer El-Kheir. The survey covered 31 samples in three villages. The Survey results analyzed and presented in percentage.

## 2.4 Results

### 2.4.1 Modeling study (Agriculture model)

#### 2.4.1.1 The primary calibration of the model

In the default crop file of tomato in AquaCrop the length of the crop life was 110 days, whereas, 150-180 days are the observed length of the winter tomatoes (October/ November) cultivars usually cultivated in

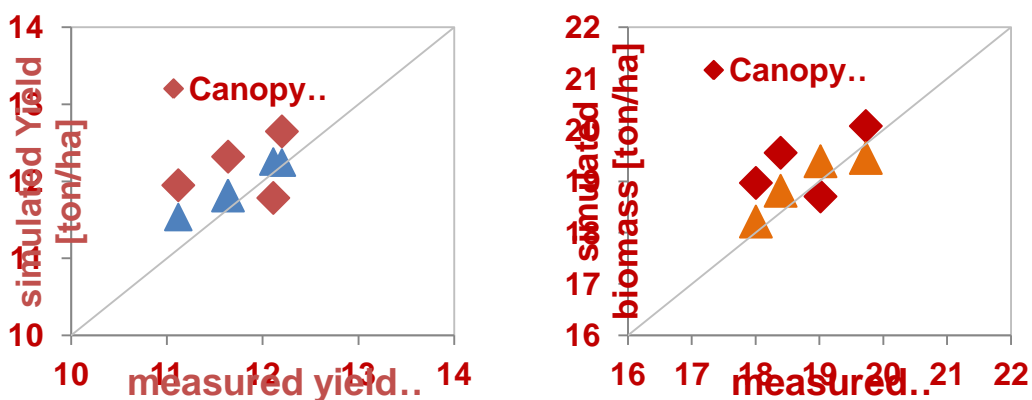


Upper Egypt. Because of the extreme hot weather of the southern part of Upper Egypt, tomato is usually cultivated at the middle of November.

Table (3) shows the actual crop growth and development indicators observed from the field trials. These parameters with the actual biomass and yield were used to calibrate the model under each trial. As shown in Fig. (1), both crop biomass and yield for most trials were slightly overestimated, when the actual development parameters of each trail were used. Using the average values of the development parameters for all calibration trials provided the best fit for all trials.

**Table (3): Actual crop growth and development indicators observed from the field trials, used in AquaCrop calibration to local conditions of western bank of Lake Nasser**

	Kalabsha		Gurf Hussen		Average
	Season 1	Season 2	Season 1	Season 2	
Number of days after transplanting to:					
a- Recovery	5	6	6	7	6
b- Full canopy	77	72	81	79	77
c- Senescence	137	129	135	142	136
b- Maturity	163	158	171	168	165
Number of days from transplanting to flowering	43	48	49	41	45
Duration of flowering	51	47	57	52	52
Number of days from transplanting to reach the maximum root depth	59	51	62	52	56



**Fig (1): AquaCrop primary calibration: the effect of using actual crop development parameter of each trial (canopy actual), and the average development parameter of each trail (canopy adj), on actual and simulated biomass [ton/ha] and yield [ton/ha] of the tomato crop.**

**2.4.1.2 Observation & evaluation of the farmers’ irrigation strategies...**

Two irrigation strategies were usually applied by the farmers in western bank of Lake Nasser. Generally, the farmers use the application time instead of application volume or depth in all irrigation strategies, with 4 L/h drippers, which gave about 9 mm/h. The first farmers’ irrigation strategy (P1) is starting the

season with long application time, up to 45 minutes per day after the transplanting, then the application time start to decrease gradually, to reach about 15 minutes per day by the end of season. The average winter tomato observed yield under P1 10 ton/ha, with total irrigation of about 550 mm, and water productivity (WP) of about 2.2 kg/m<sup>3</sup>.

The second farmers' irrigation strategy (P2) is start the season by small application time of about 10-15 minutes per day, with gradual increase in application to reach 30 minute per day at the flowering and fruit development phases, and tends to decrease once more at the maturity and late season phase to reach about 20-15 minute per day by the end of the season. The average observed yield under P1 is about 9 ton/ha, with total irrigation of about 420 mm, and WP of about 2 kg/m<sup>3</sup>. Reference to the model evaluation, both P1 and P2 induce biomass and yield reduction due to stomatal closure and early senescence, reducing harvest index (HI), and reduce water productivity (WP).

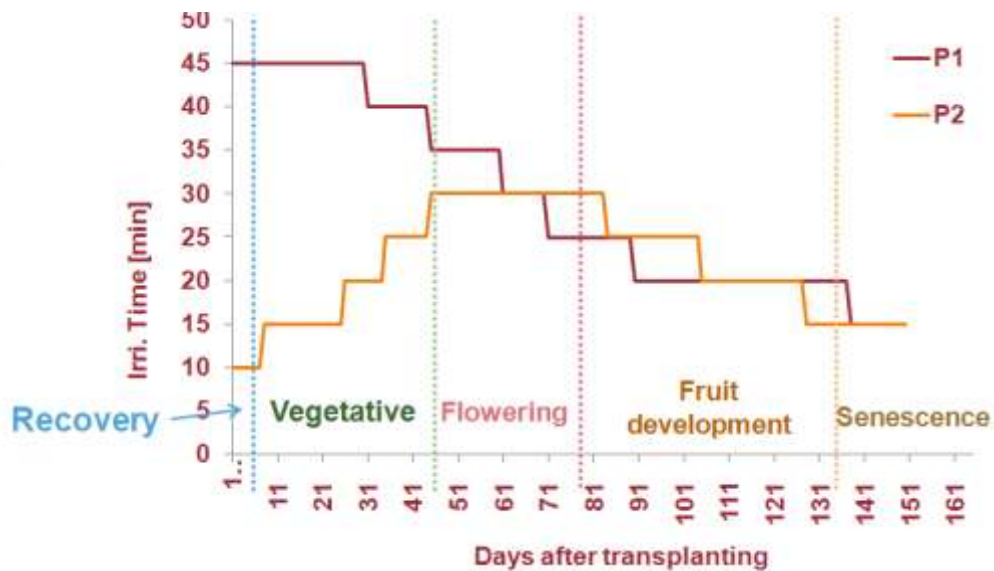


Fig. (2): the observed farmers' on-farm irrigation strategies

2.4.1.3. Evaluate some adaptation options of irrigation strategies...

Under arid and water shortage conditions, the balance between irrigation application and crop yield is highly recommended, and could be achieved by selecting the irrigation strategy that require the minimum irrigation application, and obtain high WP compared with the optimal conditions. Figure (3) shows the effect of evaluated strategies on the total irrigation application and WP, at both current and future climate conditions. At the same time that OP3 60% strategy had the lowest irrigation application under all climate conditions, it had the lowest WP too. Even thought, it still could be one of the possible options to coop with the sever water shortage conditions, to save about 40% irrigation water, if the yield reduction accepted.

Indeed, applying deficit irrigation at both early and late stages of crop development could have a negative impact on canopy expansion and early senescence. While this practice could generate the required balance between the required irrigation application and WP, with lower levels of crop reduction compared to full season deficit practice. This could be observed through OP4 60 and 80% strategies. Additionally, this practice could allow to apply higher deficit levels, as OP4 60% and OP4 80% almost have the same WP, with high irrigation application for OP4 80%. Furthermore, it's clear that obtaining high WP could not only achieved by applying net irrigation application, different combinations

between net irrigation application and deficit practices could obtain the same levels of WP with less water.

Generally, applying less irrigation has a favorable negative effect on irrigation energy consumption and total production cost. Under western Lake Naser, the reduction in energy cost unit is more pronounced to the farmers than the increase in crop yield unit.

The relation between Irrigation application and WP of the evaluated strategies is quiet have the same trend under current and future climate conditions. The increase in air temperature had negative impacts on both irrigation application and WP for all strategies (Fig. 3). It's clear that the higher temperature increase, the higher irrigation application, whereas, the temperature impact on WP is not clear observed under this study as heat and water stresses response is not yet well-calibrated, and adjustments are still needed. Therefore, most strategies have the same trend of the current climate conditions with higher irrigation applications and lower WPs. OP1 was an exception of the trend under temperature increase, that both OP1 and OP3 60% had the lowest WP, while OP1 had the highest irrigation application among all evaluated strategies, under temperature raise maximum and minimum levels.

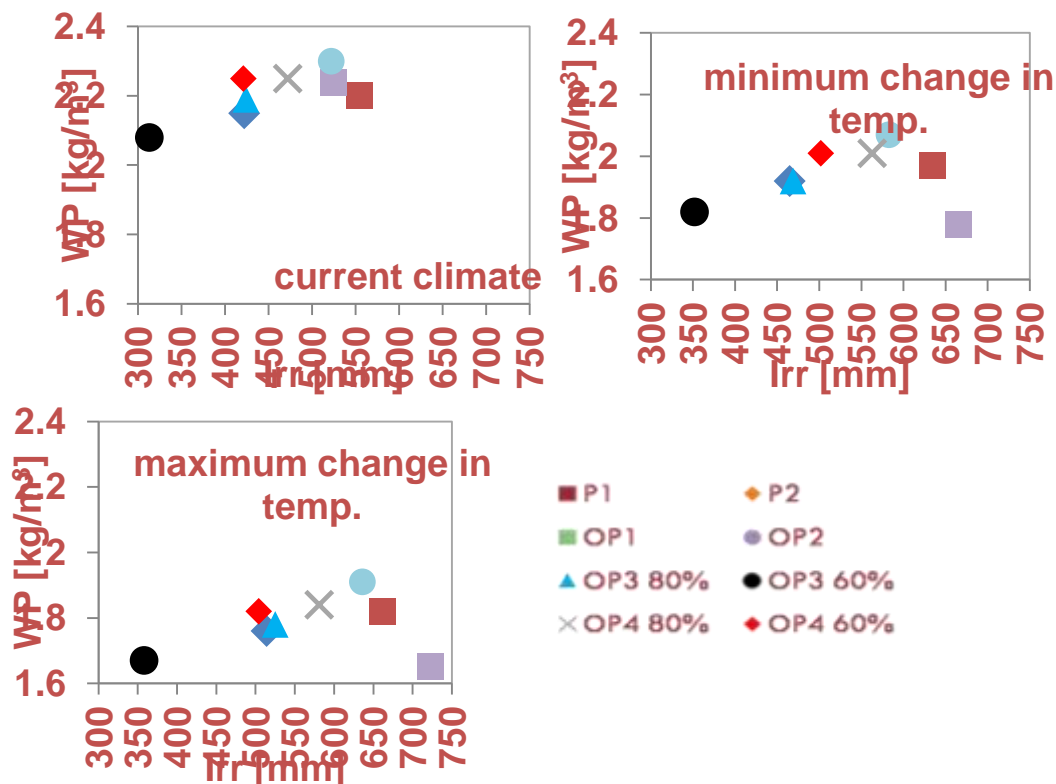


Fig. (3): The effect of the evaluated strategies on the total irrigation application and WP, at both current and future climate conditions.

### 2.5 Adaptive capacity analysis:

#### 2.5.1 General specifications of the questioned farmers and the dominated on-farm irrigation systems

Table (4) presented the general specification of the questioned farmers. The results indicated that, the majority of the questioned farmers were above 45 years old (65% of the total sample), and 96% of the total sample have education levels ranged from illiteracy to under-ordinary level. This low education

level accompanied with elder age could slow the ability of the farmers to accept and manage high level irrigation and agriculture technologies, and reduce the resilience of the community to the environmental pressures.

**Table (4): the specifications of the questioned farmers in the three settlement villages of the western Bank of Lake Nasser**

	<b>Bashayer El-kheir</b>	<b>Garf Hussein</b>	<b>Kalabsha</b>	<b>Total</b>
<b>Number of the sample</b>	9	8	14	31
<b>Age category (%)</b>				
Under 20	0	0	0	0
20-45	44	12	50	35
Above 45	56	88	50	65
<b>Education levels (%)</b>				
Illiterately	44	13	14	24
Read & write	0	63	44	36
Mandatory	11	5	14	10
under-ordinary	44	7	27	26
Ordinary	0	13	0	4
Unvi. Degree	0	0	0	0

The land ownership size of the three villages is five feddan for each farmer, the dominate on-farm irrigation system is surface irrigation in Kalabsha and Garf Hussen, and sprinkler and drip irrigation in Bashayer El-Kheir. The mix between crop production and livestock production is a remarkable parameter of the farming system of the study region. The crop pattern, as illustrated in Table (5), could be characterized as limited pattern depends basically on fresh vegetables production. In the many cases, vegetables production has higher marketing opportunities with high profit. Whereas, the remote location of the studied region combined with high temperature and aridity increase the yield shipping and transportation costs, and increase the yield losses at reaching to the markets in Aswan. The yield losses in marketing are considered as one of the important sources of reducing the overall water productivity of the agriculture system in the region, and the economical losses too. These parameters of the crop pattern could be one of the remarkable keys of the vulnerability of the agriculture system of the western bank of Lake Nasser.

**Table (5): The general specifications of the agriculture system in the western bank of Lake Nasser**

	Bashayer El-kheir	Garf Hussein	Kalabsha	Total
<b>Farm type (%)</b>				
Crop production only	33	28	36	32
Livestock production only	0	0	0	0
Mixed Agric. Activities	67	72	64	68
<b>Crop pattern</b>				
Winter Field crops	Onion, Berseem		Wheat, Barley, Faba been, onion, Berseem	
Summer Field crops	Maize	Sesame	Sesame,	
vegetables	Tomato, eggplants, cucumber, sweet paper	Tomato, eggplants, cucumber, sweet paper, squash	Tomato, eggplants, cucumber, sweet paper	
Ornamentals		Hibiscus	Hibiscus	
Perennials	Long clover	Long Clover	Long Clover	

**2.5.2. Farmers’ background about concept, design, structure, management and the maintenance of modern irrigation systems,**

The majority of the questioned farmers believe that drip irrigation is the better irrigation system that can be used under the local conditions of their farms (Fig. 4.). They attributed their content of drip irrigation, because of for main reasons, that it needs less labor, give better crop-yield, easy in operating, and help in reducing pests and diseases. In general, the farmers are strongly encouraging to switch from surface irrigation systems to drip irrigation in recent time.

At the main while, there are noticed low background of the farmers about the basics of modern irrigation systems installation, operation and maintenance. This low level of knowledge is clearly indicated in Table (6). In this table we can notice that the farmers’ knowledge level about modern irrigation in Bashayer El-Khier has better knowledge level than the the other two villages, because the dominated irrigation system in Bashyer is drip irrigation, which improve the farmers background by the daily practice. Evan though the background of Bashayer farmers’ is limited to manage their drip systems efficiently, which affect the actual water productivity negatively.

The lack to good background about operating and maintenance of modern irrigation systems could be important limitation to replace the current low efficiency irrigation systems with other systems with high efficiency, and/ or obtain higher levels of overall water productivity.

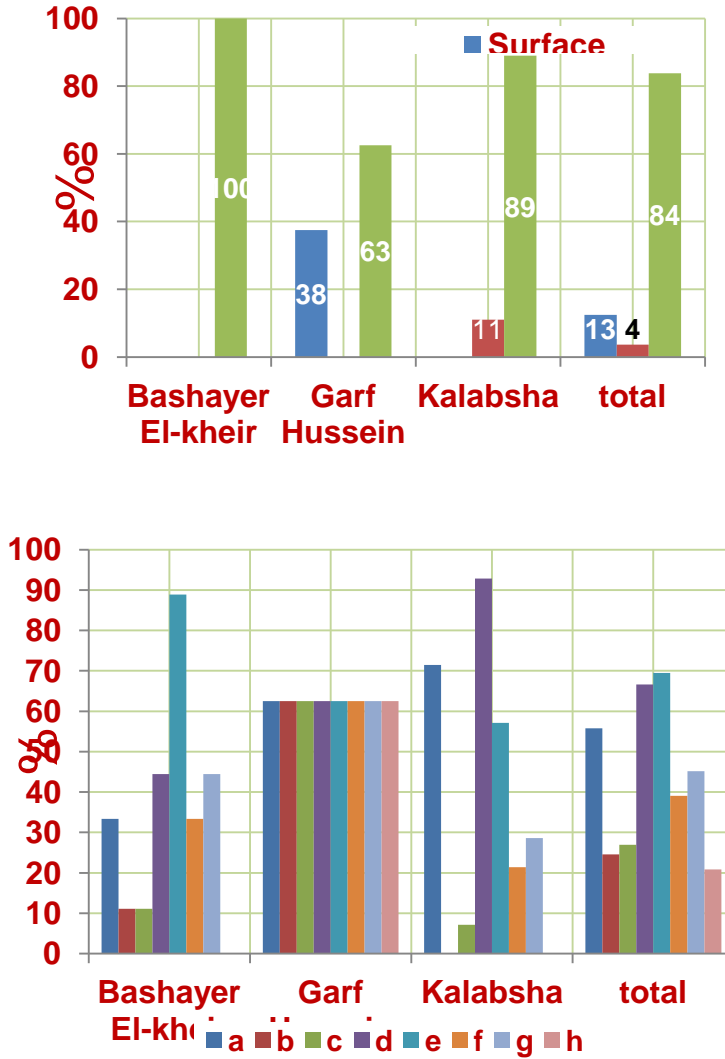


Fig. (4): farmers' back ground about the best irrigation system, and the reasons that make modern irrigagation systems are better than surface irrigation (a= easy operating, b=easy maintenance, c= Consumes less power, d= give better crop-yield, e = needs less labor, f= better water distribution, g= reduce pests and the disease, and h= reduce soil problems)

**Table (6): farmers' background about concept, design, structure, management and the maintenance of modern irrigation systems**

	<b>Bashayer El-kheir</b>	<b>Garf Hussein</b>	<b>Kalabsha</b>	<b>Total</b>
<b>Network installation</b>				
No	89	88	100	92
Yes	11	12	0	8
source of the knowledge	personal experience	Technical assistance	0	0
<b>Buy the network components &amp; equipment</b>				
No	89	88	79	85
Yes	11	12	21	15
source of the knowledge	Personal experience	Technical assistance	personal experience	
<b>Determine the adequate water-irrigation requirements</b>				
No	34	87	93	71
Yes	66	13	7	29
source of the knowledge	Personal experience, technical assistance	Technical assistance	personal experience	
<b>Inspect the operating problems of the network</b>				
No	78	88	100	84
Yes	22	12	0	12
source of the knowledge	Technical assistance	Technical assistance	0	0
<b>Maintain the network</b>				
No	67	87	100	85
Yes	33	13	0	15
source of the knowledge	Technical assistance, training program	Technical assistance, training program	0	0

### 2.5.3 Limitations and opportunities of using modern irrigation systems

The entire sample of the farmers indicated that the difficulty of having the components and equipment of the modern irrigation systems is the one of the challenges facing the application of modern irrigation systems in this region. The asserted that the nearest supplier is in Aswan city, which is far from their villages by more than 20 km. Some of the farmers (22%) reported that they buy these components from Cairo, because they couldn't find components with good quality at Aswan, besides the prices in Cairo are much better with different choices. Of cures buying the network components from Cairo increasing



the shipping and transporting costs, and the farmers estimated this increase by about 15- 20% of the network fixed costs.

