Food and Agriculture Organization of the United Nations

AgWA
Partnership for agricultural water for Africa

COMESA

National Investment Profile

Water for Agriculture and Energy

Egypt

EXECUTIVE SUMMARY

This analysis has been conducted within the TCP/INT/3404 "Support to the pre- and post-CAADP compact process for improved agricultural water management" project that covers four countries in Africa: Egypt, Malawi, the Sudan, and Swaziland. The project aims at assisting these countries to foster sustainable agricultural water management (AWM) through the effective implementation of the Comprehensive Africa Agriculture Development Programme (CAADP) compact and post-compact process, the refinement of national agricultural water development strategies and the alignment to national strategies for food security strategies and programmes.

The Egyptian economy traditionally relied on agriculture as one of the main sectors. The agricultural sector currently contributes about 13.3 percent of the total Gross Domestic Product (GDP) of Egypt (CAPMAS, 2015).

Industries related to agriculture, (e.g. processing, marketing, and supplies) account for a further 20 percent of the total GDP (CAPMAS, 2015). The agricultural sector provides formal and informal employment for about 6.70 million persons (CAPMAS, 2015) and about 8.25 million persons respectively (ILO, 2011). It furthermore accounts for 10 percent of the total national exports (CAPMAS, 2015). The majority of agricultural holdings were of small size. More than 62 percent of the agricultural output comes from agricultural holdings with less than one to three hectares under cropping. Typical farm sizes range from one to two hectares (MALR, 2014 b).

Egypt has achieved good progress in agricultural productivity, reflecting the success of horizontal expansion by the expansion of reclaimed areas and vertical expansion by improving productivity.

Egypt ranked third in terms of dietary energy supply[1] top 20 countries in 2015 reaching about 3550 kcal/cap/day and exceeding the average global calorie availability of 2870 kcal/cap/day as estimated by (FAO, 2015).

[1] The dietary energy supply (DES) is the food available for human consumption, expressed in kilocalories per person per day. At the country level, it is calculated as a measure of food available for human use after taking out all non-food utilization, including exports, industrial use, animal feed, seed, wastage and changes in stocks.

Over the past decade, Egypt has faced a series of shocks that have triggered a decline in food security and nutrition trends. Egypt is self-sufficient in rice, vegetables, fruits, dairy products, poultry, eggs and fresh milk. However, increased food supplies are needed not only to meet nutritional needs of the population, but also to enhance the food self-sufficiency and security position. According to (MOP, 2015 a), the percentage of the population below the poverty line in Egypt declined from about 24.3 percent (12.9 million out of 53.0 million) in 1990/1991 to about 19.6 percent (13.9 million out of 70.7 million) in 2004/2005. However, a recent increase of this percentage was reported to reach about 26.3 percent (22.0 million out of 83.7 million) in 2012/2013 (MOP, 2015 a).

Egypt's irrigation potential is estimated at 4.42 million hectares. The total actual renewable surface water resources are estimated at 56 km^3/year (of which 55.5 km^3/yr from the River Nile and 0.5 km^3/yr from internal renewable surface water resources). Internal renewable groundwater resources are estimated at 1.3 km^3/yr. The overlap between surface water and groundwater are considered negligible, the total actual renewable water resources of the country are thus 58.3 km^3/yr (FAO-Aquastat, 2015).

According to (EEHC, 2014), most of Egypt's economic hydropower potential has been exploited. This can be easily noticed by the declining percentage contribution of generated hydro-electricity into the total electricity generated on the national level, where the 70 percent of the generated electric energy in 1970 decreased to reach 11.3 percent in 2007 then to about 8 percent in 2014 (MOP, 2015 b). The (EEHC, 2014) estimated Egypt's technically and economically feasible hydropower potential at about 50,000 GWh/year. According to (EEHC, 2014), Egypt has eight hydropower plants in operation.

Climate change impact studies predicted a reduction in the productivity of the major crops in Egypt such as wheat, rice, maize, soybeans and barley (MSEA, 2010).

The Strategic Framework for Economic and Social Development Plan (SFESDP 2022) aims at poverty reduction (MOP, 2012). Under the framework of overall development policies and the CAADP, Egypt has prepared different policy documents and investment plans regarding agriculture and food security. The National Water Resources Plan (NWRP) (MWRI, 2005) aims at improving overall water use efficiency in agriculture, improving water allocation and distribution of Nile water, preventing or reducing emissions, and treatment of wastewater.

The SADS 2030 focuses on achieving sustainable use of agricultural natural resources, and improving agricultural productivity (MALR, 2009). Besides, the Sustainable Agricultural Development Strategy (SADS) aims to attain food security by promoting self-sufficiency in strategic food commodities, rationalizing local demand and consumption, improving consumption patterns in order to improve nutritional standards, reducing pre- and post-harvest food losses, improving food quality and safety, and improving social safety nets (MALR, 2009). Egypt has a national energy strategy that covers the diversification of the energy mix, higher energy efficiency, and a reform of the electricity, oil and natural gas markets as well as a reduction of energy subsidies. Based on (NREA, 2014), wind, hydro and solar energies contribute for about 12 percent, 4 percent and 4 percent of the total energy generated by 2020, respectively.