Moreover, about one half of the questioned farmers asserted that they don't know enough information about the criteria of selecting irrigation networks components and equipment, so they think they can not be able to buy good quality components, and they can't go through the risk of dealing with professional suppliers.

Irrigation labor is another important limitation to use modern irrigation in the study region. About 83% of the samples are facing problems with irrigation labor, because of unavailability and the increasing high cost. The casual labours working in this region are usually not familiar with modern irrigation systems, and needs to professional technical assistance especially to support the farmers with immediate troubleshooting recommendations. This level of the technical assistance is not yet available in the region of the study.

On the other hand, all the above mentioned limitations could be considered as new opportunities for the extend of modern irrigation in the western lake Nasser region, that there is a good window for establish new marketing centres of network components in this region, this centres could offer the different levels of training and technical assistance.

#### **2.5.4 Sustainability of the current on-farm irrigation systems**

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The irrigation system in the study region are basically depends on central pumping station working with diesel flues. Under the condition of remote regions the high depends on petroleum fuels convey the risk of regular supply problems due to economical, environmental and any other logistic problems. Generally it affects the sustainability of the production systems to work efficiently.

In both Bashayer El-khier and Kalabsha, the world food program is supporting the farmers with the required diesel power, as a social aid. The activities of this program will be ended by the next five years. After the ending of this program, the farmers should sustain the irrigation power costs by their own, which will produce new pressures on the production system. More than 65% of the samples assure that they can not assume the irrigation power costs after the end of the activities of the world food program in the region, because they have not enough financial resources, besides their return from the agriculture production is very low compared to the high production cost. The farmers estimated 20-50 % increase in the production costs due to assuming irrigation power cost. Furthermore, about one half of the sample in Bashayer El-khier and Kalabsha indicated three actions to coop with irrigation power problem, as the extend in livestock production instead of crop production, work in fish packaging and processing, and rent their lands.

#### **2.5.5 Farmers' perceptions about on-farm irrigation development**

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The entire questioned farmers agreed with on-farm irrigation development activities, in terms of using modern irrigation systems, and/ or improving the management practices. The agreement of the farmers reflects their strong perception to change the current situation, because they believe that the current on-farm irrigation systems have a lot of problems in design and management. The farmers stressed that the irrigation development activities should be support by establish technical assistance authority at the region, plus supporting and conducting more training activities. The farmers are sure that on-farm irrigation development will increase the production cost, as a result to the increase in irrigation power costs, maintenance cost and the spare parts costs. While, they are sure about the potential benefits of the improved irrigation systems on the crop-yield quantity and quality.

### 2.5.6 General remarks on developing adaptive capacity

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Based on the aforementioned results, it could be concluded that the on-farm irrigation system in the western bank of Lake Nasser is facing several problems and limitations, which could put it in a vulnerable situation under climate change conditions and the increase in water demands. Above all, this system is having some good opportunities to adapt with current and future pressures, as:

- This region's lands are new lands with good quality and cultivated just recently, this could give a better opportunity to improve the current crop pattern, through adopting some exporting crops, which are characterized by high economical return and high water productivity.
- The farmers' strong encouragement to improve on-farm irrigation, could increase their ability to interact positively with training and extension activities, regardless of their education level.
- The region presents a good window to irrigation components companies and irrigation services authorities.
- The improvement of on-farm irrigation systems could offer new job opportunities, in installing, maintaining and managing modern irrigation systems.
- The irrigation power problems could find efficient answers through conducting research programs of using renewable energy (solar, wind) in water pumping.

## 2. Conclusion

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The agriculture system in the western bank of Lake Nasser is vulnerable to the future projected changes in the climate system. The current specifications of the on-farm irrigation system, and the limitation factors affecting its efficiency and sustainability, are the main factors increasing the vulnerability of the agriculture system. Moreover, the knowledge and technical levels of the community are considered important constraints to improve the adaptive capacity, and introduce adaptation options and plans. The on-farm irrigation system in the study region will be developed in the coming few years, by replacing the surface irrigation systems by modern irrigation systems. Whereas, the farmers' community have not the required knowledge to work efficiently with the improved systems, to optimize the crops production with the operating costs.

Climate change is projected to increase the irrigation demands in the region by about 9- 17% by 2050s, and it will reduce the crops production at the same time, which will reduce the water productivity of most crops.

To cope with this situation, a set of possible adaptation options relevant to irrigation management should be addressed, evaluated and applied shortly. As well as, improving the adaptive capacity of the farmers is essential. This could be achieved by reducing the assessed limitations and increasing the knowledge level relevant to on-farm irrigation.

The current study tried to follow the integrated concept of adaptation, by developing some possible technical adaptation options, and assessing the adaptive capacity of the farmers. The study concluded the following:

- Under arid and water shortage conditions, the balance between crop product and the irrigation requirements, is an essential parameter controlling the agriculture production system.

- The results indicated that the combination between deficit irrigation levels and irrigation scheduling could improve the water productivity to the optimal level (2.4 kg/m<sup>3</sup>), especially when deficit levels of 80 and 60% applied at the both early and late stages of crop development. This type of strategies could present acceptable adaptation options with the projected temperature increase due to climate change.
- This study includes a simplified evaluation of some irrigation strategies by using AquaCrop under climate change, in terms of temperature increase only. The results included under this section of evaluation should be considered with careful, that the temperature impact on WP is not clear observed under this study as heat and water stresses response is not yet well-calibrated, and adjustments are in progress. This level of calibration and evaluation will be preceded in further work.
- To implement the abovementioned adaptation options, the farmers' community should have enough and clear background about the operating, management and maintenance of modern irrigation systems.
- The current on-farm irrigation system in the study region is facing several socio-economical problems, which reduce its capacity to cope with the future pressures.
- Although the on-farm irrigation system in the western bank of Lake Nasser has low adaptive capacity, the system has different opportunities that could improve its adaptive capacity. These opportunities should be utilized in the development projects and programs working in this region.

#### 4. Recommendation

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- Conduct extensive training activities to introduce deficit irrigation concept and techniques and how to manage it under modern irrigation systems.
- Conduct farmers' integrated public awareness program about climate change impacts and adaptation option based on irrigation.
- The governmental programs should support the current available opportunities in the western bank of the lake Nasser, and encourage more strong participation of the private sector.
- Support the several mechanisms of reducing the vulnerability of the on-farm irrigation system, which based on changing the crop pattern, improve the farm types, and establish strong cooperation between the agri-business companies and farmers to support the agriculture production.
- Establish special research programs of using renewable energy for irrigation.

#### 5. Publications

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1. " Attaher S. M., 2010. Developing on-farm irrigation strategies for current and future climate conditions on the western bank of Lake Nasser", accepted paper to be published in the proceeding of International Workshop on "Improving farm management strategies through AquaCrop: Worldwide collection of case studies" will be held on 8-9 October 2010 at Yogyakarta, Indonesia. The workshop is jointly organized by the International Commission on Irrigation and Drainage (ICID), Food and Agriculture Organization of the United Nations (FAO), and United Nations Water Decade Programme on Capacity Development (UNW-DPC) and co-hosted by the INACID.

2. "Attaher S. M., 2010. The needs and gaps of on-farm irrigation system adaption on the western bank of Lake Nasser", submitted paper to agricultural water management journal.
3. The paper still under revision process

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**Annex**  
**Annex 1: Abstracts of paper (1)**

DEVELOPING ON-FARM IRRIGATION STRATEGIES FOR CURRENT AND FUTURE CLIMATE  
CONDITIONS ON THE WESTERN BANK OF LAKE NASSER

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Attaher S. M.

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**Abstract:**

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The agricultural region in the western bank of Lake Nasser is one of the new promising agricultural settlements, which has the advantage of early season production for several high quality cash crops. The agriculture production in this region is fully-irrigated, and constrained by sever environmental, biophysical and socio economical conditions. Moreover, farmers are facing several additional challenges in irrigation management due to lack of knowledge of the best practices.

The aim of this study is to evaluate the current farmers' irrigation strategies in terms of water productivity and irrigation-water use. The study examined some possible irrigation strategies in order to improve water productivity with minimum irrigation requirement and to co-op with projected water shortage and temperature increase induced by climate change. The study is based on modeling approach utilizing the FAO crop model "AquaCrop" on drip irrigated tomato. It was performed (i) to calibrate AquaCrop via tow field trials at two seasons, (ii) to observe and evaluate the current farmers' irrigation strategies based on fixed application time, and (iii) to evaluate six irrigation strategies under current and future climate conditions. The evaluated strategies included different combinations between net irrigation application and deficit practices at two levels of 80% and 60% of net water requirements, under current and future climate conditions, based on the change in irrigation application and water productivity. The results indicated that the combination of deficit irrigation levels and irrigation scheduling could improve tomato water productivity to the optimal level (2.4 kg/m<sup>3</sup>), especially when deficit levels of 80 and 60% applied at both early and late stages of crop development. These strategies could present acceptable adaptation options with the projected temperature increase due to climate change.

**Keywords:**

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Aqua Crop, deficit irrigation, irrigation strategies, net irrigation application, tomato.

Annex 6: Physicochemical Characteristics of Lake Water, Drinkable Water & Wastewaters

**Researches implemented under the New land New Life project Lake Nasser, Aswan**

**Physicochemical Characteristics of Lake Water,  
Drinking Water and Wastewaters  
As related to Climate Change**

**Research Institution:**

Research institution:	Aswan Faculty of Science, South Valley University
Institution address:	Sahary, Aswan,Egypt
Institution Telephone:	097-348 22 33
Institution website:	<a href="http://www.svu.edu.eg">www.svu.edu.eg</a>
Researcher:	Prof.Dr. Mohamed Nageeb Rashed
E-mail:	mnrashed@hotmail.com

**Research Data:**

Research title:	Physicochemical Characteristics of lake water, drinking water and wastewaters as related to Climate Change
Research objectives:	<ol style="list-style-type: none"> <li>1-To assess the relationship between rising temperature in Lake Water and its water quality;</li> <li>2-Study the impact of fluctuation of water level in the lake on the distribution of water contamination;</li> <li>3-Study the water quality from lake main stream at Kalabsha and Gerf Hussein, purification units, water tanks and pipes, and water reservoirs in houses to assesses the effect of these containers on water quality for drinking;</li> <li>4- Studying the water pollution index of the Lake; and</li> <li>5-Study the effect of climatic change on wastewater quality.</li> </ol>
Linkage between the research and project research questions	Houses drinking water in the three villages are supposed to be safe according to WHO and the Egyptian standards for drinking water. The high water pollution index (WPI) for irrigation canals from the lake to the agriculture site, fish cultures (both concrete and earth pond systems) at Garf Hussein and Kalabsha areas, and drainage canal from fish bonds must be treated before it charged to the lake or it is better to reuse it after treatment in agriculture purpose or cycled it again to the fish cultures.

Research approach:	<p>1-Sampling water from lake mainstream, at Kalabsha and Gerf Hussain, purification units, water tanks and pipes, water reservoirs in houses, Fish cultures, Fish cultures wastewater and irrigation canal;</p> <p>2- On site analysis of some items i.e. temperature, pH, dissolved oxygen, conductivity;</p> <p>3-Chemical analysis of the water samples:- Organic matter, Bicarbonate, total hardness, nitrates, chloride and turbidity;</p> <p>4-Office documentation and computer analysis of the data; and</p> <p>5- Applying the different models of water quality distributions and pollution index of water.</p>
Resources to be used:	Fifteen representative water samples were collected from the three villages (Garf Hussein, Bashaier and Kalabsha) in west of Lake Nasser as well as from the lake water.
Date of implementation:	October 2009-July 2010
Duration and frequency of implementation:	<p>3 sessions for collecting samples in ten months:</p> <p>1- October (Autumn) - 2- February (Winter) 3-July (Summer)</p>
Expected results:	<p>1-New picture about the effect of temperatures on water quality of lake water and other domestic water resources; and</p> <p>2- Extraction of water pollution index of the lake.</p>



## Physicochemical Characteristics of lake water, drinking water and wastewater as related to Climate Change.

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**By: Prof. Dr. Mohamed Nageeb Rashe**

Professor of Environmental and Analytical Chemistry  
Aswan Faculty of Science, South Valley University

### Abstract

The present study monitored Fifteen representative water samples (different drinking water and wastewater sources) collected from the three villages (Garf Hussein, Bashaier and Kalabsha) in west of Lake Nasser as well as from the lake water. The representative drinking water and wastewater samples of study locations aiming to record physicochemical characteristics of lake water, drinking water and wastewater as related to climate change. The obtained results revealed that the difference in temperature between water samples in autumn, winter and summer affected the water chemical parameters as well as in the wastewater sources. The investigated water samples of lake and houses drinking water in the selected three villages supposed to be chemically safe water according to WHO and the Egyptian standards for drinking water. Water pollution index (WPI) was used in this study and the result concluded that for irrigation canals from the lake to the agriculture site, fish cultures (both concrete and earth pond systems) and drainage canal from fish ponds need to be treated before it discharged to the lake or it is better to reuse it after treatment in agriculture purpose or cycled it again to the fish cultures.

### Key Words:

Bacteria in drinking water; Nasser Lake; water quality, pollution index,

### Introduction

Warmer water temperatures affect physical, chemical, and biological processes. As air temperature increases, water temperatures in rivers, streams, lakes, reservoirs, and ground water are also expected to mirror that rise. Warmer water temperatures reduce dissolved oxygen concentrations, which are a critical aquatic ecosystem requirement. Changes in rate of chemical reactions in the water column, sediment-water interface, and water-atmosphere interface are also expected. Evapotranspiration is the loss of water to the atmosphere through evaporation from the earth's surface (land and water) and the transpiration of plants. Evaporation plays a very important role in determining water availability; it affects soil moisture, stream flow, ground water recharge, and lake levels.

### Research objectives

1. To assess the relationship between rising temperature in lake water and its water quality.
2. Study the impact of fluctuation of water level in the lake on the distribution of water contamination.
3. Study the water quality from lake main stream at Kalabsha and Gerf Hussain, purification units, water tanks and pipes, and water reservoirs in houses to assesses the effect of these containers on water quality for drinking.
4. Studying the water pollution index of the lake.
5. Study the effect of climatic change on wastewater quality.

### Research approach

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1. Sampling water from lake mainstream, at Kalabsha and Garf Hussain, purification units, water tanks and pipes, water reservoirs in houses, Fish cultures, Fish cultures wastewater and irrigation canal.
2. On site analysis of some items i.e. temperature, pH, dissolved oxygen, conductivity.
3. Chemical analysis of the water samples:- Organic matter, Bicarbonate, total hardness, nitrates, chloride and turbidity.
4. Office documentation and computer analysis of the data.
5. Applying the different models of water quality distributions and pollution index of water.

**Date of implementation:** October 2009-July 2010

**Duration and frequency of implementation**

3 sessions for collecting samples in ten months:

1- October (Autumn) - 2- February (Winter) 3-July (Summer)

**Expected results:**

- New picture about the effect of temperatures on water quality of lake water and other domestic water resources.
- Extraction of water pollution index of the lake.

**Experimental Part**

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**a) Sampling:**

*Fifteen representative water samples were collected from the three villages (Garf Hussein, Bashaier and Kalabsha) in west of Lake Nasser as well as from the lake water. These include different water sources:*

1. **Lake water from Garf Hussein and Kalabsha sites.**
2. Irrigation canals from the lake to the agriculture sites.
3. Purification units at Garf Hussein and Kalabsha villages.
4. Fish cultures (both concrete and earth pond systems) at Garf Hussein and Kalabsha areas.
5. Drainage canal from fish ponds.
6. Drinking water from houses tanks at the three villages Garf Hussein, Bashaier and Kalabsha.

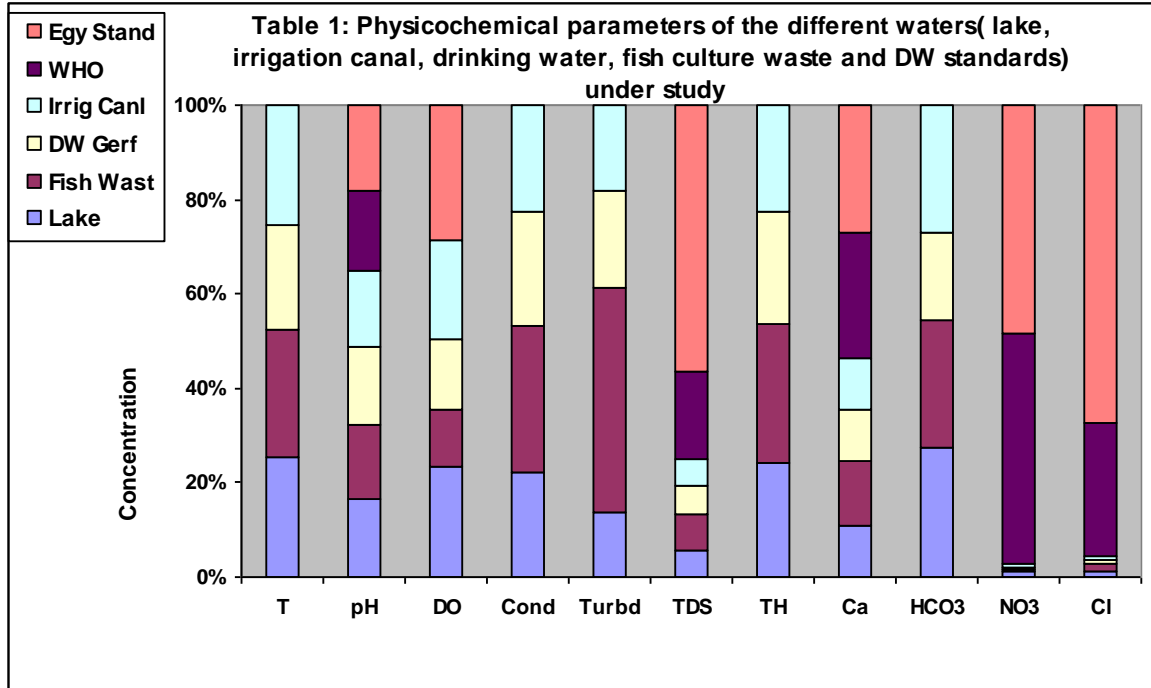
**b) Physicochemical measurements**

The physical and chemical were analyzed according APHA to determine regional variation in different sites. The sequence of some parameters such as temperature, dissolved oxygen, electrical conductivity and pH value were measured directly in the field. Temperature in water was measured by thermometer while electrical conductivity by electrical conductivity meter (YSI Model 33. S.C.T). Also, the concentrations of bicarbonate were determined directly by titration with standard 0.02 HCl acid and phenolphthalein and methyl orange as indicators. The pH value was determined using a portable pH meter. The total chloride was measured by titration of 50

ml of sample against silver nitrate (0.0141 N) solution using potassium chromate as indicator. Water turbidity measured by turbidity meter.