To translate these goals into reality, Egypt is currently implementing and planning to implement a number of irrigation and hydropower projects at an average investment costs of US$43 million and US$92 million for the on-going and pipeline projects respectively. The vast majority (91 percent) of these projects is focusing on irrigation categories whereas hydropower categories represent only 1 percent of the envelope; indicating a lack of diversity of investment in this envelope. However, the New and Renewable Energy Authority is pursuing other types of renewable projects, primarily solar and wind power, to diversify the country's energy mix. Investment in the rehabilitation and modernization of irrigation is predominant in the envelope (74 percent). The financial analysis of projects also illustrated that the investment in irrigation within this country is focused on short and medium term projects; investment in the long term is insufficient. Besides, investment is mostly executed by international donors and public funding partners. It is important to mention that Egypt enacted a new Investment Law to attract private sector investors to foster sustainability of funding.

It would be important for the country to ensure that the institutional and political environment is adequate for the success of these investments. In addition to this, it is recommended that mechanisms are put in place to encourage the participation of the public and private sectors in developing water resources and to support project formulation in the longer term.

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ABBREVIATIONS

ACIAR	Australian Centre for International Agricultural Research
AFD	French Agency for Development
AfDB	African Development Bank
ARC	Agricultural Research Centre
AusAid	Australian Agency for International Development
AWF	African Water Facility
BCM	Billion Cubic Meter
BCWUAs	Branch canal water users Associations
BMZ	German Federal Ministry for Economic Cooperation and Development
CAADP	Comprehensive Africa Agriculture Development Programme
CAPMAS	Central Agency for Public Mobilization and Statistics
CWANA	Central and West Asia and North Africa
DES	Dietary Energy Supply
EIB	European Investment Bank
GEF	Global Environment Facility
GIS	Geographic Information System
GIZ	Deutsch Gesellschaft für Internationale Zusammenarbeit
GoE	Government of Egypt
GWh	Gigawatt hour
ha	hectare (1 ha = 2.38 feddans)
HAD	High Aswan Dam
HPPEA	Hydropower Plants Execution Authority
IBRD	International Bank For Reconstruction And Development
ICARDA	International Center for Agricultural Research in the Dry Areas
IDA	World Bank Group
IDRC	International Development Research Center, Canada
IFAD	International Fund for Agricultural Development
ILO	International Labour Organization
IsDB	Islamic Development Bank
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
JSDF	Japan Social Development Fund
kcal/cap/day	kilocalories/capita/day
KFAED	Kuwait Fund for Arab Economic Development
KfW	Kreditanstalt für Wiederaufbau - KfW Development Bank
Kg	Kilogram
Km	Kilometer
Km^2	Square Kilometer
km^3	10 m^3 = 1 000 million m^3 = 1 000 million Cubic Meter
kW	Kilowatt
L.E.	Egyptian Pound

m	meter
MALR	Ministry of Agriculture and Land Reclamation
MDGs	Millennium Development Goals
mm	millimeter
MOH	Ministry of Health
MOP	Ministry of Planning
MSEA	Ministry of State for Environmental Affairs
MW	Megawatt
MWRI	Ministry of Water Resources and Irrigation
NREA	New and Renewable Energy Authority
NWRP	National Water Resources Plan
O&M	Operation and Maintenance
OFID	OPEC Fund for International Development
SADS	Sustainable Agricultural Development Strategy
SFD	Saudi Fund for Development
SFESDP	Strategic Framework for Economic and Social Development Plan
SMEs	small and microenterprises
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development

1. CONTEXT

This chapter portrays the role of the Egyptian agriculture as a source of growth and contribution to GDP, exports and employment. Besides, agricultural area, typology of agricultural holdings, land tenure, and agricultural production in Egypt will be discussed in this chapter.

Irrigation potential, total area equipped for irrigation, typology of irrigation and water control holdings, main crops cultivated and state of infrastructure are also highlighted in this chapter.

Moreover, this chapter illustrates trends in food security, undernourishment, food self-sufficiency, and food and agriculture trade in Egypt. Finally, water resources, hydropower, and expected impact of climate change on the Egyptian agriculture are highlighted in this chapter.

1.1 AGRICULTURE AND FOOD SECURITY

Agriculture

Based on the Central Agency for Public Mobilization and Statistics (CAPMAS, 2015), Egypt's GDP at constant prices increased from L.E. 838 billion in 2009/2010 to about L.E. 873 billion in 2011/2012. Agriculture is one of the largest sectors of the economy, comprising about 13.3 percent of the GDP during the period 2009-2012. Industries related to agriculture, such as processing, marketing, and supplies, account for a further 20 percent of GDP (CAPMAS, 2015).

The Egyptian economy has traditionally relied heavily on agriculture as a source of growth and support for the non-agricultural sectors of the economy. This pivotal role was re-enforced by the strong performance of the sector in the 1960s and 1970s. During the 1980s and 1990s, this dominance declined, but agriculture still accounts for a significant share of growth, exports and employment. Agriculture is thus still a key sector in the Egyptian economy.

Rural population increased from around 31.4 million inhabitants in 1993 to reach about 38.8 million inhabitants in 2003, which increased to about 48.4 million inhabitants in 2013, representing respectively 56.9, 57.1 and 57.2 percent of Egypt's total population (CAPMAS, 2015).

Currently, agriculture is the largest source of employment in rural areas, though non-farm activities are becoming increasingly important. These comprise a highly diverse range of activities: from manufacturing (usually artisan) to trading, to the provision of services of all kinds. Despite the heterogeneity, some features of rural work are common across sectors and locations.