**Results and Discussions:**

The mean of water quality parameters in the fifty water samples are presented in Figure 1



**1. Temperature**

Mean water temperature was ranged 19°C - 34°C in Autumn, 24°C-26°C winter and 32°C- 41°C in summer (Fig.1.). There was significant difference in temperature between water samples in autumn, winter and summer as well as from different water and wastewater sources.

Temperature plays an important role in the physical and chemical characteristics of the Nasser Lake environment. In addition, temperature affects the bacterial activities, which responsible in the decomposition of organic matter for nutrient recycling as well as solubility and liberation of dissolved gases like O<sub>2</sub>, CO<sub>2</sub>, NH<sub>3</sub> and H<sub>2</sub>S.

**2. Turbidity**

The mean turbidity ranged from 0.59 to 9.3 NTU.

**2.1. Fresh and drinking water:**

Lake water showed low water turbidity at winter 0.6 NTU to high one at summer 2.1 NTU. Drinking water in villages show turbidity in the range 0.5-3.6 NTU.

**2.2. Fish culture and wastewater:**

Water samples from fish culture ponds (earth and concrete systems) showed the higher turbidity (9.3 and 7.2 NTU, respectively) than in the other water samples from other sites.

This high turbidity values are related to the nature of earth pond of clays as well as the residues of fish foods and waste.

### 3. pH

Mean pH of lake water ranging from 8 to 8.2.

#### 3.1. Fresh and drinking water:

Lake water showed pH 8.2-8.6, while drinking water in villages from 7.9-8.6

#### 3.2. Fish culture and wastewater:

Water samples from fish culture pond (earth and concrete systems) showed pH of 8.2 and 7.9. Drinking water from houses exhibited pH values from 8.3 to 8.4.

The available data indicated that the Lake Nasser is in the limit according to National River Water Quality standard which is ranged between 6.5 and 8.5. On the other side, the pH value of drinking water is the ranges of WHO and EGS. water according to Target Water Quality Range (TWQR) for domestic use is 6.0 to 9.0.

### 4. Electrical Conductivity EC

Electrical conductivity (EC) in the range 115 to 322  $\mu\text{s}/\text{Cm}$

#### 4.1. Fresh and drinking water:

EC for lake water was in the range 125-298  $\mu\text{s}/\text{Cm}$ , while for drinking water in houses and villages were between 115-308  $\mu\text{s}/\text{Cm}$ .

#### 4.2. Fish culture and wastewater:

Water samples from fish culture pond (earth and concrete systems) and drainage wastewater of fish ponds were in the range 115-322

The distribution of EC among sample sites showed spatial variability that it was lower in sites than in the others. Seasonally, EC was lower in summer and autumn than in winter seasons.

The low EC value recorded could be related to the adsorption of dissolved salts in the surface of suspended particles which coming with water flood.

### 5. Total Dissolved Solids (TDS):

#### 5.1. Fresh and drinking water:

TDS in lake water in the range 124-165 ppm, while in house drinking water from 115-308 ppm. This high TDS indicate that the Lake Nasser has a high water quality for drinking, fisheries and irrigation.

#### 5.2. Fish culture and wastewater:

Water samples from fish culture pond (earth and concrete systems) and fish culture drainage showed. TDS in the range 131-203 ppm.

### 6. Dissolved Oxygen (DO):

#### 6.1. Fresh and drinking water:

DO of lake water ranged 6.5-8.5 ppm, while in drinking water at houses 5.6-9 ppm

#### 6.2. Fish culture and wastewater:

The concentration of dissolved oxygen varied between 6.8 to 8.1 ppm the highest value in winter and autumn, while the lowest value recorded in summer season.

Importance of dissolved oxygen (DO) in an aquatic ecosystem bringing out various biochemical changes and many ecologists discussed its effect on metabolic activities organisms. The low oxygen level was recorded during summer mainly due to the removal of free oxygen through respiration by bacteria and other animals as well as the oxygen demand for decomposition of organic matter. Free oxygen (DO) is the single most important gas for most aquatic organisms. When the aquatic organisms exposure to less than 2.0 mg/g free oxygen for few days may kill most of biota in the aquatic system. While values of 5.0 to 6.0 mg/l are usually for most of fish population. So it could be thinking that the bottom water layer of main channel of Lake Nasser is free from fish population during summer especially in northern part of Lake where DO below 1 mg/g will not support for fish respiration

## **7. Bicarbonate:**

### **7.1. Fresh and drinking water:**

Bicarbonate in lake water ranged between 120 to 183 ppm, while in drinking water at houses and villages ranged between 118 to 183 ppm. The lowest bicarbonate value during summer resulting the income of flood water which contain low value of dissolved salts, while the highest value was recorded during winter related to the nature of this area which rich by carbonate and bicarbonate.

### **7.2. Fish culture and wastewater:**

Water samples from fish culture pond (earth and concrete systems) and fish culture drainage showed. bicarbonate in the range 104-183 ppm.

## **8. Chloride:**

### **8.1. Fresh and drinking water:**

Lake water ranged from 10.3 to 11.8 ppm, while houses and village drinking water ranged from 4.1 to 14 ppm.

### **8.2. Fish culture and wastewater:**

Water samples from fish culture pond (earth and concrete systems) and fish culture drainage showed. chloride in the range 11.3-13.4 ppm

## **9. Nitrates**

### **9.1. Fresh and drinking water:**

Nitrate in lake water were from 0.81 to 1.08 ppm, while in houses and village drinking water ranged from 0.38-1.52 ppm.

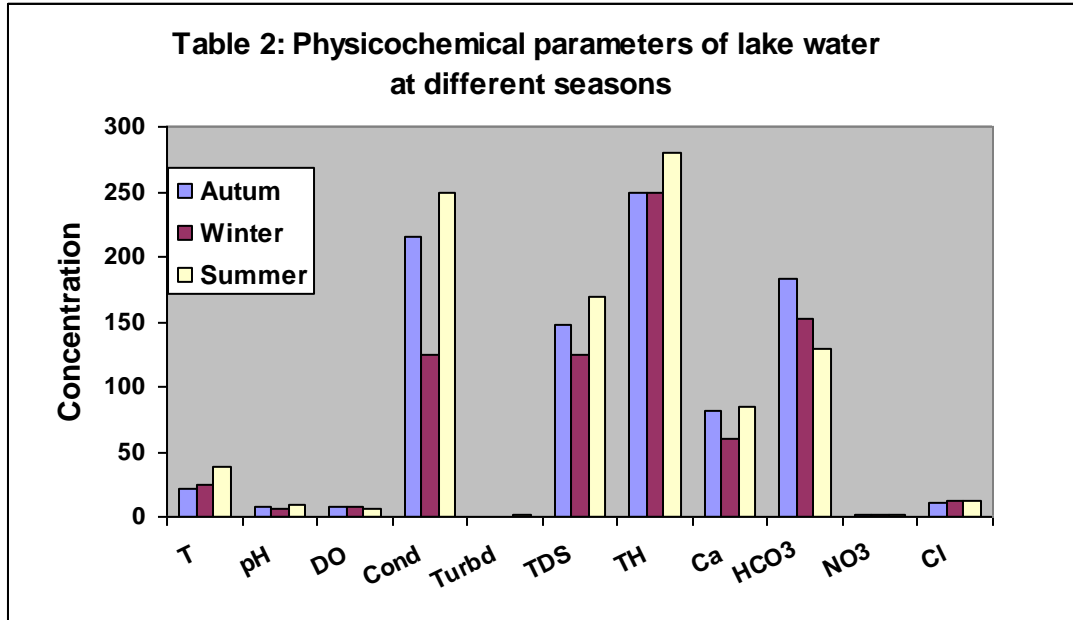
### **9.2. Fish culture and wastewater:**

Nitrate in water samples from fish culture pond (earth and concrete systems) and fish culture drainage range 0.38-1.2 ppm

The increase in nitrate concentration could be mainly due to the human activity in the vicinity of sampling sites in Lake Nasser or managing with various nutrients including nitrates in aquaculture. Otherwise, the decrease in nitrate contents could be mainly due to its consumption by phytoplankton, or its reduction by denitrifying bacteria. Such reduction may restrict the growth of some taxa of planktonic algae that are unable to fix atmospheric nitrogen.

Seasonal Variation of Physicochemical Parameters

Figure 2 shows the physicochemical concentration of all the studied water at different seasons, autumn, winter and summer. The resulted reveal that all the parameters increased in summer season than in the other seasons except for dissolved oxygen(DO) and bicarbpionate (HCO3) which decreased, this because the effect of increasing temperate which result for low DO and HCO3.



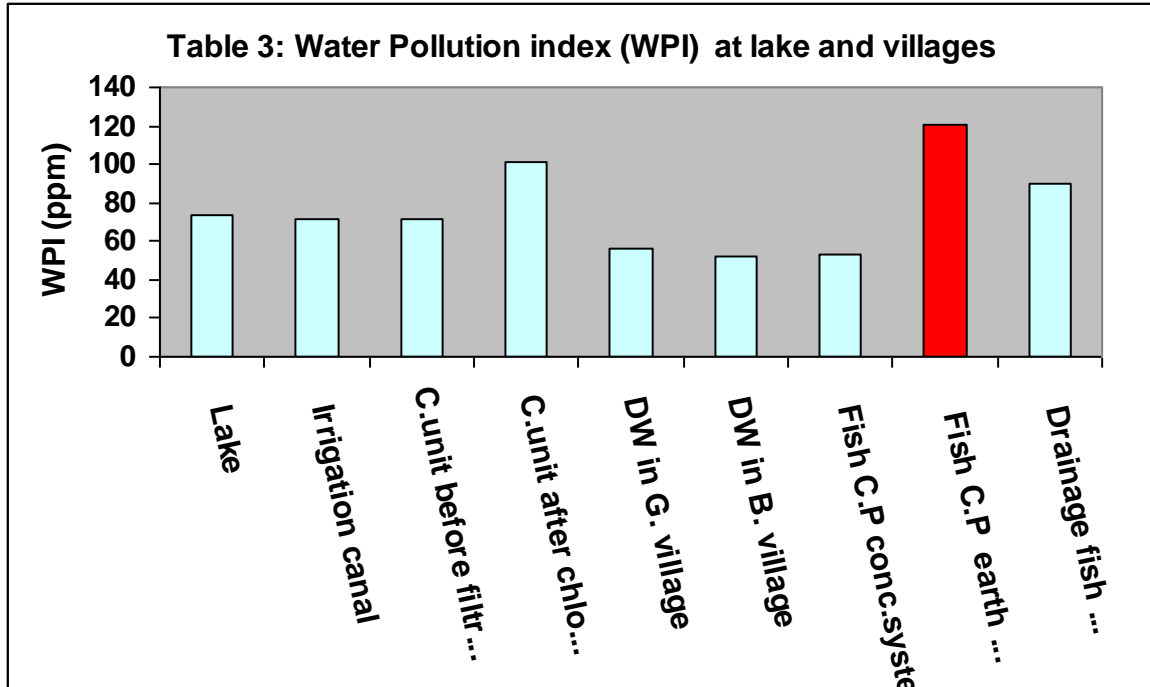
Water Pollution Index (WPI)

Figure 3 shows the WPI for all the studied water. All drinking and lake water revealed low WPI, while Fish culture and fish drainage water are high WPI. The high WPI are related to the presence of high nitrates.

It takes considerable expertise to understand and appreciate the significance of individual emissions to water. The category encompasses a relatively large number of individual substances with varying environmental impacts. Water pollution indices are developed to capture ecosystem and/or human health effects of groups of substances emitted at various life cycle stages. In this case the commonly recognized and accepted critical volume method is used to estimate the volume of water that would be required to dilute contaminants to acceptable levels, where acceptability is defined by the most stringent standards (i.e., drinking water quality standards).

The equation for the Water Pollution Equivalence (arbitrary scaling) is:

$$\text{Water Pollution Index (WPI)} = \text{TDS}/5(\text{mg/L}) + \text{Nitr-Amn}/.02(\text{mg/L}) + \text{Chlor}/3.5(\text{mg/L}) (\text{mg/L}) + \text{Sulphate}/5(\text{mg/L}) + \text{Iron}/.003$$



### Conclusion and Recommendations

The investigated water samples of lake and houses drinking water in the selected three villages supposed to be safe water according to WHO and the Egyptian standards for drinking water. The high water pollution index(WPI) for irrigation canales from the lake to the agriculture site, fish cultures (both concrete and earth pond systems) at Garf Hussein and Kalabsha areas, and drainage canal from fish bonds need that all those water must be treated before it charged to the lake or it is better to reuse it after treatment in agriculture purpose or cycled it again to the fish cultures.

Annex 7: Impact of the Climatic Changes on the Accumulation of Trace Metals in terrestrial and Aquatic Environments

Researches implemented under the New Land New Life Project Lake Nasser, Aswan

**Impact of the Climatic Changes on the Accumulation of Trace Metals in Terrestrial and Aquatic Environments**

**Research Institution:**

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**Research Data:**

Research title:	The impact of the climatic changes on the accumulation of trace metals in terrestrial and aquatic environments, Western Lake Nasser.
Research objectives:	<ul style="list-style-type: none"> <li>-Establishing baseline concentrations of environmentally sensitive metals (As, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, V and Zn) in top cultivated and uncultivated soils.</li> <li>-Delineating areas of trace metals deficiency or excess that may affect plant and animal nutrition as well as human health.</li> <li>-Investigating the accumulation of these metals in Lake Nasser bottom sediments and detecting their variability due to sediment-water interaction and the biological productivity as well.</li> </ul>
Linkage between the research and project research questions	<ul style="list-style-type: none"> <li>-The flow velocity as well as water level fluctuation is the basic factor for the distribution of heavy metals in bottom sediments (Lénczowska-Baranek, 1996).</li> <li>-Distribution of metals in soils depends strongly on the soil moisture conditions and soil to soil solution equilibrium (Karczewska, 1996).</li> </ul>
Research approach:	In order to determine the impact of the widespread environmental problems and issues (eg., climatic change, pollution control) environmental geochemical monitoring has to be used. This method gives information on the concentrations of heavy metals in the environment in trying to find connections between



	<p>their accumulation and the environmentally related diseases. It would improve the way we plane and support human communities. Understanding the role of rocks, soils and surface as well as ground water in controlling the health of local populations requires collaboration of geochemist, climatologists and medical researchers.</p>
Resources to be used:	<ul style="list-style-type: none"> <li>- 4weel drive car.</li> <li>- Soil sampler &amp; sample containers.</li> <li>-Equipped research boat &amp; assistant workers.</li> <li>- Set of sieves.</li> <li>-Suitable instrumental analyses to detect 13 metals in 200 soil and lake bottom sediment samples.</li> </ul>
Date of implementation:	February, 2009-2010
Duration and frequency of implementation:	Ten Months
Expected results:	<p>Geochemical maps showing the distribution of trace metals in the terrestrial and aquatic environments. The impact of this metal distribution on both human health and plant and animal nutrition could be detected.</p>

Annex 8: Assessing Ecosystem Qualities in Lake Nasser under Climate Change

**Researches implemented under the New Land New Life Project Lake Nasser, Aswan**

**Assessing Ecosystem Qualities in Lake Nasser under Climate Change**

**Research Institution:**

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Researcher:	Samir Abdel Zaher El-Gendi
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**Research Data:**

Research title:	Assessing the ecosystem qualities in Nasser Lake under climate change
Research objectives:	Impact of climatic change on latent heat capacity of lake sediments and : 1- role of sediments in partitioning toxic metals 2- influence of human activities on environmental quality 3- study the speciation of the heavy metals 4- identifying the solid –phase which controlling the availability of the studied metals Assessing the impact of climatic change on flora, aquatic creation and natural vegetation
Linkage between the research and project research questions	The research point will cover the question Number two
Research approach:	Interpretation and uses of the pervious data of Naser Lake Sampling (soil,sediment, water in an area of 5 Km long and 0.5 Km width in the Lake Analysis and evaluation Reporting and conclusion
Resources to be used:	Sampling tools Containers Analytical Equipments Human resources

Date of implementation:	Jan 2009
Duration and frequency of implementation:	16 months
Expected results:	<ul style="list-style-type: none"><li>1-Evaluating the impact of human activities in that area.</li><li>2-Assessing the effect of climatic change on environmental quality</li><li>3- Strengthening the ecosystem for the possibility of climatic change</li><li>4-Helping the stakeholders and decision in putting the appropriate policies of conservation the ecosystem</li></ul>

## Soils and Water and Environment Research Institute Agriculture Center

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By: Dr. Samir Abdel Zaher El – Gendi

### A-Research Problems and Justification:

Changes in Climate can have Significant impacts on agriculture productivity, and thus on rural livelihoods. Poor People in rural areas are the most vulnerable to the effects of Climate Change. Many live on ecologically Fragile land and Depend upon Agriculture Which remains pillar of Poverty Reduction as well as employment and income– generating opportunities.

If the Predicted trends in climate change are confirmed, severe limitation will be imposed on future potential gains from agriculture.

The impacts of climate change including more frequent and severe drought and flooding as well as short growing season are becoming a source of grave to the sustainability of agriculture in many developing country.

The west Lake Nasser region is considered one of the biggest promising area of desert settlement and development in Egypt. This area is endowed with great natural resources, including the largest water storage body for the whole country.

The settlers in this region remain trapped in dire poverty, heavily dependent on fragile natural resources base and vulnerable to economic and environmental- friendly agriculture practices by settler, demographic characters as well as some of ecological problems such as rising in temperature and water and level Fluctuation.

Furthermore, water and soil management is crucial factor because certain uses of land can drive climatic change, while others can mitigated it.

### The aims of this experiment are :

1. Enhancing natural soils regeneration processes involving management.
2. Efficient use of the limitation water resources.
3. Maintenance of physical properties and chemical of soils.
4. The prerequisite for use inorganic fertilizer is to develop its capacity to avoid the pollution of aquifers and damage to ecosystem.
5. building human capital, through lectures and training courses which are the most powerful weapons in the fight against poverty because the settlers are bring with them traditional agriculture practices which don't suit to the new region.

To achieve these goals, the research team is eager to introduce Package of practices including; new hybrids and new agriculture practices adapted with the environmental conditions of west Nasser Lake to increase profitability as well as conversation of natural assets.

### B- Experiment Design

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#### • Experimental Location :

The experiment is established in the experimental station of the project at **Calabash**.

#### • Irrigation and soils amending design :

1. The main plot Consists of two water regimes, the first one irrigation

2. The sub main Plots consists of five applications of mixture of inorganic and organic fertilizers, where one of them compensate the other, consequently the total amount of both fertilizers at each treatment being equal at all treatments.
  3. There are there replicates.
- **Drought resist vegetable varieties Experiment :**  
The present Experiment was including three drought resist varieties of cash vegetables crops of tomato, Watermelon and musk melon.

#### **C - Sampling and Analytical procedures:**

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1. Distributed and undistributed soil samples at depths of (0-30,30-60, and 60-90 cm) were collected from each experiment from 10 soil profiles representing the different treatments for each of the tested crops.
2. each sample was air dried, sieved and stored for the following analysis as described by the standard soil analysis procedures.
3. the amount of applied irrigation water of each treatment was determined by water gauge.

#### **Methods of analysis :**

- **Calcium Carbonate content** was determined volumetrically as described by Piper (1950).
- **Soil Moisture characteristic Curves** were determined by exposing the completely saturated samples to constant suction levels of 0.1, 0.33,0.66,1.0,3.5 and 15 atmosphere using the pressure cooker and membrane according to Stakman 1966.
- **Organic matter content** was determined by the method of walkley and Black(1954).
- **Electretical conductivity** was carried on soil extract by EC meter as described by Jackson(1967).
- **Soil Reaction (PH)** was carried in soil paste using PH meter, Page et al (1982).
- **Sodium and Potassium** were determined in soil extracting using Flame Photometer, Page et al (1982).
- **Sodium and Magnesium** were titrated by versinate solution using EBT as indicator Page et al (1982).
- **Soluble Choride** was determined according Mohrs method, Page et al (1982).
- **Carbonate and bicarbonate** were determined titration with a standard solution HCl using phenol Phethalian as indirector for the former and methyle orange for the later Page et al (1982).
- **Soleplate** was calculated by difference.
- **DTPA- Fe and Mn:**  
Soluble Fe and Mn in the tested soils analysis were carried according to this method could be summarized as follow ; 10g soil sample of each soil was shaken for two hours with 20ml of (0.005 DTPA; 0.01M, Ca C12; 0.01M and TEA ;0.1M at adjacent pH 7.3) Solution.

#### **D- Results and Discussions**

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##### **1. Soil Reaction**

The data of the table (1) reveals that as the pH values decrease as the quantity of organic amendment increase. PH value of T1, T2, T3, T4 and T5 were 8.42, 8.37, 8.29, 8.21 and 8.16, respectively. these results may attributed to the effect of organic amending which contain organic acids, also the data of the upper surface layer of tested soil support these findings since they contain the lower PH vales.

## **2. Calcium Carbonate content:**

On the average, the results showed that the CaCO<sub>3</sub> content in F5 treatment which received the highest portion of its nutrient demand as organic forms had the lowest value of CaCO<sub>3</sub>, while F1 treatment which received all its nutrients demand as inorganic forms had the lowest value of CaCO<sub>3</sub>. This result may de attributed to the action of the action of the applied organic forms had the lowest value of CaCO<sub>3</sub>. This result may be attributed to the action of the applied organic matter in the lowering PH values and consequently increasing solubility of calcium Carbonate content.

Furthermore, the content of CaCO<sub>3</sub> in the surface layer in T1, T2, T3, T4 and T5 were 4.44, 4.10, 3.71, 3.62 and 3.59%, respectively confirmed the previous results (as shown from Table 1).

## **3. Organic Matter Content :**

The present gate revel that initial date organic matter presented from Table (1) was 0.21% and increased by 28.57% (on average basis) due to the application.

The results also indicate that there are significant relations between the quantities of applied organic matter and soil organic matter contents.

**Table (1) : general chrematistic of the tested soils :**

Treatment	Depth	Sp	EC	pH	OM%	CaCO3%
F1M1	o-30	22.5	0.96	8.42	1.01	4.44
	30-60	22.5	0.75	8.41	0.04	3.88
	60-90	23.5	0.76	8.23	00.03	3.82
F1M2	o-30	21.0	1.06	8.5	0.12	2.88
	30-60	20.0	0.72	8.62	0.09	3.53
	60-90	26.5	1.29	8.68	0.1	3.42
F2M1	o-30	20.5	1.46	8.37	0.15	4.10
	30-60	23.5	3.41	8.51	0.04	4.05
	60-90	28.0	5.09	8.42	0.09	3.00
F2M2	o-30	25.0	1.52	8.08	0.48	3.68
	30-60	22.2	1.39	8.42	0.07	3.50
	60-90	30.0	1.5	8.6	0.04	3.71
F3M1	o-30	22.0	0.85	8.29	0.1	3.7
	30-60	23.5	0.66	8.4	0.04	3.67
	60-90	28.5	0.59	8.41	0.03	3.62
F3M2	o-30	27.0	5.79	8.51	0.41	3.70
	30-60	35.0	3.52	8.44	0.34	3.45
	60-90	27.5	0.74	8.51	0.31	3.62
F4M1	o-30	29.0	1.46	8.21	0.39	3.72
	30-60	26.5	0.83	8.3	0.33	3.98
	60-90	28.0	0.85	8.34	0.33	3.59
F4M2	o-30	20.5	0.92	8.34	0.47	3.42
	30-60	21.3	0.72	8.54	0.29	3.33
	60-90	26.0	0.84	8.62	0.31	3.51
F5M1	o-30	25.0	1.12	8.19	0.46	3.54
	30-60	24.0	0.52	8.44	0.34	3.65
	60-90	24.0	0.54	7.98	0.36	3.58
F5M2	o-30	23	0.71	8.53	0.4	3.68
	30-60	25	0.66	8.18	0.34	3.58
	60-90	24	0.53	8.15	0.334	3.58

### Soil Retention Capacity

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Results of soil moisture at both field and wilting point as well as available water in treated soil are shown in the Table. Field capacity and wilting point were affected by different application of organic and mineral fertilizers. Data showed that application of organic fertilizers combined with mineral fertilizers was more effective than the application of them separately. It is worth to mention here that the rate of increase in soil moisture content at field capacity was higher than that at wilting point. Consequently, the best improvement occurred in available portion was at F3 application. This finding can be attributed to the role of organic material and their decomposition products which act as binding materials and consequently enhancing aggregation process and create suitable conditions for strengthening of soil structure.

### Macro- micro element analysis:

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On average basis the results showed that the highest content of K, P, Fe, Mn, Zn and Cu in the soils which received all its nutrient requirement as organic forms. The values (in ppm) were 2.41, 8.47, 4.27, 4.11, 3.67, and 0.86 for the treatments, respectively. Meanwhile, the treatments which received its nutrient demands 50% as inorganic and 50% as organic fertilizer had the highest values of nitrate (54.76 ppm) and ammonia (26.12 ppm).



**Table (2) Concentration of some micro and macro nutrients in the tested soils:**

Treatment	Depth	k	p	Fe	Mn	Zn	Cu	NO3	NH4
F1M1	0-30	482	15.2	6.25	10.05	5.95	1.32	8.43	1.2
	30-60	172	6.1	3.43	2.43	4.32	0.76	1.71	5.4
	60-90	111	4.7	2.96	1.73	5.09	0.69	3.21	8.5
F1M2	0-30	288	9.9	4.79	4.48	1.68	1.01	6.23	7.7
	30-60	155	7.3	4.1	2.11	1.78	0.69	5.03	0.0
	60-90	238	7.6	4.1	3.84	3.22	0.69	8.03	10.7
F2M1	0-30	216	6.3	3.19	3.26	1.7	0.76	10.03	0.0
	30-60	152	4.1	3.19	1.6	2.45	0.57	7.53	14.5
	60-90	176	4.0	3.43	2.3	3.38	0.44	6.73	9.8
F2M2	0-30	280	4.1	3.87	2.82	2.45	0.57	204.23	80.3
	30-60	244	2.7	5.02	3.65	2.11	0.5	92.53	49.3
	60-90	108	2.4	2.96	3.14	4.92	0.44	7.53	2.8
F3M1	0-30	192	3	4.97	4.93	2.3	0.69	25.03	0.9
	30-60	176	3	5.02	2.75	2.47	2.47	10.23	2.7
	60-90	114	3.7	3.19	2.05	1.49	1.49	11.13	3.7
F3M2	0-30	226	7.6	5.24	4.09	2.09	2.09	12.23	10.8
	30-60	194	4.7	5.47	2.94	1.68	1.68	12.63	5.5
	60-90	118	10.2	2.51	1.66	1.75	1.75	10.03	19.4

Annex 9: Seasonal Periodicity of Algae in the Aquatic Habitats at Kalabsha

Researches implemented under the New Land New Life Project Lake Nasser, Aswan

Seasonal Periodicity of Algae in the Aquatic Habitats at Kalabsha, West side of Lake Nasser

**Research Institution:**

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**Research Data:**

Research title:	Seasonal periodicity of algae in the aquatic habitats at Kalabsha - Garf Hussein region, west side of Lake Nasser
Research objectives:	The water level in Lake Nasser is subjected to dramatic fluctuations from one year to another due to fluctuations in the amount of flood water flowing into it. Since the construction of the High Dam, the highest water level of 181.6 m a. s. l was reached in the flood season of 1999. The irregular hydrological events due to the fluctuations in water level may influence the life conditions in Lake Nasser. The objective of the study is to emphasize that the monitoring of the biological aspects of Lake Nasser are important for detecting the alterations that might take place due to the irregular hydrological events particularly flood and the concomitant fluctuations in water turbidity. Also, this investigation was carried out to provide information on the seasonal periodicity of the characteristics of the algal assemblages in a trial to understand how far the water habitats in this region can be altered in response to the climate change and differ from time to time.
Linkage between the research and project research questions	The development project at Kalabsha - Garf Hussein region is regarded as an example site for the sustainable development projects that were initiated since the early 1980's on the west shore of Lake Nasser. Such studies have an important role in providing valuable insights that will inform sustainable management of Lake Nasser's area. In addition, the results will provide useful information

	<p>for the national-level decision-making on the integrated outcomes of environmental changes occurring due to the climate change in this large important area.</p> <p>The aquatic habitats at Kalabsha – Garf Hussein may offer a relatively large habitat for the development of assemblages of algae. This investigation was carried out to provide information on the seasonal periodicity of the characteristics of the algal assemblages in a trial to understand how far the water habitats in this region can be altered in response to the climate change and differ from time to time.</p>
<p>Research approach:</p>	<p>Water samples were collected from 15 sites in the area. The collected water samples were analyzed for estimations of the population density and community structure of algae.</p> <p>Other water samples were collected from 15 sites and were subjected to physico-chemical determinations as well as qualitative and quantitative estimations of planktonic algae.</p>
<p>Resources used:</p>	
<p>Date of implementation:</p>	<p>summer, 2009 - summer, 2010</p>
<p>Duration and frequency of implementation:</p>	<p>One year</p>
<p>Results:</p>	<p>The dense populations of phytoplankton in drainage water of aquaculture can positively affect the development of agricultural crops. Irrigation of the cultivated soil in this region with water rich in planktonic algae from the drainage water of aquaculture may improve the biological state (oxygen supply fixation of atmospheric nitrogen and humic substances in the soil, its enrichment with proteins, vitamins auxins, microelements, indispensable amino acids and mineral salts) and the struggle against root putrescence become more successful.</p> <p>Regarding to the drinking water in this region, maintenance of high-quality water should be among the principal priorities in management plans. Furthermore, the aquatic habitats should be protected through finding the means that ensure the healthy functioning of the ecosystem in this region. For drinking water, problems may arise, when mass development of planktonic algae takes place and the technology of drinking water production is not adapted. Some species of algae are notorious for their production of taste and odor compounds. Clogging of filters by bulky and/or slimy algae is another serious problem. It is necessary to avoid mass development of planktonic algae, which cause problems for the drinking water preparation.</p> <p>Development of water blooms during the last four decades of the</p>

	<p>lake's history was recorded intermittently particularly in the southern third of Lake Nasser mainly due to the enormous masses of the toxic cyanobacterium: <i>Microcystis aeruginosa</i>. This alga forms very heavy water blooms, in some places several centimeters thick floating layers on the surface, like a blue green colored sour cream. This layer may be driven to the shore forming a blue green drift with a very peculiar smell. In this respect, <i>Microcystis aeruginosa</i> is recorded in this investigation as a rare taxon in aquaculture. However, its over growth should be avoided to protect the area from the toxic water blooms.</p>
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## Report on the seasonal periodicity of algae in the aquatic habitats at Kalabsha - Garf Hussein region, west side of Lake Nasser

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**By: Dr. Ahmed El-Otify**

The pressures exerted by the climate change and the need for the socio-economic development projects have a major influence on the freshwater biota in inland water systems. The development project at Kalabsha - Garf Hussein region (about 50 Km south of Aswan High Dam, at 23° 00, 33° 41 latitudes and 32° 00, 52° 04 longitudes) is regarded as an example site of the sustainable development projects that were initiated since the early 1980's on the west shore of Lake Nasser. Thus, it is necessary to follow the seasonal variations that may take place in the communities of the freshwater algae inhabiting the aquatic habitats in this area. Such studies have an important role in providing valuable insights that will inform sustainable management of Lake Nasser's area. In addition, the results will provide useful information for the national-level decision-making on the integrated outcomes of environmental changes occurring due to the climate change in this large important area.

The aquatic habitats at Kalabsha – Garf Hussein may offer a relatively large habitat for the development of assemblages of algae. This investigation was carried out to provide information on the seasonal periodicity of the characteristics of the algal assemblages in a trial to understand how far the water habitats in this region can be altered in response to the climate change and differ from time to time.

The aquatic ecosystem in Kalabsha - Garf Hussein region was investigated seasonally during the period from summer, 2009 through summer, 2010. Water samples were collected from the following 15 sites: 1. Lake Nasser (Garf Hussein); 2. Irrigation canal; 3. Near a compact unit before filtration at (Garf Hussein village); 4. Water container (after chlorination); 5. The compact unit (after filtration); 6. Fish culture pond (concrete pond system) for rearing of the Nile perch (*Tilapia nilotica*); 7. Drainage canal of the fish ponds; 8. Fish culture pond (earth pond system) for rearing of the Nile perch (*Tilapia nilotica*); 9. Water tank (metallic tank "iron") for supplying drinking water in Bashaier Elkheir village; 10. Water tank (plastic "polyethylene" tank) for supplying drinking water in Kalabsha village; 11. Kalabsha irrigation canal (at the end of the canal); 12. Kalabsha irrigation canal (at the beginning near Lake Nasser); 13. Near a compact unit before filtration (at Kalabsha village); 14. Water container (after chlorination); 15. The compact unit (after filtration). It is worthy to mention that those are the same sites that were investigated in winter, 2007 during the eco-health assessment of the area.

The collected water samples were analyzed for estimations of the population density and community structure of algae. The data obtained are presented in table1. The data herein obtained indicated some irregular seasonal fluctuations in the population density of algae. In aquacultures, the densities of algal populations were always higher than those in the other investigated sites of Lake Nasser or drinking water. The high algal growth potential in summer seasons was reflected by the substantial high densities of algal assemblages in aquacultures. The high temperature and relatively standard light conditions in summer seasons enhanced the growth and development of the algal assemblages. In Daleel Kalabsha, the density of algal assemblages were always increased considerably as compared by the Lake Nasser's water in Garf Hussein region particularly in summer season depending mainly on the low water level of Lake Nasser. In this respect, The water level increased gradually in late summer and autumn, while started to decrease gradually in late winter spring and early summer periods.

Generally, the main groups forming the community of algae in the region are: Chlorophyta (green algae), Bacillariophyta (diatoms), Cyanophyta (blue-green algae), and Pyrrophyta (dinoflagellates). The most common individuals of algae were related to the genera:

*Cosmarium*, *Crucigenia*, *Elakatothrix*, *Golenkinia*, *Lagerheimia*, *Scenedesmus* and *Schroederia* (Chlorophyta).

*Anabaenopsis*, *Planktolyngbya* and *Merismopedia* (Cyanophyta)

*Aulacoseira*, *Cocconeis*, *Cyclotella*, *Cymbella*, *Fragillaria* and *Navicula* (Bacillariophyta).

*Ceratium* and *Peridinium* (Pyrrophyta).

It is of special important to mention that Euglenophyta was sparsely represented by few individuals particularly in the drainage water of the aquacultures.

It is necessary to establish an environmental monitoring system that would record biological features of the aquatic ecosystem in terms of qualitative and quantitative compositions of algal assemblages as well as any alterations that may take place in association of climate change. In addition, the resulted positive or negative impacts upon human health should be considered.

At Kalabsha - Garf Hussein region (about 50 Km south of Aswan High Dam, at 23° 00, 33° 41 latitudes and 32° 00, 52° 04 longitudes). During the last two decades, a certain area of land was reclaimed and cultivated, small villages were built for settlement of farmers, compact units for potable water supply and fish culture ponds for rearing of the Nile perch; *Tilapia nilotica* in order to increase fish production of Lake Nasser were established. Thus, it is necessary to emphasize that, in this region, water for agricultural irrigation, livestock watering, and aquaculture or probably other human activities may be of prime importance.

Therefore, it is necessary to provide decision makers of economic and environmental development over freshwater and agriculture as well as health conditions with information for help in sustainable development of this region.

Water quantity and quality are inter-related and water quality can be managed by regulation of water quantity. The aquatic habitats at Kalabsha – Garf Hussein may offer a relatively large habitat for the development of assemblages of algae. This investigation is carried out to provide information on water quality and biological characteristics in a trial to understand how far the water habitats in this region can be altered and differ from each other.

Shore-line farming in Kalabsha - Garf Hussein cultivated area was visited in Saturday, 3/ 2/ 2007 in order to investigate the water quality of aquatic habitats as well as water biology in terms of planktonic algae qualitative and quantitative composition. Water samples are collected from 15 different sites *viz.* 1. Lake Nasser (Garf Hussein); 2. Irrigation canal; 3. Near a compact unit before filtration at (Garf Hussein village); 4. Water container (after chlorination); 5. The compact unit (after filtration); 6. Fish culture pond (concrete pond system) for rearing of the Nile perch (*Tilapia nilotica*); 7. Drainage canal of the fish ponds; 8. Fish culture pond (earth pond system) for rearing of the Nile perch (*Tilapia nilotica*); 9. Water tank (metallic tank "iron") for supplying drinking water in Bashaier Elkheir village; 10. Water tank (plastic "polyethylene" tank) for supplying drinking water in Kalabsha village; 11. Kalabsha irrigation canal (at the end of the canal); 12. Kalabsha irrigation canal (at the beginning near Lake Nasser); 13. Near a compact unit before filtration (at Kalabsha village); 14. Water container (after chlorination); 15.