Most rural workers are self-employed in their own farms or in very small enterprises typical for rural non-farm activities (CAPMAS, 2008). Based on research from the International Labor Organization (ILO, 2011), informal employment in Egypt reached about 8 247 000 persons in 2009 (7 percent of females and 93 percent of males) of which agricultural employment contributed to about 48.8 percent whereas, non-agricultural employment contributed to about 51.2 percent.

The agricultural sector provides formal employment for about 28 percent of the labor force and plays an important role for many people as subsistence farming (CAPMAS, 2015). In 2014, the total labor force reached around 24 million (as compared to around 16 million in 1996) of which about 19 million (80 percent) were men and about 5 million (20 percent) women; with about 7 million (around 28 percent) engaged in agriculture. Besides, about 5 million (19 percent of total labor force) of employees were men engaged in agriculture and about 2 million (9 percent of total labor force) were women engaged in agriculture in 2014 (CAPMAS, 2015).

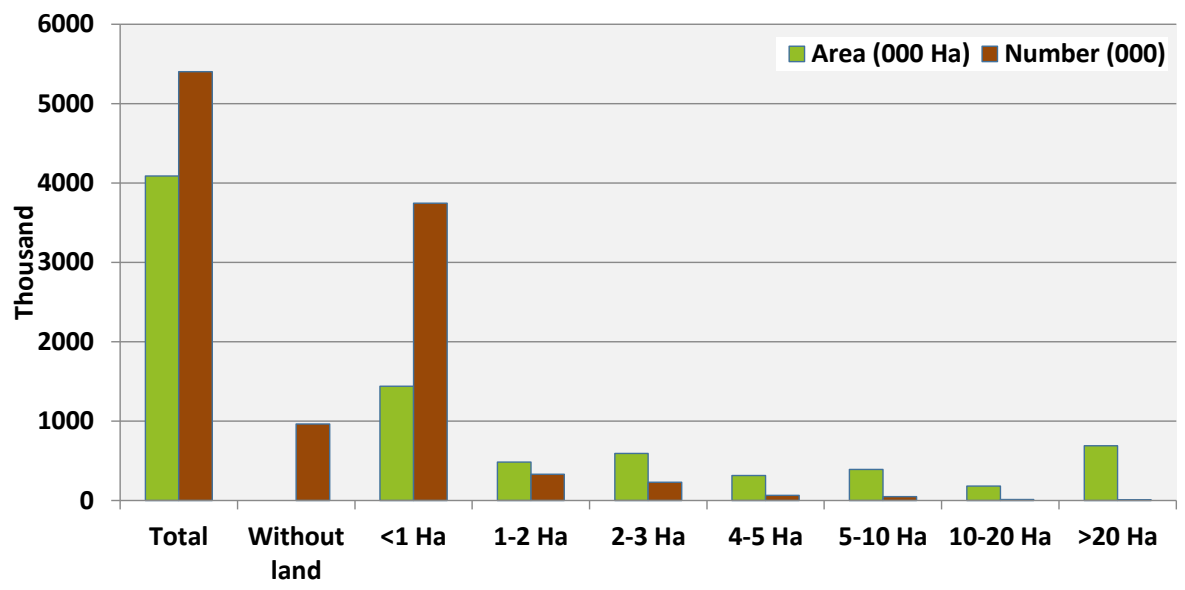
The country consists predominantly of desert, arid, and semi-arid rangelands covering a total area of about 100.15 million hectares. Majority of the cultivated area is located near the Nile banks, its main branches and canals. Egypt's inhabited area is about 3.99 million hectares, representing only 4 percent of Egypt's total area. Based on the Ministry of Agriculture and Land Reclamation (MALR, 2014 a), the total land dedicated to agriculture has increased in recent decades.

Currently, Egypt's irrigated area covers about 3.76 million hectares in 2013, as compared to about 3.69 million hectares in 2009 due to the loss of agricultural land to illegal urban encroachment. However owing to increasing cropping intensification the total cropped area increased from 4.7 million hectares in 1980 to reach about 6.51 million hectares in 2013. It is also worth mentioning that the cropping intensity indicator showed that most of Egypt's cultivated land was cropped almost twice in 2013 (more than 173 percent). This could be a result of the introduction of early maturing varieties for various crops, allowing the cultivation of the same land for up to three harvests per year (MALR, 2014 a).

Land tenure in Egypt takes three forms: i) ownership: holder and owner are the same person; ii) rent, cash or in-kind: the holder is not the same person as the owner and iii) mixed holding, where the holder is the owner of one part of the land holding and the tenant owns the other part, that it, both of them have the ownership as well as the utilization rights for one part of it but only the utilization right for its other part (FAO-Database, 2015).

Moreover, agricultural holdings fragmentation is one of the most distinguished phenomena in the agricultural sector. The results of the Agricultural Censuses for 2009/2010 (MALR, 2014 b) revealed that the majority of agricultural holdings were of small size (Figure 1). About 47 percent of agricultural holdings did not exceed two hectares while about 14.5 percent of agricultural holdings range ranging between two and three hectares (MALR, 2014 b). More than 62 percent of the agricultural output comes from agricultural holdings with less than one to three hectares under cropping. Typical farm sizes range from one to two hectares (MALR, 2014 b).

Figure 1. The Typology of Agricultural Holdings in Egypt for 2010.