The compact unit (after filtration). The collected water samples are subjected to physico-chemical determinations as well as qualitative and quantitative estimations of planktonic algae. The data obtained are presented in table1 and summarized in the following paragraphs:

The relatively alkaline pH value could be related to the photosynthetic activity of phytoplankton particularly in the fish culture ponds. The oxygen super saturation of the majority of water samples recorded in this investigation could be principally attributed to the photosynthetic activity of phytoplankton. However, the fish culture ponds contained relatively lower oxygen contents than Lake Nasser or the other water samples. The oxygen saturation of water in these habitats may reflect the influence of some factors: temperature, the effect of wind, aquatic life conditions and the desert surroundings.

Pronounced differences are recorded in both nitrate and phosphate contents of the collected water samples in this investigation. The increase in nitrate concentration could be mainly due to the human activity in the vicinity of sampling sites in Lake Nasser or manuring with various nutrients including nitrates in aquaculture. Otherwise, the decrease in nitrate contents could be mainly due to its consumption by phytoplankton, or its reduction by denitrifying bacteria. Such reduction may restrict the growth of some taxa of planktonic algae that are unable to fix atmospheric nitrogen.

Total counts of algae appear to be of considerably higher values in the sites of fish culture ponds compared to those in the other investigated sites. Such pronouncing local variations could be mainly due to the nature of the water area itself as well as to the availability of nutrients. The algal growth potential in aquaculture seems to be relatively high due to the incubation of water under standard light and temperature conditions. The populations of planktonic algae are represented mainly by: green algae, diatoms and cyanobacteria. Dinoflagellates are sparsely represented only by two genera namely *Ceratium* and *Preidinium*. The percentage compositions, which illustrates the relation between the different groups of algae is provided in table 1. In fish culture ponds, green algae and diatoms are recorded to be the dominant groups of algae. In water samples collected from Lake Nasser and the adjacent water areas, the diatoms represent the most dominant group of algae. However, the data concerning the water samples that are collected from the compact units or around them reveal that that diatoms and green algae are collectively the dominant groups. In general, these data indicated that the different water areas acquired specific environmental conditions and man-made effects, although the sampling sites are located in the same district. The major recorded taxa in the present investigation are:

Cyanobacteria:

- *Anabaenopsis cunningtonii* Taylor
- *Merismopedia warmingiana* Lagerh.

Diatoms:

- *Aulacoseira granulata* (Ehr.) Simonsen
- *Cyclotella meneghiniana* Kütz.
- *Cymatopleura solea* (Breb.) W. Smith
- *Cymbella ventricosa* Kütz.
- *Gomphonema olivaceum* (Hornemann) Breb.

- *Navicula cryptocephala* Kütz.
- *Navicula exigua* Greg.
- *Nitzschia holsatica* Hust.
- *Nitzschia* sp.
- *Rhopalodia gibba* (Ehr.) O. Mull.

Green algae:

- *Cosmarium botrytis* Menegh.
- *Cosmarium depressum* Lundell
- *Crucigenia rectangularis* (Nag.) Gay
- *Elakatothrix genevensis* (Reverdin) Hindak
- *Golenkinia radiate* Chod.
- *Lagerheimia quadriseta* (Lemm.) G. M. Smith
- *Scenedesmus ecornis* (Ehr.) Chod.
- *Schroederia setigera* (Schröd) Lemm.

Dinoflagellates:

- *Peridinium* sp.

From the preceding survey of data concerning this investigation of the aquatic ecosystem in Kalabsha-Garf Hussein region, it can be concluded that, it is necessary to establish an environmental monitoring system that would record physical, chemical and biological features as well as any alterations that may take place in water quality. Such system may have the scientific backstopping that enable the effective supervision of monitoring and research programmes and the formulation of scientifically based decisions of managements. In addition, it should act as an early warning for any environmental hazardous and be capable of advising on corrective measures. Thus, the management plan of the ecosystem in Kalabsha - Garf Hussein region should include a programme of multidisciplinary research that aims at understanding the ecological processes and interactions operating in the system as well as the impact of resource use including impact of discharge that flow to Lake Nasser on the health and sustainability of the system. It is of special important to avoid or at least minimize the environmental stress beyond the capacity of the system of agriculture development projects, farming and associated human settlements in this region.

Records of species richness and population density of all water biota should be carried out continuously and comparing them with the data obtained during the four decades of the history of Lake Nasser ecosystem, since this ecosystem is in state of flux and did not reach a steady state.

The dense populations of phytoplankton in drainage water of aquaculture can positively affect the development of agricultural crops. Irrigation of the cultivated soil in this region with water rich in



planktonic algae from the drainage water of aquaculture may improve the biological state (oxygen supply fixation of atmospheric nitrogen and humic substances in the soil, its enrichment with proteins, vitamins auxins, microelements, indispensable amino acids and mineral salts) and the struggle against root putrescence become more successful.

Regarding to the drinking water in this region, maintenance of high-quality water should be among the principal priorities in management plans. Furthermore, the aquatic habitats should be protected through finding the means that ensure the healthy functioning of the ecosystem in this region. For drinking water, problems may arise, when mass development of planktonic algae takes place and the technology of drinking water production is not adapted. Some species of algae are notorious for their production of taste and odor compounds. Clogging of filters by bulky and/or slimy algae is another serious problem. It is necessary to avoid mass development of planktonic algae, which cause problems for the drinking water preparation.

Development of water blooms during the last four decades of the lake's history was recorded intermittently particularly in the southern third of Lake Nasser mainly due to the enormous masses of the toxic cyanobacterium: *Microcystis aeruginosa*. This alga forms very heavy water blooms, in some places several centimeters thick floating layers on the surface, like a blue green colored sour cream. This layer may be driven to the shore forming a blue green drift with a very peculiar smell. In this respect, *Microcystis aeruginosa* is recorded in this investigation as a rare taxon in aquaculture. However, its over growth should be avoided to protect the area from the toxic water blooms.

**Table1. Seasonal fluctuations in the density of algal assemblages estimated as chlorophyll  $a$  concentrations ( $\text{mg.m}^{-3}$ ) in Kalabsha - Garf Hussein region during 2009 – 2010.**

	Summer 2009	Autumn 2009	Winter 2009/2010	Spring 2010	Summer 2010
<b>Lake Nasser</b>					
Garf Hussein	6.07	5.07	3.68	3.15	6.11
Daleel Kalabsha	31.55	20.32	9.20	4.96	10.99
<b>Aquacultures</b>	65.60	34.32	28.45	38.01	104.33
<b>Drinking water</b>					
Garf Hussein	3.46	3.74	2.05	1.62	0.31
Kalabsha	2.58	2.39	1.54	0.96	0.16
Bashaier Elkheir	2.90	2.41	0.65	0.54	0.10

Annex 10: Bacteriological Evaluation of Drinking Water

Researches implemented under the New Land New Life Project Lake Nasser, Aswan

**Bacteriological Evaluation of Drinking Water implemented under the New Land New Life Project (Climate Change), Lake Nasser, Aswan**

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**Research Data:**

Research title:	Bacteriological evaluation of drinking water implemented under the New Land New Life Project (Climate Change), Lake Nasser, Aswan
Research objectives:	The current study was carried out to evaluate the chemical and microbiological characteristics of drinking water used for human consumption and to what extent the people of the three villages (Garf Hussein, Bashaier and Kalabsha) in west of lake Nasser in Aswan suffer from community health problems. The study aimed to reveal the failure of the treatment system of the investigated water in removing the classical indicators of pollution.
Linkage between the research and project research questions	Availability of safe drinking water is very important. To ensure this, reliance has to be placed on regular bacteriological analyses to assess portability and to determine the best course of action for protecting the population against water-borne diseases. With the development of a variety of multiple test kits for specialization of many waterborne aerobic and anaerobic organisms, more attention is being given to selected species of microorganisms for use as indicators of water pollution.
Research approach:	Fifteen representative water samples were collected from the three villages (Garf Hussein, Bashaier and Kalabsha) in west of Lake Nasser. Water samples were taken from the purification units, water tanks & pipes and water storage in houses. The methods of sampling were developed from the WHO guidelines for drinking water quality (1996). Allowing water to run for 3-5 min was done before running it into the bottle. The bottles were delivered to the laboratory within 6h

	and kept in cool container and protected from light.
Resources used:	Bottles
Date of implementation:	
Duration and frequency of implementation:	
Results:	The obtained results indicated that the produced water, supposed to be for domestic use, contained bacteria (all the tested organisms). The results also revealed the ill performance and poor drinking water quality of the purification systems of the investigated water samples.

## Bacteriological evaluation of drinking water implemented under the New Land New Life Project (Climate Change), Lake Nasser, Aswan

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### Abstract

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The present study monitored fifteen representative suspicious drinking water samples of study locations aiming to record the classical indicators of pollution, Total viable counts, Total coliform, and fecal coliform and fecal streptococci are monitored as classical indicators of pollution. The study aimed to reveal the failure of the treatment system of the investigated water in removing the classical indicators of pollution. Chemical and microbiological qualification of water was achieved. The obtained results indicated that the produced water, supposed to be for domestic use, contained all the tested organisms. The results also revealed the ill performance and poor drinking water quality of the purification systems of the investigated water samples. Recommendation was suggested for the new treatment systems of investigated suspicious water to prevent human and animal illness.

### Key Words:

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Bacteria in drinking water.

### Introduction

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The provision of adequate clean water supply to the rapidly growing population is increasingly becoming a challenge facing many countries worldwide including Egypt (Younis *et al.*, 2003, Taha and Younis, 2009). The last decades of the twentieth century were characterized by an accelerated growth in water demand, which is rising today at a rate never experienced in any previous time of history.

Human use of water has increased more than 35-fold over the past three centuries and four folds since 1940 (Easter and Hearne, 1995). Availability of safe drinking water is very important. To ensure this, reliance has to be placed on regular bacteriological analyses to assess portability and to determine the best course of action for protecting the population against water-borne diseases (Ramteke and Bhattacherjee, 1992). With the development of a variety of multiple test kits for specialization of many waterborne aerobic and anaerobic organisms, more attention is being given to selected species of microorganisms for use as indicators of water pollution (Geldreich, 1982). In addition several studies investigate the relation of indicators organisms with some pathogens, several outbreaks of gastroenteritis and hepatitis (Kramer *et al.*, 1996), giardiasis and cryptosporidiosis (Smith and Smith, 1990) in communities with water meeting current regulations (Anonymous, 1994) have been recorded. This has brought to the public attention the fact that current standards may not provide complete protection (Shaban and El-Taweel, 2002). The current study was carried out to evaluate the chemical and microbiological characteristics of drinking water used for human consumption and to what extent the people of the three villages (Garf Hussein, Bashaier and Kalabsha) in west of lake Nasser in Aswan suffer from community health problems.

### Materials and Methods

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#### Sampling:

Fifteen representative water samples were collected from the three villages (Garf Hussein, Bashaier and Kalabsha) in west of Lake Nasser. Water samples taken from the purification units, water tanks & pipes and water storage in houses. The methods of sampling were developed

from the WHO guidelines for drinking water quality (1996). Allowing water to run for 3-5 min was done before running it into the bottle. The bottles were delivered to the laboratory within 6h and kept in cool container and protected from light.

### ***Bacteriological Examinations:***

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#### **a) Classical Indicators of Pollution**

For total viable counts, poured plate method according to APHA (1989) was used, while Total and faecal coliforms as well as faecal streptococci were estimated on MacConky agar (Oxoid, 1982).

### **Results and Discussion**

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#### **1. Bacteriological evaluation;**

It is generally accepted that natural water sources used by settlements in developing countries are very prone to fecal contamination (Feachem, 1980). Indeed, a more recent estimate based on WHO reports suggests that 80% of all human illness in the developing worlds is associated with polluted water and that most of those illnesses are caused by biological contamination (Taha and Younis, 2009). Infectious diseases caused by pathogenic bacteria, viruses and parasites are the most common and widespread health risk associated with drinking water. The elimination of all these agents from drinking water has a high priority. The provision of a safe supply of drinking water depends upon use of either a protected high-quality ground water or a properly selected and operated series of treatments capable to reduce pathogens and other contaminants to the negligible health risk (Shaban and El-Taweel, 2002). This study was undertaken to evaluate the bacteriological characteristics of drinking water used for human consumption and to what extent the people of the three villages (Garf Hussein, Bashaier and Kalabsha) in west of lake Nasser in Aswan suffer from community health problems.

**Table (1): Classical bacterial indicators counts in the studied water samples**

Location	Temperature (°C)	Total viable Counts /1ml	Total Coliform /100ml	Faecal Coliform /100 ml	Faecal Streptococci /100ml
1. Lake Nasser (Garf Hussein) (harbour)	21.7 °C	962	6123	4200	1923
2. Irrigation canal (Lake Nasser) (Garf Hussein)	21.7 °C	438	472	372	100
3. Near a compact unit before filtration at (Garf Hussein)	20 °C	792	739	529	210
4. Water container (after chlorination) (Garf Hussein)	29 °C	21	54	31	23
5. Fish culture pond (concrete pond system) (Garf Hussein)	20 °C	1002	6834	4211	2623
6. Fish culture pond (earth pond system) (Garf Hussein)	19 °C	982	7493	6285	1208
7. Drainage canal of the fish ponds (Garf Hussein)	23°C	592	4120	3723	784
8. Drinking water in Garf Hussein village	19°C	19	159	127	32
9. Drinking water in Bashaier village	25°C	16	79	46	31
10. Drinking water in Kalabsha	24°C	8	53	34	19
11. Kalabsha irrigation canal (at the end of the canal)	23°C	829	5386	4921	829
12. Kalabsha irrigation canal (at the beginning near Lake Nasser)	30°C	634	4398	2751	1292
13. Near a compact unit before filtration (at Kalabsha village)	23°C	791	3299	3120	128
14. Lake Nasser before filtration (at Kalabsha village)	34°C	693	3479	3071	408
15. Near a compact unit after filtration (at Kalabsha village)	31°C	15	2769	1983	786

The investigated water samples supposed to be safe water, the safety of the drinking water based on the determination of the classical (total viable counts, Total coliform, fecal coliform, coliform streptococci) and new indicator (total yeasts, *Candida albicans*, *Aeromonas hydrophila* and total staphylococci), as reported by El-Abagy *et al.*, 1999 and Taha & Younis, 2009), where the Egyptian standards for drinking water declared that potable water must be free from total and faecal coliforms as well as faecal streptococci, in addition total bacterial counts must be less than 50 cfu/ml.

The results of table 1 revealed that all investigated water samples in the selected three villages contain considerable numbers of Total viable counts, Total coliform, fecal coliform, coliform streptococci which monitored as classical indicators of pollution, and exceed the permissible limit recommended by WHO (1996). The highest classical pollution indicator of the drinking water of the three villages was recorded in the water samples of drinking water in Garf Hussein village while the lowest classical pollution indicator detected in the drinking water samples of Kalabsha village. The microbiological criteria and standards for drinking water supplies are based mainly on total and faecal coliforms, faecal streptococci

and total bacterial counts (Geldreich, 1982). Our results agreed with (Wright, 1982 and Taha & Younis, 2009) whom investigated the levels of faecal coliforms (FC), indole, positive FC (presumptive *Escherichia coli*), faecal streptococci (FS), *Streptococcus faecalis* and *Clostridium perfringens* in the natural water sources used by 29 rural settlements in Sierra Leone and drinking water samples of Wadi El Saaida villages e. g. Al-Shahama, Amer Ben-Alas and Al-Iman (an agricultural society) in Aswan Governorate, Egypt. They found that all water sources were contaminated with the indicator bacterial.

The data obtained in this study support the need for monitoring water that will be consumed by the people of the three villages (Garf Hussein, Bashaier and Kalabsha) in west of Lake Nasser in Aswan for the classical pollution indicators. In conclusion, the obtained results suggested a recommendation for the new treatment and distribution systems of investigated suspicious water to prevent human and animal illness.

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Annex 11: Natural Vegetation of Kalabsha & Garf Hussein

Soil Researches implemented under the New Land New Life Project Lake Nasser, Aswan

**Natural Vegetation of Khalabsha and Garf Hussein of Egypt**

**Research Institution:**

Research institution:	Department of Botany, Faculty of Science, Aswan, Egypt
Institution address:	Sahary, Aswan, Egypt
Institution Telephone:	097-348 22 33
Institution website:	<a href="http://www.svu.edu.eg">www.svu.edu.eg</a>
Researcher:	Dr. Mohamed Sheded
E-mail:	

**Research Data:**

Research title:	Natural Vegetation of Khalabsha and Gerf Hussein of Egypt
Research objectives:	This paper aims to report the changes in the weed flora along the shores of Lake Nasser (Khalabsha and Garf Hussein) as a result of the new land use systems, particularly those related to land reclamation.
Linkage between the research and project research questions	Changes in environmental conditions result in a continuous change of the native plant cover. Due to the rapid growth of the Egyptian human populations, more and more land being cultivated during the last few decades, some native plants that were once common are now rare or almost extinct due to impact of human, and several exotic species are now stabilized and almost naturalized.
Research approach:	The shores of Lake Nasser at Gerf Hussein and Kalabsha were surveyed for weeds and natural vegetation during the four seasons during September 2009 to July 2010. Voucher specimens were prepared for each species and deposited at Botany Department, Faculty of Science at Aswan (ASW). Nomenclature is according to Tackholm (1974), and the scientific names are updated following Boulos (1995, 1999, 2000, 2002, 2005, 2009) Floristic categories (FC) are from Zohary (1966, 1972), Feinbrun-Dothan (1978, 1986).
Resources used:	
Date of implementation:	September 2009 to July 2010
Duration and frequency of	The whole four seasons from September 2009 to July 2010

implementation:	
Results:	<p>The list of the species at Shores of Lake Nasser at Khalabsha and Gerf Hussein including 110 species belonging to 89 genera and 35 families. 36 species are monocotyledonous and 74 are dicotyledonous. These species represent about 23.5% of the total weeds of Egypt. The largest families in the present study are Graminae (27 species, 25%). Leguminosae (10 species, 9.1%). Composite (10 species, 9.1%). As for the entire Egyptian flora (Hassib, 1951), therophytes (66 annuals) are the most common life form in the present study (66 species 60%). 13 of the sampled trees are ornamentals and 32 species are crops and vegetables.</p>

## Natural Vegetation of Khalabsha and Gerf Hussein of Egypt

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By: M. Sheded

Botany Department, Faculty of Science At Aswan, South Valley University

### Abstract

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110 wild species have been recorded as a result of the new land use systems along the shores of Lake Nasser (Khalabsha and Garf Hussein). These species were possibly introduced with reclamation of the lands. Long term study to follow the development of the weed populations recently introduced into the region is recommended

### Introduction

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Changes in environmental conditions result in a continuous change of the native plant cover. Some native plants that were once common are now rare or almost extinct due to impact of human, and several exotic species are now stabilized and almost naturalized.

Due to the rapid growth of the Egyptian human populations, more and more land was cultivated, during the last few decades.

This paper, reports the changes in the weed flora along the shores of Lake Nasser (Khalabsha and Garf Hussein) as a result of the new land use systems, particularly those related to land reclamation. In this area, December and January are the coldest and wettest months of the year and July and August are the hottest and driest.

### Methods and Materials

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The shores of Lake Nasser at Gerf Hussein and Kalabsha were surveyed for weeds and natural vegetation during the four seasons during September 2009 to July 2010. Voucher specimens were prepared for each species and deposited at Botany Department, Faculty of Science at Aswan (ASW). Nomenclature is according to Tackholm (1974), and the scientific names are updated following Boulos (1995, 1999, 2000, 2002, 2005, 2009) Floristic categories (FC) are from Zohary (1966, 1972), Feinbrun-Dothan (1978, 1986).

### Results and discussion

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The list of the species at Shores of Lake Nasser at Khalabsha and Gerf Hussein including 110 species belonging to 89 genera and 35 families. 36 species are monocotyledonous and 74 are dicotyledonous. These species represent about 23.5% of the total weeds of Egypt (El-Hadidi and Fayed (1994/1995:v). The largest families in the present study are Graminae (27 species, 25%). Leguminosae (10 species, 9.1%). Composite (10 species, 9.1%). Chenopodiaceae, Polygonaceae, Amaranthaceae, Cruciferae, Zygophyllaceae, Euphorbiaceae and Cyperaceae, each of them has 4 species, 3.6%). As for the entire Egyptian flora (Hassib, 1951), therophytes (66 annuals) are the most common life form in the present study (66 species 60%).

20 of the recorded species 18.2% are Pantropical, 10 are Cosmopolitan (9,1%) and 27 are Palaeotropical (24.5 %). 19 species belonging to Sudano-Zambeian - Saharo-Sindian (17.2%). Fewer species belonging to the other floristic categories Mediterranean, Irano-Turanian, Saharo sindian elements.

*Ambrosia maritime*, *Citrullus colocynthis*, *Heliotropium supinum*, *Glinus lotoides*, *Astragalus eremophilus*, *Tribulus pentandrus*, *Calotropis procera*, *Leptadenia pyrotechnica*, *Ammi majus*, *Pulicaria undulata*, *Hyoscyamus muticus*, *Lawsonia inermis*, *Hibiscus sabdiffera* are medicinal plants but for example *Sorghum* sp., *Echinochloa colona*, *Digitaria sanguinalis*, *Dihanthium annulatum*, *Sacchari spontenium*, *Trigonella hamosa*, *Sesbania sesban*, *Cajanus cajan*, *Vigna* sp., *Melilotus indicus*, *Astragalus vogelii* and *Cynodon dactylon* are grazing plants. Other plants used as timber as *Acacia raddiana*, *Tamarix nilotica*. Other as fruit Plants as *Hyphaene thebica*, *Ziziphus spini christi* and *Phoenix dactylifera*.

We recorded 13 trees as ornamentals for example *Ficus* sp., *Casuarina* sp., *Eucalyptus* sp., *Salix* sp., *Acacia farnesiana*, *Dalbergia sisso*, *Dodonea viscosa*, *Leucaena gluaca*, *Khaya senegalensis*, *Morus* sp. and *Melia azedarch*. Also we recorded 8 fruit trees for example; *Mangifera indica*, *Psidium guava*, *Ficus carica*, *Punica grantium*, *Vitis vinifera*, *Optunia ficus indica* and *Citrus* sp.

Also we recorded 32 species as crops and vegetables for example: *Hordium* sp., *Allium cepa*, *Allium sativum*, *Citrullus vulgaris*, *Zea mays*, *Triticum vulgare*, *Vicia faba*, *Solanum lycopersicum*, *Hibiscus esculentum*, *Mentha sativa*, *Anethum graveolens*, *Coriandrum sativum*, *Sesamum indicum*, *Helianthus annuus*, *Cucurbita pepo*, *Ipomea batatas*, *Raphanus sativus*, *Solanum tuberosum*, *Capsicum annum*, *Capsicum frutescens*, *Solanum melango*, *Lactuca sativa*, *Gossypium* sp., *Eruca sativa*, *Vigna sinensis*, *Lupinus termis*, *Medicago sativa*, *Trifolium alexandrum*, and *Saccharium officinarum*.

Annex 12: Insects Carrying Vector-Borne Diseases in Lake Nasser Area and Their Impacts on Climate Change

Researches implemented under the New Land New Life Project Lake Nasser, Aswan

Water Non-Vertebrates Insects Carrying Vector-Borne Diseases in Lake Nasser Area and Their Impacts on Climate Change

Research Institution:

<b>Research institution:</b>	Aswan Faculty of Science, South Valley University
<b>Institution address:</b>	Sahary, Aswan, Egypt
<b>Institution Telephone:</b>	097-348 22 33
<b>Institution website:</b>	<a href="http://www.svu.edu.eg">www.svu.edu.eg</a>
<b>Researcher:</b>	Prof.Dr. Hoda Mostafa Abdel Wahab
<b>E-mail:</b>	

Research Info:

<b>Research title:</b>	Non-Vertebrates Insects Carrying Vector-Borne Diseases in Lake Nasser Area and Their Impacts on Climate Change
<b>Research objectives:</b>	<ul style="list-style-type: none"> <li>- Conduct a survey regarding the dynamics of the insects seasonal activities in Lake Nasser area;</li> <li>- Gathering data related to insects carrying vector-borne diseases in the area</li> </ul>
<b>Linkage between the research and project research questions</b>	The project results will cover the questions 1 and 2
<b>Research approach:</b>	<ol style="list-style-type: none"> <li>1-Select a suitable area where insects are abundant;</li> <li>2-Take samples of different insects;</li> <li>3-Study the type of insects; and</li> <li>4-Assess the type of diseases these insects can carry and transfer to humans;</li> </ol>
<b>Resources to be used:</b>	
<b>Date of implementation:</b>	Early summer 2009 – Spring 2010
<b>Duration and frequency of</b>	1 year (May 2009 – April 2010) every month

<b>implementation:</b>	
<b>Results:</b>	<ul style="list-style-type: none"><li>-There is a significant presence of mosquito and dragonfly in Lake Nasser area;</li><li>-There is a significant presence of Exuvia of pupae(big and small ones) in the area (50/ml of water)especially during winter (October &amp; November 2009);</li><li>-Presence of Larvae, small mosquitoes, and backswimmer bug, especially during summer;</li><li>-The volume of water in Lake Nasser decreases during summer where plants appear in the middle of the Lake.</li></ul>

Annex 13: Ideal Crop Composition in the Area West of Lake Nasser

Researches implemented under the New Land New Life Project Lake Nasser, Aswan

**Ideal Crop Composition in the Area West of Lake Nasser**

**Research Institution:**

<b>Research institution:</b>	Desert Research center
<b>Institution address:</b>	1 Materia Museum st., Materia, Cairo,Egypt
<b>Institution Telephone:</b>	02-26335519, 02-26332846, 02-26330759, 02-26435171
<b>Institution website:</b>	www.drc.org
<b>Researcher:</b>	Dr. Mohamed Fathy
<b>E-mail:</b>	

**Research Info:**

<b>Research title:</b>	Ideal Crop Composition in the Area West of Lake Nasser
<b>Research objectives:</b>	<ul style="list-style-type: none"> <li>- Conducting a survey regarding the different type of crops that are suitable to be cultivated in Lake Nasser area;</li> <li>- Studying the dynamics of the ideal seasonal crops in Lake Nasser area; and</li> <li>- Gathering data related to ideal crops composition to be cultivated in the area</li> </ul>
<b>Linkage between the research and project research questions</b>	The project results will cover the questions 1, 2 and 3
<b>Research approach:</b>	1-Select a suitable land area; 2-Plant samples for different crops; 3-Study the type of crops regarding the agricultural seasonality; and 4-Assess the ideal type of crops to be cultivated in the area under climate change conditions.
<b>Resources to be used:</b>	<ul style="list-style-type: none"> <li>- Land</li> <li>- grains</li> </ul>
<b>Date of implementation:</b>	2009 – 2010
<b>Duration and frequency of implementation:</b>	2 years (2009 –2010) every agricultural season (winter and summer)
<b>Results:</b>	-During the summer season (1 <sup>st</sup> year), the crops to be cultivated are Alfalfa “bersim” and lobby fodder and during the second year, soya

	<p>beans are the best crop to be cultivated;</p> <ul style="list-style-type: none"><li>- During the winter season (1<sup>st</sup> year), the crop to be cultivated is Alfalfa “bersim” and during the second year, beet is the best crop to be cultivated;</li><li>-Crop Composition 1 for Animal husbandry: Fodder Crops (60%); Field Crops (10%); Oil Crops (10%); Vegetable Crops (10%) and Fruit Crops (10%).</li><li>-Crop Composition 2 for Export: Medicinal Plants (30%); Oil Crops (30%); Vegetables (20%); and Fruits (20%).</li><li>-Crop Composition 3 for Agricultural Industry: Oil Crops (25%); Fruit trees (20%); Vegetables (20%); Fiber Crops (20%) and Medicinal Plants (15%).</li></ul>
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## Brief on the Study

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As the study has included several aspects, a multi- aspects approach was used in analyzing the earth materials, such as the type of the soil; physical and chemical characteristics and fertilization degree of it. The Topography and climate of the study area has been analyzed, as the study area has a special nature in which high temperatures reaches 15° C in winter and 40 ° C in summer, while the solar radiation exceeds 800 calorie/ hour. Moreover, the soil of the study area is too poor from its nutritive elements and its ability of saving water is too weak, as the saturation degree doesn't exceed 38%, with a low PH number ranges from neutral to weak alkaline.

The study also used the results of the socio-economic study carried out with the residents of the area. This socio-economic study has occurred through interviews were held with the farmers and officials of developing the social and economic sectors in the governorate.

The most irrigation method used was the flood irrigation, and there are no problems in terms of salty or drainage water because the irrigation methods depend on the governmental project.

It was noted that the characteristics of the crop pattern in the study area are different from those normal crop patterns in other regions. The agriculture area has a special nature in terms of the prevailing climate in the region as well as the topography of the area and the quality of the cultivated soil, in contrary to other regions in Egypt.



Annex 14: The Effects of Different Agricultural Seasons and Sprinkling Dry Active Yeast on the Growth of Vegetables, Dates, Nigela Sativa and Coriander

Researches implemented under the New Land New Life Project Lake Nasser, Aswan

**The Effects of Different Agricultural Seasons and Sprinkling Dry Active Yeast on the Growth of Vegetables, Dates, Nigela Sativa & Coriander**

**Research Institution:**

<b>Research institution:</b>	Horticulture Research Institute, Agriculture Research Center
<b>Institution address:</b>	9,Gamma St, Giza,Egypt
<b>Institution Telephone:</b>	33572060
<b>Institution website:</b>	WWW. ARC.Sci.eg
<b>Researcher:</b>	Dr. Shadia Qotb Ahmed
<b>E-mail:</b>	

**Research Info:**

<b>Research title:</b>	The Effects of the Different Agricultural Seasons and Sprinkling Dry Active Yeast on the Growth of Vegetables, Dates, Nigela Sativa & Coriander
<b>Research objectives:</b>	<ul style="list-style-type: none"> <li>- Reach the ideal timing for agricultural crops under the climate change conditions; and</li> <li>- Increase in the production of crops.</li> </ul>
<b>Linkage between the research and project research questions</b>	The project results will cover the questions 1 and 2
<b>Research approach:</b>	1-Select a suitable land area; 2-Plant samples for different crops; and 3-Study the type of crops regarding the agricultural seasonality and sprinkling.
<b>Resources to be used:</b>	<ul style="list-style-type: none"> <li>- Land</li> <li>- Grains/plants</li> <li>- Dry active yeast</li> </ul>
<b>Date of implementation:</b>	17 October 2009; 17 November 2009; 17 December 2009
<b>Duration and frequency of implementation:</b>	3 months – 3 times and sprinkling every 15 days
<b>Results:</b>	-Regarding the Nigela Sativa and the coriander: the height of each

	<p>plant sprinkled and the number of its branches is superior than the plants that were not sprinkled by dry active yeast;</p> <p>-The average productivity of each feddan is higher while sprinkled with dry active yeast and the highest productivity is witnessed in October.</p>
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Annex 15: Bacterial, Physiological, Fungal & Viral Infections in some Crops in the Area of West Lake Nasser under Climate Change

Researches implemented under the New Land New Life Project Lake Nasser, Aswan

**Bacterial, Physiological, Fungal & Viral Infections in some Crops in the Area West of Lake Nasser under Climate Change**

**Research Institution:**

<b>Research institution:</b>	Botany Research Institute, Agriculture Research Institute
<b>Institution address:</b>	9,Gamma St, Giza,Egypt
<b>Institution Telephone:</b>	33572060
<b>Institution website:</b>	WWW. ARC.Sci.eg
<b>Researcher:</b>	Dr. Ehab El Far
<b>E-mail:</b>	

**Research Info:**

<b>Research title:</b>	Bacterial, Physiological, Fungal & Viral Infections in some Crops in the Area West of Lake Nasser under Climate Change
<b>Research objectives:</b>	<ul style="list-style-type: none"> <li>- Assess the potential impacts of climate change on diseases affecting crops;</li> <li>- Study the negative impacts caused by crops holding bacterial, fungal, physiological and viral infections on human health;</li> <li>- Raise the awareness of farmers regarding these type of diseases and safe ways to control the spreading of the infections to multiple crops;</li> <li>- Decrease in the use of pesticides and directing the farmers to safer alternatives.</li> </ul>
<b>Linkage between the research and project research questions</b>	The project results will cover the questions 1 and 3
<b>Research approach:</b>	1-Select a suitable land area; 2-Plant samples for different crops studied
<b>Resources to be used:</b>	
<b>Date of implementation:</b>	2009 – 2010
<b>Duration and frequency of</b>	2009-2010

<b>implementation:</b>	
<b>Results:</b>	<ul style="list-style-type: none"><li>-Regarding tomatoes, they witness a 30% rate of infection.</li><li>-Regarding potatoes, they witness an approximate 25% rate of infection (varying from 60% to 10% according to the type of potatoes).</li><li>-Regarding green pepper, eggplant, cucumber and eggplant, they witness a “Blank Farinae” infection and viral infections.</li><li>-Regarding strawberries, they witness a 10% rate of infection mainly due to “Blank Farinae”.</li></ul>

Annex 16: Medical Health Care & the Relation between Humans, Animals and the Environment

Researches implemented under the New Land New Life Project Lake Nasser, Aswan

**Medical Health Care & the Relation between Humans, Animals and the Environment**

**Research Institution:**

<b>Research institution:</b>	Vaccines and Veterinary Vaccines Research Institute
<b>Institution address:</b>	9,Gamma St, Giza,Egypt
<b>Institution Telephone:</b>	33572060
<b>Institution website:</b>	WWW. ARC.Sci.eg
<b>Researcher:</b>	Prof. Dr. Essam Amin Nasr
<b>E-mail:</b>	

**Research Info:**

<b>Research title:</b>	Medical Health Care & the Relation between Humans, Animals and the Environment
<b>Research objectives:</b>	<ul style="list-style-type: none"> <li>- Conduct a survey regarding livestock diseases in the area and especially the venereal diseases;</li> <li>- Draw a map on the different livestock diseases present in the area;</li> <li>- Cure some diseases such as skin diseases and vaccinate livestock;</li> <li>- Raise the awareness of the population in Lake Nasser regarding the spread of diseases and vaccinations through different programs; and</li> <li>- Conduct medical seminars to raise the awareness of farmers regarding the common diseases between humans, livestock and the environment.</li> </ul>
<b>Linkage between the research and project research questions</b>	The project results will cover the questions 1, 2, 3, 4 and 5
<b>Research approach:</b>	<ul style="list-style-type: none"> <li>-Conducted awareness raising seminars;</li> <li>-Conducted veterinary and medical convoys.</li> </ul>
<b>Resources to be used:</b>	

<b>Date of implementation:</b>	2009
<b>Duration and frequency of implementation:</b>	2009
<b>Results:</b>	<ul style="list-style-type: none"> <li>- The survey showed a high percentage of venereal diseases in cows specifically in the area; a high percentage of anemia in the population related to mal-nutrition and under-nutrition; a low rate of awareness regarding the livestock diseases;</li> <li>- Seven (7) medical convoys were conducted;</li> <li>- 3,000 free vaccinations were given to newborns, children and the rest of the population (BCG, etc.)</li> <li>- 2,000 free vaccinations were given to livestock and especially regarding parasites;</li> <li>- 50 livestock cases suffering from venereal diseases cured; and</li> <li>- Conducted 10 awareness campaigns regarding common diseases between humans, livestock and environment (cholera, RVF, Tuberculosis, etc.).</li> </ul>

## Annex 17: Media Content

The role of the media is important in educating and raising the awareness of the community regarding general ecological and environmental problems as well as specific issues related to climate change and global warming. Some local news papers tackled the issue with a focus on the New Life New Land project in a concise and thorough manner. As follows, some examples of articles published on Egyptian news papers:

Al Ahram News paper – 25<sup>th</sup> of April 2010 -

**بحضور اعضاء المجالس الشعبية بأسوان**

## خطط التغلب على التغير المناخي في بحيرة السد العالي

بعد مرور عامين على الظواهر المختلفة للتغيير المناخي في منطقة بحيرة السد العالي وتحت شعار «أرض جديدة وحياة جديدة» تقام ندوة بحثية عن خطط وسبل التغلب على الظواهر المختلفة للتغير المناخي في البحيرة تحت رعاية اللواء مصطفى السيد محافظ أسوان، وبالتعاون مع هيئة تنمية بحيرة السد العالي وجامعة جنوب الوادي ومركز البحوث الزراعية ويحضر أعضاء مجلس محلي محافظة أسوان الندوة التي تعقد الاربعاء المقبل بأسوان. ويقول المهندس أحمد فاروق

مدير مشروع التغيير المناخي بمؤسسة ومركز خدمات التنمية ان الندوة سوف تستعرض نتائج بحوث التغيير المناخي على الصحة والمياه والنباتات والأراضي وعرض البدائل، الكيفية التي يمكن التعامل معها خاصة مع ارتفاع درجات الحرارة مصحوبا بالتغير في الموارد المائية المتاحة لتجنب المخاطر البيئية والصحية والزراعية والسلوكية المحتملة في المستقبل.