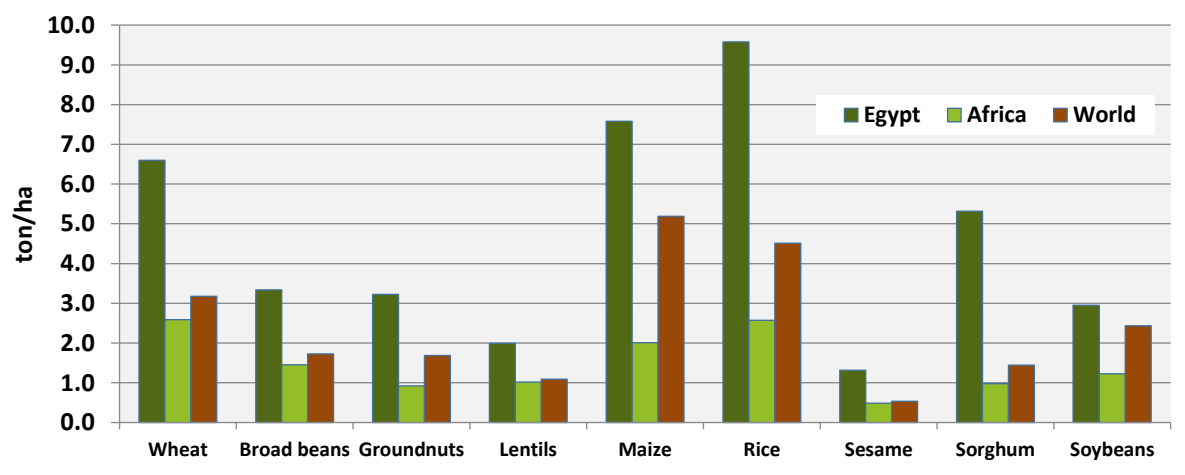
Own elaboration using (MALR, 2014 b) *data.*

Egypt has achieved good progress in agricultural productivity, particularly during the past two decades, hence reflecting the success of horizontal expansion by the expansion of reclaimed areas and vertical expansion by improving productivity. Besides, great efforts are currently being made to introduce high yielding, early maturing wheat varieties as well as high yielding maize hybrids. According to the Ministry of Agriculture and Land Reclamation (MALR, 2014 a), the average yield of wheat increased by about 29 percent from around 5.12 ton/hectare in 1991-1993 to about 6.43 ton/hectare in 2001-2003 to about 6.61 ton/hectare in 2011-2013.

Based on (ARC, 2015), a joint program for wheat improvement in Egypt (as an irrigated farming system) between the Agricultural Research Centre (ARC) and the International Center for Agricultural Research in the Dry Areas (ICARDA). The objective of this program was to develop wheat germplasm with the attributes suitable for irrigated agriculture (including high yield potential, heat tolerance, good grain quality and resistance to diseases and insect pests), and to make the germplasm freely available, in the form of international nurseries to national wheat breeding programs in the areas of concern to ICARDA, particularly Central and West Asia and North Africa (CWANA) region. Considerable progress was made in identifying superior lines with high yield potential and desired attributes for Egypt through selection of segregating populations and subsequent advanced lines under raised-bed planting. Five promising bread wheat lines were promoted for on-farm trials. In 2013/14 season, three Bread Wheat and four Durum Wheat elite lines proved superior to others. These improved genotypes of wheat have shown yield potential of more than 10 tons/hectare, which turned out to be 10-20 percent higher than the best checks (Sids 12 and Misr 1).

However, the average yields for rice, cotton, sugarcane and maize increased by about 26, 53, 10 and 26 percent, respectively during the period 1991-2013 (MALR, 2014 a). Figure 2 compares the average yields for some field crops during the period 2011-2013 in Egypt with the averages of Africa and the world.

Figure 2. Comparison of yields for some field crops among Egypt, Africa and the world in 2011-2013.



Own elaboration using (MALR, 2014 a) *and* (FAOSTAT, 2015) *data.*

Irrigation and Water Control

Based on data from the FAO (FAO-Aquastat, 2015), Egypt's irrigation potential is estimated at 4 420 000 hectares. The total area equipped for irrigation was 3 422 178 hectares in 2002; 85 percent of this area is in the Nile Valley and Delta.

Based on (FAO-Aquastat, 2015), rainwater harvesting is practiced on about 133 500 hectares in Matruh and North Sinai. All irrigation is full or partial control irrigation; surface irrigation was practiced on 3 028 853 hectares in 2000, while 171 910 hectares were under sprinkler irrigation and 221 415 hectares under localized irrigation. Surface water was the source for 83 percent of the irrigated area in 2000, while 11 percent (361 176 hectares) of the area was irrigated with groundwater in the Governorates of Matruh, Sinai and New Valley. The remaining 6 percent (217 527 hectares) was irrigated with mixed sources (FAO-Aquastat, 2015).