**موفق أبو النيل**



**أحمد فاروق**

## .. ومسؤول في «البحوث الزراعية»: مصر لا تملك خطة لمواجهة تأثير التغير المناخي على النيل.. والاحتمالات «كارثية»



جانب من المؤتمر

مصر نهائياً. وقال قطب إن مصر من أكثر الدول تأثراً بظاهرة التغير المناخي وأصبحت تواجه في الفترة الأخيرة موجات حارة تليها موجات باردة، مما ترتب عليه انخفاض في الإنتاجية الزراعية، وبيات المزارع في حاجة إلى أجهزة وخبرة مزرعية لمواجهة هذه التغيرات.

على البحار بدلاً من الأنهار وبالتالي ستفقد مصر من ٧٠٪ إلى ٨٠٪ من حصتها المائية. ووصف قطب كلا الاحتمالين بأنه كارثة، موضحاً أن زيادة حصة مصر من المياه بنسبة ٣٠٪ أمر يفوق قدرة تحمل السد العالي، أما فقدان ٧٠٪ إلى ٨٠٪ من المياه فيعني القضاء على الزراعة في

كتبت - شيماء عادل، قال الدكتور مسعد قطب، مدير المعمل المركزي للمناخ الزراعي بمركز البحوث الزراعية، إن مصر لا تملك «سيناريو» خاصاً بها للتعامل مع تأثير التغير المناخي والارتفاع المتزايد في درجات حرارة الأرض على مواردها المائية خاصة حصتها من مياه النيل.

وأكد خلال مؤتمر مشروع التغير المناخي وأثره على الصحة والمياه، الذي نظّمته مؤسسة الشرق الأدنى ومركز خدمات التنمية، أمس، أن السيناريوهات العلمية المطروحة حتى الآن «متضاربة»، فبعضها يعتبر ارتفاع درجة الحرارة في مصلحة مصر حيث سيزيد من نسبة البخر التي ستتحول بدورها إلى أمطار تسقط على منابع النيل لتزيد حصة مصر من المياه بنسبة ٣٠٪، بينما تشير توقعات أخرى إلى أن ارتفاع درجات الحرارة سيحدث خللاً في تساقط الأمطار التي ربما توطل

## دراسة أثر التغير المناخي على بحيرة السد العالي



أعضاء الورشة في زيارة صوتيات الزراعة النظيفة في البحيرة

الإرشاد الزراعي بوزارة الزراعة، واستعرض د. إبراهيم الأنشطة المنقذة في البحيرة من زراعة وصيد أسماك وتعددين وخضوعها لحاثير البيئة واشتراطاتها بكل حزم باعتبار أن بحيرة السد العالي هي الخزان المائي لمصر كلها. وانتهت ورشة العمل التي ادارتها الدكتورة سامية عبدالعزيز بجامعة قناة السويس إلى وضع خطة عمل مدتها عامان يمولها مركز البحوث للتنمية الدولية بكتندا، وتتضمن الخطة الاهتمام بكل التخصصات البحثية التي تخدم البيئة وتحسين دور كل الشركاء ودعم المزارعين وتدريبهم على اليات الزراعة البيئية النظيفة، باعتبار أن البحيرة هي أمل مصر في الزراعة النظيفة واستخدام التدريب والإرشاد في رفع مهارات المزارعين وتدريبهم على التعامل مع اليات السوق وتنظيم قوافل طبية وبيطرية ترصد التغير المناخي وتأثيراته المختلفة على البيئة.

موفق أبو النيل

من أجل إيجاد استراتيجيات للتكيف اتجاه التغير المناخي في بحيرة السد العالي والخروج بخطة عمل تطبيقية تساهم فيها الجهات البحثية نظم مركز خدمات التنمية بالتعاون مع هيئة تنمية بحيرة السد العالي وورشة عمل ياسوان استمرت يومين افتتحها د. علاء الدين صابر المدير الاقليمي لمؤسسة الشرق الأدنى بمصر ود. إبراهيم موسى رئيس هيئة تنمية بحيرة السد العالي، وشاركت فيها ٧ مراكز بحثية تابعة لوزارة الزراعة وقرع جامعة جنوب الوادي ياسوان ومديرية الصحة وبسببشنفي اسوان التعليمي وبيطرية الزراعة والطب البيطري وجهاز شؤون البيئة ياسوان.

وتضمنت ورشة العمل زيارات ميدانية للمواقع التي تجرى فيها دراسة المشروع في مناطق كلايشنه وجوف حسين ببحيرة السد العالي، وتتناول الدراسة تأثير الحرارة على البيئة وانعكاس ذلك على صحة الانسان والحيوان والمياه وقاد الزيارات الميدانية الدكتور مصطفى الجارحي رئيس قطاع



## التغير المناخي.. وبحيرة السد العالي

لقد كان شعار يوم البيئة العالمي لعام ٢٠٠٩ «الوعي» حيثما كانت المجتمعات تتخذ خطوات نحو التغيير المناخي، وذلك لتحقيق العمل على مواجهة التغير المناخي الذي يواجهه هذا الجيل وهو تحدي تغير المناخ وما يعرف بالاحتباس الحراري، وقد أصبحت قضية التغير المناخي تحظى بالاهتمام العالمي، مما يتطلب من الحكومات العمل على معالجة هذه القضية من خلال اتخاذ خطوات لتقليل انبعاثات الغازات الدفيئة التي تسبب تغير المناخ.

الهدف من هذا التقرير هو زيادة الوعي بالمشكلة التي تواجهها المجتمعات والوصول إلى مجتمع متعلم ومتحمس يساهم في الحد من تغير المناخ والتكيف معه. وهذا التقرير هو جزء من سلسلة من التقارير التي تصدرها منظمة «البيئة» بالتعاون مع وزارة البيئة المصرية، وذلك من خلال تنفيذ الأنشطة التي يتم تنفيذها وتبنيها في إطار استراتيجية الوزارة في الحد من تغير المناخ والتكيف معه. وهذا التقرير هو جزء من سلسلة من التقارير التي تصدرها منظمة «البيئة» بالتعاون مع وزارة البيئة المصرية، وذلك من خلال تنفيذ الأنشطة التي يتم تنفيذها وتبنيها في إطار استراتيجية الوزارة في الحد من تغير المناخ والتكيف معه.



د. محمد مغربي

يتمتع هذا التقرير بخصائص مميزة تجعله أداة تعليمية فعالة في مجال التغير المناخي، وذلك من خلال توفير معلومات دقيقة وعملية يمكن استخدامها في اتخاذ القرارات المتعلقة بالتغير المناخي. وهذا التقرير هو جزء من سلسلة من التقارير التي تصدرها منظمة «البيئة» بالتعاون مع وزارة البيئة المصرية، وذلك من خلال تنفيذ الأنشطة التي يتم تنفيذها وتبنيها في إطار استراتيجية الوزارة في الحد من تغير المناخ والتكيف معه.

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سازت مع نخبة من خبراء من وزارة البيئة المصرية، وذلك من خلال توفير معلومات دقيقة وعملية يمكن استخدامها في اتخاذ القرارات المتعلقة بالتغير المناخي. وهذا التقرير هو جزء من سلسلة من التقارير التي تصدرها منظمة «البيئة» بالتعاون مع وزارة البيئة المصرية، وذلك من خلال تنفيذ الأنشطة التي يتم تنفيذها وتبنيها في إطار استراتيجية الوزارة في الحد من تغير المناخ والتكيف معه.

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Al Ahram News paper – 27th of April 2010 -

## مؤتمر التغيرات المناخية بمداينة أسوان

تحت عنوان سبل التغلب علي الظواهر المختلفة للتغيرات المناخية في منطقة بحيرة ناصر تعقد مدينة أسوان اليوم ندوة بحثية تحت رعاية الدكتور مصطفى السيد محافظ أسوان بالتعاون مع مؤسسة الشرق الأدنى ومركز خدمات التنمية وهيئة تنمية بحيرة السد العالي وجامعة جنوب الوادي ومركز البحوث الزراعية. يحضر الندوة نخبة من المتخصصين من الجامعات والمؤسسات البحثية والأجهزة التنفيذية للدولة ويناقش المؤتمر شعار أرض جديدة وحياة جديدة.

ويعرض المؤتمر نتائج بحوث التغير المناخي علي الصحة والمياه والنباتات والأراضي ووضع البدائل الكيفية التي يمكن التعامل معها عند ارتفاع درجات الحرارة المصحوبة بالتغير في الموارد المائية المتاحة لتجنب المخاطر البيئية والصحية والزراعية والسلوكية المحتملة في المستقبل.

## خطط بحثية لتجنب مخاطر التغيرات المناخية بأسوان

أسوان - منال الغمري:  
أطلق السيد مصطفى السيد أحمد محافظ أسوان شعار «أرض جديدة وحياة جديدة» عند عرض أول خطة للتكيف والتأقلم المناخي على مستوى الجمهورية في أسوان، في ندوة علمية تنظمها مؤسسة الشرق الأدنى ومركز خدمات التنمية التعاونية مع هيئة تنمية بحيرة السد العالي وجامعة جنوب الوادي ومركز البحوث الزراعية في إطار مشروع التغير المناخي ببخيرة ناصر - أسوان بتمويل من مركز البحوث للتنمية الدولية - كندا.

وستعرض بالندوة نتائج المشروعات والأبحاث الخاصة بالتغير المناخي ومخاطرها على الصحة والمياه والنباتات والأراضي وكيفية التعامل مع ارتفاع درجات الحرارة المصحوب بالتغير في الموارد المائية المتاحة وتجنب المخاطر المستقبلية.

## دراسة أثر التغير المناخي على بحيرة السد العالى



أعضاء الورشة فى زيارة صوبات الزراعة النظيفة فى البحيرة

الارشاد الزراعى بوزارة الزراعة، واستعرض د. ابراهيم الأنشطة المنفذة فى البحيرة من زراعة وصيد اسماك وتعددين وخضوعها لمحاذير البيئة واشتراطاتها بكل حزم باعتبار ان بحيرة السد العالى هى الخزان المائى لمصر كلها.

وانتهت ورشة العمل التى ادارتها الدكتورة سامية عبدالعزيز بجامعة قناة السويس إلى وضع خطة عمل مدتها عامان يمولها مركز البحوث للتنمية الدولية بكندا، وتتضمن الخطة الاهتمام بكل التخصصات البحثية التى تخدم البيئة وتحديد دور كل الشركاء ودعم المزارعين وتدريبهم على آليات الزراعة البيئية النظيفة، باعتبار ان البحيرة هى أمل مصر فى الزراعة النظيفة واستخدام التدريب والارشاد فى رفع مهارات المزارعين وتدريبهم على التعامل مع آليات السوق وتنظيم قوافل طبية وبيطرية ترصد التغير المناخي وتأثيراته المختلفة على البيئة.

### موفق أبو النيل

من أجل إيجاد استراتيجيات للتكيف اتجاه التغير المناخي فى بحيرة السد العالى والخروج بخطة عمل تطبيقية تسهم فيها الجهات البحثية نظم مركز خدمات التنمية بالتعاون مع هيئة تنمية بحيرة السد العالى ورشة عمل بأسوان استمرت يومين افتتحها د. علاء الدين صابر المدير الاقليمي لمؤسسة الشرق الادنى بمصر ود. ابراهيم موسى رئيس هيئة تنمية بحيرة السد العالى، وشاركت فيها 7 مراكز بحثية تابعة لوزارة الزراعة وفرع جامعة جنوب الوادى بأسوان ومديرية الصحة ومستشفى اسوان التعليمى ومديرية الزراعة والطب البيطرى وجهاز شئون البيئة بأسوان.

وتضمنت ورشة العمل زيارات ميدانية للمواقع التى تجرى فيها دراسة المشروع فى مناطق كلابشه وجرف حسين ببخيرة السد العالى، وتتناول الدراسة تأثير الحرارة على البيئة وانعكاس ذلك على صحة الانسان والحيوان والمياه وقاد الزيارات الميدانية الدكتور مصطفى الجارحى رئيس قطاع

# خريطة للأراضي الأكثر تأثراً بالمناخ في مصر!



لأول مرة في مصر تناهت إلى اسماعنا أخبار وفاة بعض المواطنين بسبب الانخفاض أو الارتفاع الشديد والمفاجيء في درجات الحرارة، فالتغير المناخي في مصر أصبح له تأثيرات سلبية وأضرار ليس فقط في مجال الزراعة، وهلاك المحاصيل وتدهورها وإنما مخاطر جسيمة على الموارد المائية وحياة الإنسان، ولخطورة المشكلة طالبت مصر الأمم المتحدة بتوفير الدعم لمواجهة التغير المناخي من أجل تنفيذ تدابير التأقلم مع نتائج التغيرات المناخية الواقعة على المناخ المصري.

المحاصيل الزراعية تصاب بأضرار سلبية نتيجة الارتفاع المفاجيء في درجات الحرارة

ويؤكد الدكتور سمير أن هناك تغيراً مناخياً وان الاحترار العالمي والاحتراز يعني ارتفاع درجة الحر تدريجياً على مستوى العالم وما يحدث من تد مناخى هو نتاج الاحتراز الحرارى، ولخطورة المن ركزت محطات الارصاد على منطقة بعينها الا و مصر وإثيوبيا فى الدراسات العلمية فى الوقت ال قام العالم المصرى عطية طنطاوى بدراسة وجد فيها أن المدن المسد الحاطة بالصحراء مثل اسوان زادت درجة الحرارة فيها درجة والمدن التى وسط الزراعات مثل القاهرة والاسكندرية زادت درج واحدة.

## تحقيق منال الغمري

وترجع الدكتورة سامية عبد العزيز (مدرس بجامعة قناة السويس وشورة وضع الاستراتيجية للتاقلم بداية بأسوان لأسباب أهمها بحيرة ناصر تحتمى على المزون الرئيسي للمياه لكل انحاء مة فتصل سعتها إلى نحو ١٦٥ مليار متر مكعب وهو يمثل ثلاثة أضعاف حصص مصر من المياه طبقاً لاتفاقية حوض النيل، ومع تزايد أعد السكان وتبنى الحكومة المصرية سياسة قومية لتوطين الناس فى واد النيل المكثف بالسكان.

ومن أجل ذلك قامت مؤسسة الشرق الأدنى من خدمات التنمية بعمل مشروع التغير المناخي وأل على المياه والصحة بالتعاون مع جميع القطاعا المعنية ووضعت استراتيجية لقطاع الصحة ولقط الزراعة وذلك لتجنب المخاطر الصحية وتوفير الوساء والأدوات اللازمة للوقاية من الأمراض المنقولة طريق الماء.

### مقاعب المنتفعين

على الطبيعة داخل قرى المشروع «كلايشة وبشا، الخير وجرف حسين» تقابلنا مع المزارع حريى حمد رئيس جمعية المجتمع إذ يقول كنا من المزارعين الذو يطلق عليهم تحت الصفر فلما ملك قوت يومنا ولك منذ نصح أربع سنوات وبالتحديد عقب زيارة الرئيس حسنى مبارك لقرية كلايشة وبشاشي الخير وجرة حسين تم توظيفنا واستلكتنا الأرض من خلال مشروع العون الغذاء واصبح لكل مزارع خمسة الفدنة واستقرينا نح أسرتنا وأطفالنا حينه قام المشروع ببناء قرى ثابتة فبعد ما كانت الزراعة شاطئية اصبحه دائمة بعيدة عن منسوب الفرق وتم تركيب شبكات رى حديثة غالف الثمن وتم التعاقد مع شركات كبرى وجاء مشروع المؤسسة وأغد إعادة بالغه بمعلومات كثيرة عن تنوع المحاصيل وطرق الرى وغيره ولكن بنقصنا الكثير، وتواجهنا العديد من المشاكل الناتجة من طبعه المكان الذى يبعد عن اسوان بنحو ١٥٥ كم تقريبا

ويستكمل السباعى زيدان عبد الحميد مزارع من سوهاج ومستوطن فى قرية بشائر الخير انه من المنتفعين من مشروع العون الغذاء وكذلك مشروع التغير المناخي ولكن كيف يكون هناك رعاية صحب ويتواجد الطبيب والأدوية والأصمالي فى ظل عدم وجود الكهرباء فى القرية التى تصل حرارة الجو بها ٥٠ درجة فالكثير، فحين نحيط فى ظلام داسم ونستخدم المولدات الكهربائية التى تعمل بالسولار لتنفسيها لعدد ساعات قليلة تعد على اصابع اليد الواحدة مقابل ٣٥ جنيهها تسدد لهيئة تنمية السد العالى، ونحن نطالب المسئولين بتوصيل الكهرباء للقرى الثلاث كلايشة وبشائر الخير وجرف حسين حتى نتمكن من الاستمرار فى هذه القرى.

وهنا نتساءل: هل بالفعل أصبح التغير المناخي فى مصر له تأثير سلبي ومدمر للصحة على الأرض؟ وما المخاطر التى يتعرض لها صحة الإنسان والحيوان والموارد المائية والزراعية؟ وكيف يتم التداعلات البيئية والسلوكية لتخفيف من هذه المخاطر والوقاية من الأمراض التى تهدد صحة الإنسان؟ وهل يمكن تحديد أنواع المحاصيل الزراعية الأكثر ملاءمة للمناخ فى الحاضر والمستقبل من حيث مقاومة درجات الحرارة واستهلاك كميات أقل من المياه؟ يقول المهندس أحمد فاروق مدير مشروع التغير المناخي بمؤسسة الشرق الأدنى مركز خدمات التنمية إن المؤسسة قامت بعمل مشروع التغير المناخي وعلاقته بالمياه والصحة بالتعاون مع تنمية بحيرة السد العالى واتخذت من منطقة غرب بحيرة ناصر بأسوان مكانا لتنفيذ المشروع بتحويل من مركز البحوث للتنمية الدولية منذ عام ٢٠٠٨ وحتى الآن كاستعداد لمشروع سابق عام ٢٠٠٤، وقد وقع الاختيار على ثلاث قرى هى كلايشة وبشائر الخير وجرف حسين وهما غرب بحيرة السد العالى بأسوان.