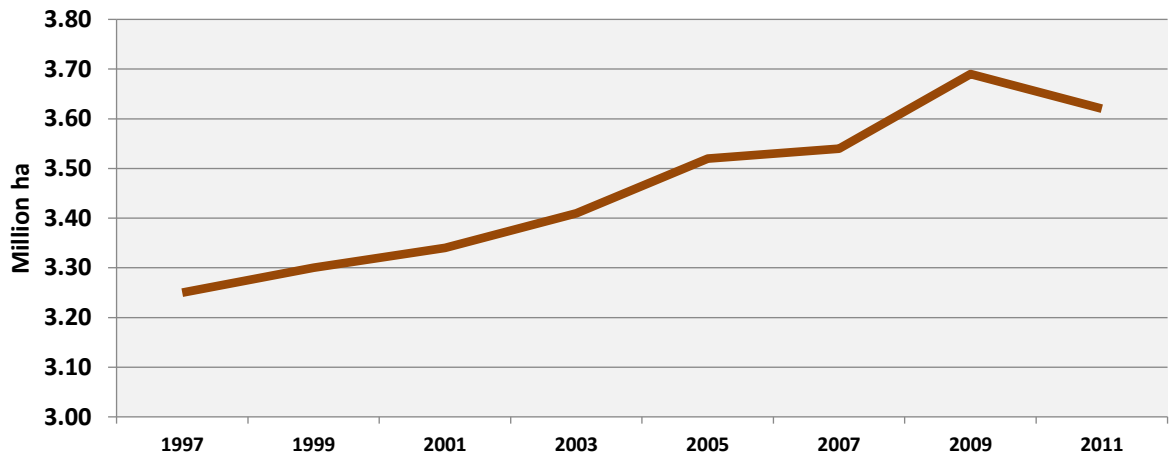
The irrigation system on the old land of the Nile Valley is a combined gravity and water lifting system. Downstream of the High Aswan Dam, there are seven barrages to facilitate abstraction. The main canal system (first level) comprises 31 200 kilometers of canals and takes its water from head regulators, located upstream of the Nile barrages (FAO-Aquastat, 2015).

According to (FAO-Aquastat, 2015), water is distributed along branches (second level) where the flow is continuous. At the third level, distributaries receive water according to a rotation schedule. Water is pumped from the distributaries to irrigate fields (lift: about 0.5-1.5 meters). The irrigation system in the new lands (reclaimed areas) is based on a cascade of pumping stations from the main canals to the fields, with a total lift of up to 50 meters. Surface irrigation is banned by law in the new reclaimed areas, which are located at the end of the systems, and are more at risk of water shortage. Farmers have to use sprinkler or drip irrigation, which are more suitable for the mostly sandy soil of those areas. If used efficiently, sprinkler and drip irrigation need less water than surface irrigation (FAO-Aquastat, 2015).

In addition to the older developments in the oasis of the New Valley, which pump water from the Nubian Sandstone aquifer, new large irrigation schemes are under development in the southwestern part of the country at Al Oweinat; in 2003 about 4 200 hectares were under cultivation and there are plans to extend the project extensively. In the Fayoum Governorate, irrigation was practiced with gravity until recently, without any water lifting system. By the year 2000, however, gravity irrigation was practiced on only 1 900 hectares, or on less than 1.2 percent of the cultivated area in Fayoum. Drainage water in the Governorate is directed by gravity into Wadi Rayan and the Qaroon Lake (FAO-Aquastat, 2015).

Water harvesting (Matruh and Northern Sinai) is possible thanks to the construction of cisterns and diversion dikes. The average rainfall in the areas is between 220 and 250 millimeters (FAO-Aquastat, 2015). Moreover, motorized pumps prevail in Egypt. The latest records for the trend in use of technology of irrigation in Egypt are illustrated in (Figure 3).

Figure 3. The trend in use of technology of irrigation (motorized pumps) in Egypt 1997-2011.



Own elaboration using (CAPMAS, 1999-2015) *data.*

There are six major field crops that cover about 60 percent of the cropped area in Egypt in 2013 namely, wheat, berseem (Egyptian clover), rice, maize, cotton and sugarcane (MALR, 2014 a).

Food security

According to (WFP, 2013), Egypt is a net food importer and heavily dependent on food imports to meet the consumption needs of the population. The recent significant depreciation in the Egyptian pound and the low level of foreign reserves has therefore put the country at risk. Besides, high population rates, increasing per capita income and urbanization, especially cereals, received an increasing number of Syrian refugees are major factors for rising food demand. Moreover, at the food supply side, Egypt is facing important challenges with diminishing agriculture potential, water scarcity, climate change, deficit on its food balance and rising imports bills. Therefore, increased food supplies are needed not only to meet nutritional needs of the population, but also to enhance the food sufficiency and security position of the nation.

Based on (MALR, 2014 c), Egypt's average global calorie availability for consumption in 2013 reached about cereals, wheat and products, maize, and rice respectively reached about 2405, 1336, 659, and 408 kcal/cap/day whereas, it reached about 398, 155, 63, 24, 72, 63, 446, 156, 46, 47, 18, and 25 kcal/cap/day for sugar, milk, potatoes, dates, vegetables, pulses, vegetable oils, fruits, red meat, poultry, eggs, and fishes, respectively.

In Egypt, the extensive social safety net include food subsidies made up of two components: (1) subsidized ration cards that allow 80 percent of Egyptian households to buy rationed amounts of set quotas of specific commodities at subsidized prices from specific outlets and (2) *baladi* bread sold at L.E. 0.05 per loaf, for which there are no entitlement restrictions and distribution takes place on a first come, first served basis (IFPRI, 2014). Therefore, Egypt achieved good results with regard to food consumption. Based on (FAO, 2015), Egypt's Dietary Energy Supply (DES) ranked third of top 20 countries in 2015 reaching about 3550 kilocalories/capita/day and exceeding the average global calorie availability of 2870 kcal/cap/day as estimated by (FAO, 2015).

Alongside growing poverty and food insecurity, stunting rates due to undernourishment among children under five have increased in the last decade (CAPMAS, 2015). The nutritional status of children under-five years of age is an important indicator of the feeding and nutrition practices in Egypt. The undernourishment is mainly characterized by three standard indices of physical growth: 1) stunting (low height-for-age); 2) wasting (low weight-for-height); and 3) underweight (low weight-for-age). In early childhood, undernourishment has negative life-long and intergenerational consequences; undernourished children are more likely to require medical care as a result of undernourishment-related diseases and deficiencies. This increases the burden on public social services and health costs incurred by the government and the affected families. Based on the Egyptian Demographic and Health Survey (EDHS) launched by the Ministry of Health in 2009 (MOH, 2009), Egypt made important progress reducing the percentage of stunted children under the age of five from 24.4 percent in 1992 to about 18.7 percent in 2000 to just over 17 percent in 2005. However, the latter percentage fell back due to increasing the prevalence of stunted children in the last few years from about 17.6 percent in 2005 to around 28.9 percent in 2008. This could be due to the increase in food and fuel prices and the avian influenza epidemic as well as existing poverty and unemployment that diminished the coping capacity of families with limited incomes. Prevalence of wasting and underweight children reached about 7.2 percent and 6.8 percent, respectively (MOP, 2015 a).

Based on (WFP, 2015), the Egyptian government has a national school feeding programme in place that aims at increasing school attendance rates, however, a large number of schools remain untargeted, especially community schools. Moreover, the World Food Programme (WFP) supports the Egyptian government's school feeding initiative to reach out to a larger number of schools through providing food incentives in community schools.

The country is on-track to achieve its long-term goal of reducing the poverty rate to 6 percent by 2022. Progress towards the Millennium Development Goals (MDGs) is significant but, due to the rapid population growth, further progresses will be essential. Based on data from the Ministry of Planning (MOP, 2015 a), the percentage of population below the poverty line in Egypt declined from about 24.3 percent in 1990/1991 to about 19.6 percent in 2004/2005. However, a recent increase of this percentage was reported from 21.6 percent in 2008/2009 to 25.2 percent in 2010/2011, then to 26.3 percent in 2012/2013 (MOP, 2015 a).

Food self sufficiency

Although Egypt has the capability to produce more than sufficient quantities of several crops such as rice, vegetables, fruits, dairy products, poultry, eggs and fresh milk; it is dependent on importing wheat, lentils, sugar, red meat, and oils.

However, increased food supplies are needed not only to meet nutritional needs of the population, but also to enhance the food sufficiency and security position of the nation.

Based on (CAPMAS, 2015), Egypt was only able to produce approximately 55.7 percent of its domestic consumption of wheat in 2012, as compared to about 54.8 percent in 2008. Egypt was also about 67.7 percent self-sufficient in maize production in 2012, as compared to about 59.3 percent in 2008.

Egypt was even less self-sufficient for faba beans and lentils with self-sufficiency rates of about 38.8 percent and 1.6 percent respectively in 2012 (CAPMAS, 2015).

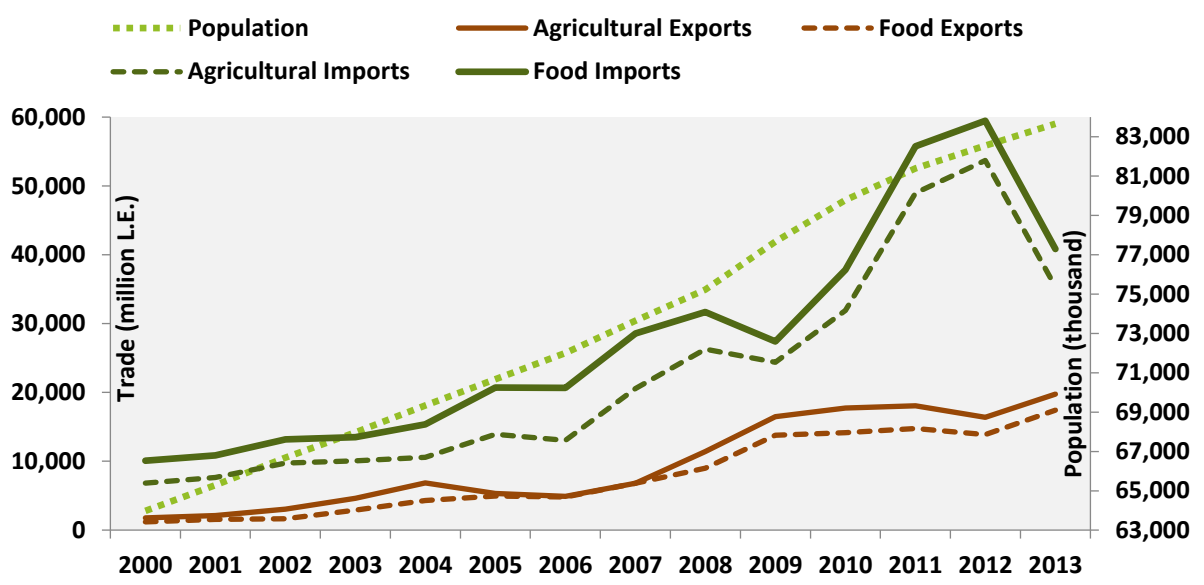
Although the contribution of the agriculture sector to the GDP has fallen over time (from 17.4 percent in 1981 to 13.3 percent), it still accounts on average for 10 percent of the total national exports in the period from 2000 till 2013 (CAPMAS, 2015). According to (CAPMAS, 2015), around 11 percent of the national imports were agricultural imports during the same period (Figure 4).