ويعتبر هذا المشروع - كما يقول - أحد مشروعات البحوث التطبيقية والتنموية الرائدة فى مصر التى تسعى إلى الوصول لأساليب التكيف مع التغيرات المناخية المتوقعة فى المستقبل.

### الهدف.. والتكيف

يضيف مدير عام المشروع أن الهدف الاساسى من المشروع هو دراسة العلاقة بين التغيرات المناخية وإدارة المياه والصحة وزراعة المحاصيل الزراعية لصالح المواطنين الذين يعيشون فى المجتمعات الجديدة بالمناطق المحيطة بحيرة السد العالى للوصول إلى سياسة تنفيذية مطلة ومسئولة فيما يتعلق بالمجتمعات الجديدة على المستوى القومى.

كما أن هناك أهدافا مرحلية للمشروع منها تقييم ومعرفة الآثار السلبية المحتملة للتغيرات المناخية على صحة الإنسان خاصة فيما يتعلق بالأمراض التى تصيبه عن طريق الماء، وكذلك الأمراض المنقولة عن طريق ناقلات الأمراض، وتبنى اساليب تكنولوجية حديثة للزراعة لتكوين أكثر كفاءة واستدامة سواء فى الرى والتنوع المحصولى وإدارة الأرض لرفع كفاءتها وزيادة إنتاجها فى مجتمعات التوطين الجديدة للوصول إلى نتائج بيئية وصحية إيجابية.

### موقع.. واحترار

يرى المهندس علاء صابر مدير مؤسسة الشرق الأدنى أنه لتحقيق الهدف لمشروع التغير المناخي وأثره على المياه والصحة فى تطوير استراتيجيات التكيف والوقاية والتاقلم كان لابد من تنظيم ورش عمل مجتمعية بالمشاركة للفئات المستهدفة مثل جميع القطاعات وصانعي القرار والأفراد لتحقيق التعاون والتنسيق والشراكة والتكامل بين كل هذه المشروعات التنموية والبحثية المنفذة فى بحيرة ناصر ومشاركة المعلومات والمعرفة الناتجة من هذه المشروعات واستخدامها والاستفادة منها ونشرها بين كل الفئات.

ويخبر سمير شير رئيس اللجنة الوطنية المصرية فى برنامج الإنسان المحيط الصحوى بمنطقة اليونسكو ورئيس قسم الموارد الطبيعية بمعهد لبحوث والدراسات الأفريقية من خطورة التغير المناخي فى مصر العالم كله.

## المنتفعون بقرى مشروع

## التغير المناخي يحتاجون

## لرعاية الصحية والكهرباء

## ووسائل المواصلات

## Annex 18: Other Development Projects

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### **Other Development Projects**

It is a good sign that NEF is not the only goodwill actor in the area. It shows that there are other actors who felt that the area is unique in its physical as well as social features. Other actors include:

1. HCI, local partner of the Center for Development Services<sup>8</sup>

HCI's team distributed meat packages to the poorest households in the marginalized new desert settlements of Kalabsha El-Jedida, Bashayer el-Kheir, New Tomas and 'Afia village located west of Lake Nasser. In order to guarantee a proper exposure to the HCI, banners, stickers and bags with the HCI logo where printed to be used on the day of distribution, so that people from the villages would recognize that the event was an HCI initiative. HCI's local partner, the Center for Development Services, contributed additional parcels bearing the logos of HCI and its partners that were distributed to additional families.

2. The University of Köln

The University of Köln<sup>9</sup> is implementing a project on "Water Supply and Waste Water Treatment" deals with the concept and implementation of water supply and waste water disposal systems in the settlements. The basic idea of this working field is the construction of two pilot plants, one for drinking water supply and another one for waste water disposal. Those plants shall be constructed in Kalabsha village in order to see their performance under hyper arid climate conditions and the given environment in order to give potential recommendations for future constructions.

- Concept for Pilot Slow Sand Filtration in Kalabsha

The area of the Slow Sand Filtration is planned to be about 9 m<sup>2</sup>. As the filtration rate is about 1 m<sup>3</sup> per 1 m<sup>2</sup> and day, the production of filtered water will be about 9 m<sup>3</sup> per day. The location should be close to the new constructing compact unit near Kalabsha. As water will be transported through channels into a new reservoir it could be used to load the Slow Sand Filtration. The filtration consists of sand with a homogeneous particle size of about 1mm. In order to have repeating results, the pilot plant is divided into two subunits, parallel working. These subunits can also be filled with different homogeneous materials in order to test the optimal filter process according to the local conditions. Fig. 1 shows the plan of the Slow Sand Filtration with the two subunits. After the filtration process the water is stored on small tanks to take water samples for chemical and bacteriological analyses. Afterwards, the water will be transferred back to the reservoir.

- Concept for Pilot Drinking Water Distribution in Kalabsha

The semi-central water distribution in Kalabsha limits the water consumption to 20-30 litres per capita and day. GLEICK recommends a total basic water requirement by minimum 50 litres (including drinking water, sanitation services, bathing, cooking and kitchen). Higher water consumption can be achieved by

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<sup>8</sup> [hcime.org/wordpress/index.php/category/egypt/](http://hcime.org/wordpress/index.php/category/egypt/)

<sup>9</sup> [www.tt.fh-koeln.de/owara/Templates/wf1specifi..](http://www.tt.fh-koeln.de/owara/Templates/wf1specifi..)

decentralised water supply into the houses. Therefore, it is planned to connect 10 houses with direct water supply. Fig. 2 shows the planned water supply system. Water from an elevated tank (like the already existing tanks) will be transported in a pipe system to ten houses. Those houses will get access to the water in two basins, one in the bathroom and another one in the kitchen. The water consumption will be measured by water meters in order to see the real consumption by every single household.

- Concept for a Pilot Constructed Wetland in Kalabsha

The waste water treatment consists of two parts: First a Sedimentation Tank for the pre-treatment of the waste water and afterwards the Constructed Wetland. The Sedimentation Tank has a size of 16 m<sup>2</sup> and consists of a 4 chamber system. A pump will transport the water from the Sedimentation Tank to the Constructed Wetland. After the treatment of the waste water it will be stored in an extra tank and from there the water can be used for irrigation within the village, for example trees and shrubs along the roads.

- Concept for a Pilot Sewer System

To collect the waste water from the single houses and to transport it to the Sedimentation Tank a sewage line is needed. From the existing inspection rooms water will be no more transported to the existing cesspools but to a new sewer line. This sewer line will transport the waste water to the new Sedimentation Tank due to gravity.

The results of another study about crop profitability by the University of Cologne team<sup>10</sup> showed that profitable crops with good water productivity are the perennial ones – especially strawberries. However, these results should be taken only as a first draft since many of them were obtained for secondary source and not directly for the region.

In the first scenario, i.e. with subsidies all crops –excepting anise – it is profitable, meaning that the farmers receive a minimum income due to their agricultural activities. In the second scenario, many cereal and vegetables generate losses due to their low revenue and their high water consumption. Therefore, if subsidies are cut off, farmers should carefully select the crops that they cultivate.

The cultivation of perennial crops is a problem in the first years since the yield is related with the age of the tree. However, expecting that in the next year subsidies will be available for farmers, they can profit for this situation and plant trees on one part of the field and the rest with traditional crops<sup>11</sup>. Then, in a few years they will be prepared to face the total costs of agriculture.

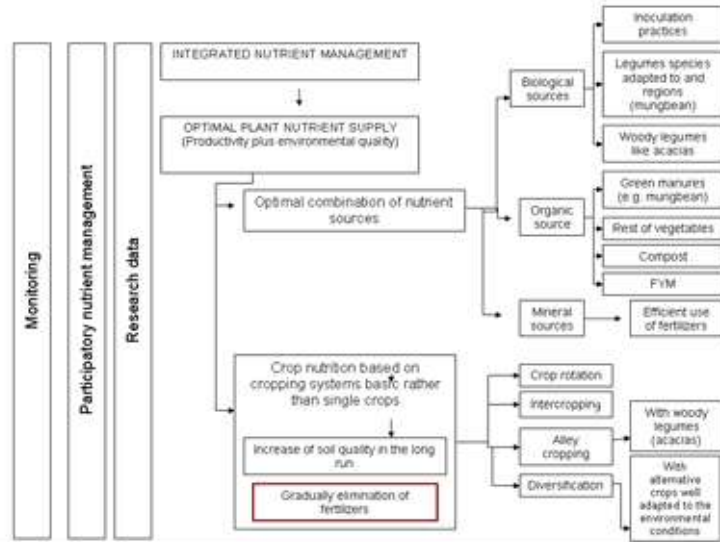
According to LNBP, the demand of fruits is not satisfied in Aswan, so fruits like strawberries would be a good option, to generate more profit and use water efficiently. However, the social acceptance for these crops needs to be assessed.

All the aspects discussed in this study are summarized in following Figures. It is expected that this analysis inspires other projects to study in detail some of the subjects discussed.

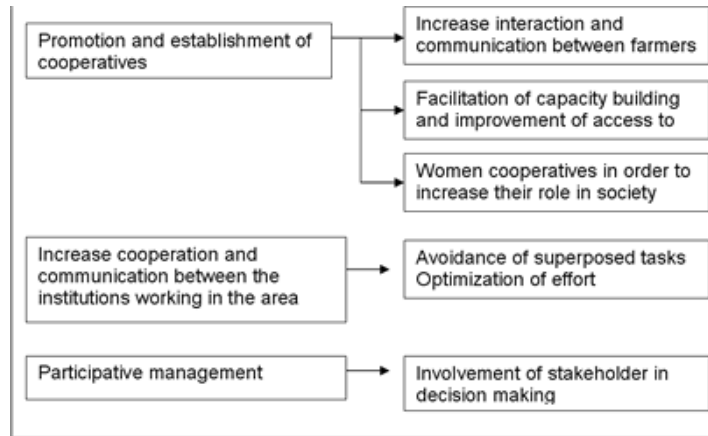
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<sup>10</sup> [http://www.tt.fh-koeln.de/semesterprojects\\_extern/egypt\\_08/09.results.agriculture.htm](http://www.tt.fh-koeln.de/semesterprojects_extern/egypt_08/09.results.agriculture.htm)

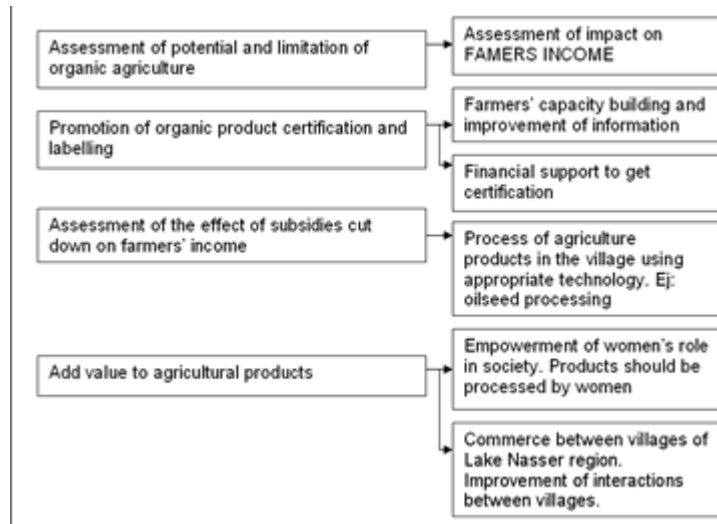
<sup>11</sup> Agro-Forestry.



Summary of different tools and recommendations (bigger figure)



Institutional aspects that should be take in consideration (bigger figure)



Economic aspects to consider (bigger figure)

### 3. Energy Supplies: The PV generator vs. solar

Qoaidar L. and Steinbrecht D. (2010)<sup>12</sup> investigated the economic feasibility of photovoltaic technology to supply the entire energy demands to off-grid irrigated-farming-based communities in the arid regions. The case study was performed in the New Kalabsha Village in the Lake Nasser Region (LNR) in southern Egypt. The work involved the technical design and the calculation of the life cycle costs (LCC) of a PV system, which is able to supply the village with its entire energy demand. The PV generator was sized in such a way to daily pump 111 000 m<sup>3</sup> of lake water to irrigate 1260 ha acreage plots and to electrify the adjacent village's households. Water from the four pumping stations flows freely by gravity forces to the different plots through overhead open canals. The electricity generation costs and the performance of the designed PV generator were compared with those of an equivalent diesel generator (genset) in order to test its competitiveness. The market value of the diesel fuel of 86.55 c€ l<sup>-1</sup> was considered for calculating the costs of genset generated electricity. The results showed that the genset electricity unit costs 39 c€ kW h<sup>-1</sup> while a unit of PV electricity costs only 13 c€ kW h<sup>-1</sup> for the equivalent system size and project lifetime. Furthermore, the subsidized genset electricity cost was calculated to be 12 c€ kW h<sup>-1</sup>, which is insignificantly cheaper than that of solar electricity.

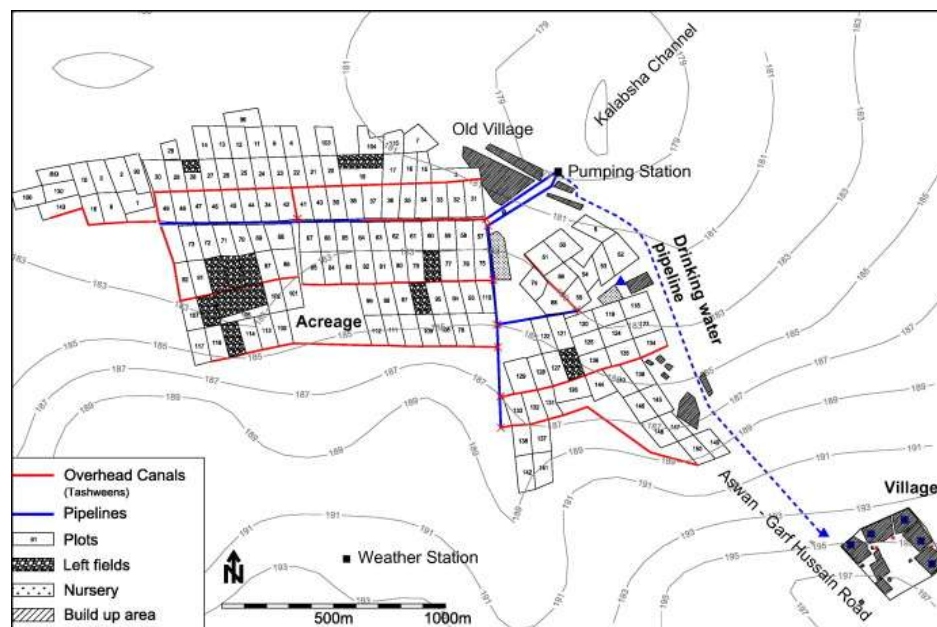


Fig. – Map of villages and fields in New Kalabsha.

### 4. Relocation and Regional Development in Kalabsha Area<sup>13</sup>

Population pressure in the Nil Delta of Egypt and poverty problems, lead to a national strategy and a development project in the Lake Nasser region. The area will be colonized by approximately 1,5 million people within the following years. The research project aims to develop sustainable strategies for

<sup>12</sup> Qoaidar L. and Steinbrecht D. (2010) Photovoltaic systems: A cost competitive option to supply energy to off-grid agricultural communities in arid regions. *Applied Energy* 87: 427-435.

<sup>13</sup> [www.tt.fh-koeln.de/.../reg\\_plan/nubia.htm](http://www.tt.fh-koeln.de/.../reg_plan/nubia.htm)



economic areas and settlements. For the identification of the most sustainable energy supply system for Kalabsha an integrated comparative assessment of different available system technologies was conducted. This assessment considered all three dimensions of sustainability, the ecological, the socio-economic, and the economical dimension, and leads to the selection of the PV/Wind hybrid system as most suitable solution<sup>14</sup>.

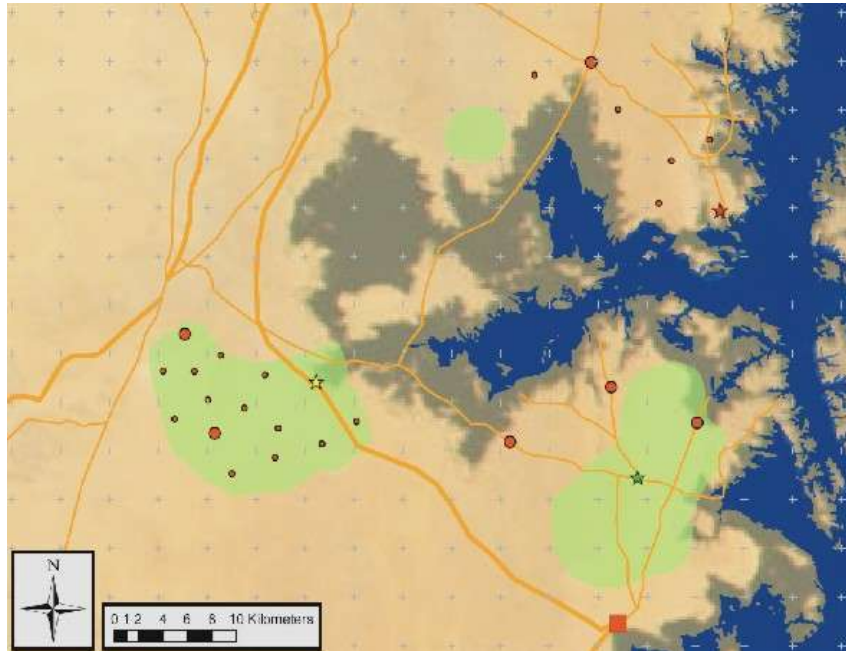


Fig. - Regional Planning - Kalabsha - Cluster Relation Structure

Considering all location factors, including climate, topology, etc, the University of Köln team came to the conclusion that a sustainable development of Kalabsha is best reached with a 3 cluster system.

#### 5. UNDP and Aswan Governorate<sup>15</sup>

In 2003 and 2004, the "Institute for Technology and Resources Management in the Tropics and Subtropics" has carried out a study of the status quo and the potentials for "Integrated Water Resources Management IWRM " in the Lake Nasser region. As a result of this study, in April 2007, the research activities of the BMBF-supported project." Optimizing Water Allocation in Rural Areas of Lake Nasser-Upper Egypt" were initialized. The Project is carried out in cooperation with the regional developing authority LNDA (=AHDLA) and the University of Aswan, the "South Valley University".

<sup>14</sup> [http://www.tt.fh-koeln.de/semesterprojects\\_extern/egypt\\_08/09.results.energy.htm](http://www.tt.fh-koeln.de/semesterprojects_extern/egypt_08/09.results.energy.htm)

<sup>15</sup> Source: Louy Qoaidar : <http://www.tt.fh-koeln.de/owara/Templates/01home.htm>