When looking at a longer time horizon, the agricultural exports increased by more than ten times from about L.E. 1.8 billion in 2000 to about L.E. 19.8 billion in 2013. However, the agricultural imports increased by more than four times from L.E. 6.8 billion in 2000 to L.E. 35.4 billion in 2013. Despite impressive gains in the production of strategic food crops, Egypt remains a food importer. Accordingly, Egypt was net food importer with a negative food trade balance of about L.E. 19.6 billion during the same period. The need to reduce the dependency on food imports and to meet the gap between consumption and production is crucial for a country with a high rate of population growth like Egypt.

Besides, trade balance deficit at the national, agricultural and food levels reached respectively L.E. 101.3, 12.7 and 19.6 billion, during the same period. The total food exports and imports are respectively 8 percent and 14 percent of the national exports (CAPMAS, 2015).

Egypt's major agricultural food imports during the period 2000–2013 were wheat, wheat flour, maize, refined sugar, meat (chilled or frozen), and dairy products. Figure 4 displays a sharp fall of agricultural and food imports in 2013 owing to the increased local production of wheat, being the main imported agricultural and food commodity in Egypt, and the big wheat carryover stocks from the 2011/2012 harvest, as well. It is also worth mentioning that 2012/2013 was a good harvest year for the local wheat following favourable weather conditions, adequate availability of improved seeds and continued Government support including higher Government procurement prices in Egypt (FAO, 2013). Moreover, figure 4 illustrates the gap between agricultural imports and exports as a result of the increasing population (CAPMAS, 2015).

Figure 4. Food and Agriculture Trade in 2000-2013



Own elaboration using (CAPMAS, 2015) *data.*

1.2 WATER RESOURCES AND HYDROPOWER

Water resources

According to (FAO-Aquastat, 2015), the Egyptian territory comprises the following river basins:

- The Northern Interior Basin, covering 520 881 km^2 or 52 percent of the total area of the country in the east and southeast of the country. A sub-basin of the Northern Interior Basin is the Qattara Depression.
- The Nile Basin, covering 326 751 km^2 (33 percent) in the central part of the country in the form of a broad north-south strip.
- The Mediterranean Coast Basin, covering 65 568 km^2 (6 percent).
- The Northeast Coast Basin, a narrow strip of 88 250 km^2 along the coast of the Red Sea (8 percent).

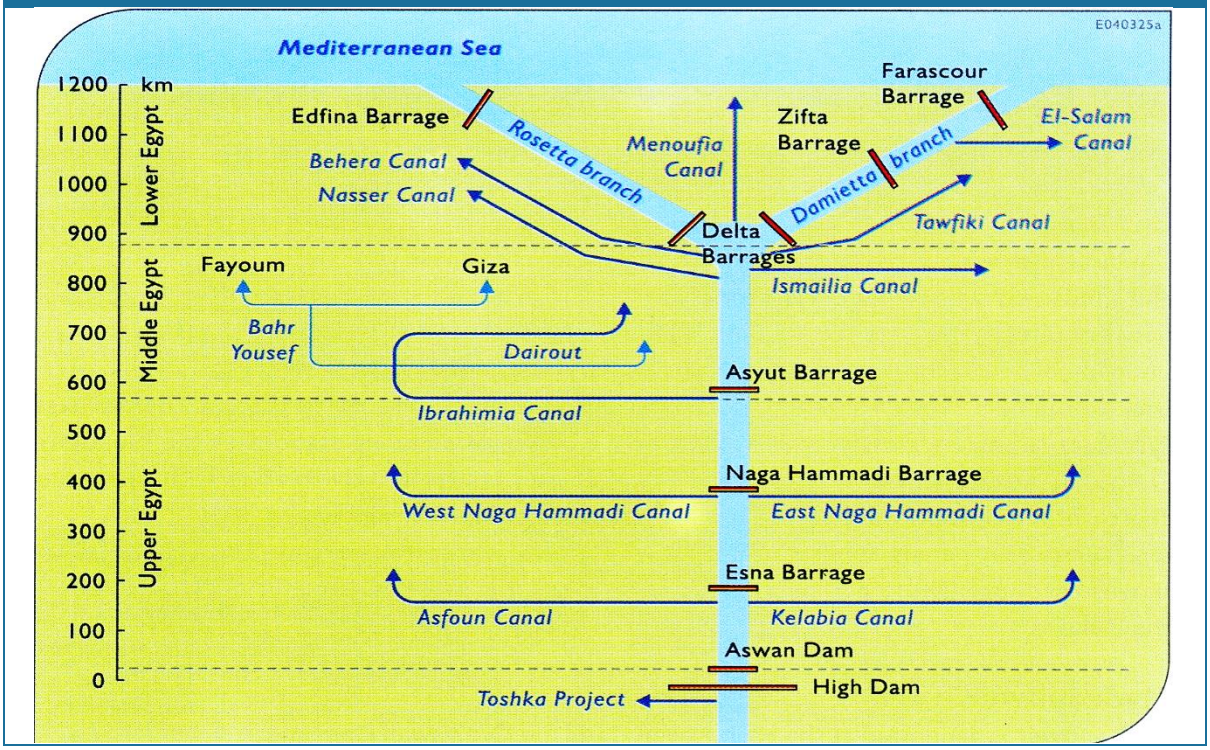
The River Nile is the main source of water for Egypt, with an annual allocated flow of 55.5 km^3/yr under the Nile Waters Agreement of 1959. Internal renewable surface water resources are estimated at 0.5 km^3/yr. This brings total actual renewable surface water resources to 56 km^3/year. Internal renewable groundwater resources are estimated at 1.3 km^3/yr. The overlap between surface water and groundwater are considered negligible, the total actual renewable water resources of the country are thus 58.3 km^3/yr (FAO-Aquastat, 2015).

The Nubian Sandstone aquifer located under the Western Desert is an important groundwater source, but only consists of fossil groundwater. The main source of internal recharge is percolation from irrigation water in the Valley and the Delta (FAO-Aquastat, 2015). All drainage water in Upper Egypt, south of Cairo, flows back into the Nile and the irrigation canals; this amount is estimated at 4 km^3/yr.

Drainage water in the Nile Delta is estimated at 14 km^3/yr. Treated municipal wastewater in 2001/2002 was estimated at 2.97 km^3/yr. There are several desalination plants on the coasts of the Red Sea and the Mediterranean to provide water for seaside resorts and hotels; total production in 2002 was estimated at 100 million m^3. The draft of the new Development and Management of Water Resources Strategy 2050 by the Ministry of Water Resources and Irrigation (MWRI, 2010) estimated the potential of non-renewable groundwater in the eastern and western deserts, mainly from the Nubian Sandstone aquifer, at 3.8 km^3/yr. Therefore, sustaining the use of this non-renewable water resource for 200 years.

Major control structures on the Nile in Egypt include the High and Old Aswan Dams, and a number of downstream barrages. The Old Aswan Dam was completed in 1902 with a storage volume of about 1 Billion Cubic Meters (BCM). By increasing the height of the dam the storage capacity was increased to 5 BCM in 1934. The High Aswan Dam (HAD), upstream of the (Old) Aswan Dam, was completed in 1964; the Lake Nasser reservoir created by this dam drastically improved the regulation of Nile water. The reservoir has a large annual carry-over capacity and is partitioned into different storage zones. Downstream of Aswan, the water levels and water distribution are controlled by a number of barrages (Figure 5). These barrages have locks to allow the passage of boats. The first barrage was the Delta Barrage at El Kanater, built as early as 1861 (MWRI, 2005).

Figure 5. Schematic diagram of major control dams and barrages on the Nile River in Egypt



(MWRI, 2005).

Hydropower

Based on the Egyptian Electricity Holding Company (EEHC, 2014), hydropower is Egypt's third-largest energy source after natural gas and petroleum. Most of Egypt's economic hydropower potential has been exploited. This can be easily noticed by the relative declining contribution of generated hydro-electricity into the total electricity generated on the national level, where the 70 percent of the generated electric energy in 1970 decreased to 11.3 percent in 2007, and subsequently to about 8 percent in 2014 (MOP, 2015 b).

The hydropower scheme in Egypt is highly dependent on the Nile. Notwithstanding the development that has already occurred in the Nile basin, only two-thirds of the generating potential of the whole river has been exploited. The (EEHC, 2014) estimated Egypt's technically and economically feasible hydropower potential at about 50,000 GWh/year. However, hydropower production depends on the flow of the River Nile, upstream requirements, and operational factors resulting from irrigation.

According to the Hydropower Plants Execution Authority (HPPEA) (EEHC, 2014), Egypt has eight hydropower plants in operation at the High Aswan Dam, the Old Aswan Dam and the Esna and Nagaa Hammadi Barrages with a total installed capacity of 2,820 MW and annual energy of 14,703 GWh. The plants' installed capacity ranges from 2,100 (12x175) MW in High Aswan Dam to 640 (2x320) kW in El Azab power plant.

The average hydro-electricity generated in 2006-2012 reached about 13466 GWh, of which the majority (94 percent) was generated at the Aswan High Dam and the Aswan Reservoir Dams across the Nile River. The share of hydro generation to the total generation represents about 8.2 percent in 2011/2012 (down from about 12.4 percent in 2007/2008) (CAPMAS, 2014).

1.3 CLIMATE CHANGE

Egypt is located in an arid region that is greatly subject to the adverse effects of climate change. The projected increase in temperature is perceived to widen the gap between water resources and demands, decrease the overall agriculture productivity, and increase the competition over the natural resources.

The effects of sea level rise on the coast of the Nile Delta would reduce the cultivated area and therefore most likely have a downward effect on the agricultural production. The vulnerability of agriculture in Egypt to climate change is mainly attributed to both biophysical and socioeconomic parameters.

Based on the Second National Communication of Egypt to the United Nations Framework Convention on Climate Change (UNFCCC) launched by the Egyptian Ministry of State for Environmental Affairs in 2010 (MSEA, 2010), climate change impact studies, based on field studies, predicted a reduction in the productivity of the major crops in Egypt e.g. wheat, rice, maize, soybeans and barley.

This reduction in crop productivity is mainly caused by the projected temperature increase, which affects the grain filling periods and has detrimental effects on sensitive development stages such as flowering, thereby reducing grain yield and quality (MSEA, 2010).

Crop-water stress is the other factor causing a productivity reduction caused by climate change. Besides, recent scientific observations conclude that the severity of some pests and disease affecting the strategic crops have increased in the last few decades. This increase in severity is mainly attributed to both climatic and socio-economic reasons (MSEA, 2010).

The impact of climate change on pests and diseases in relation to crop productivity has been studied in limited scientific trials, but not yet thoroughly at the national level under Egyptian conditions. Despite the effects of long term projected changes in temperature, agriculture in Egypt is less sensitive to climate variability, due to its reliance on irrigated agriculture systems (MSEA, 2010).

Yet, heat and cold waves can cause several harmful impacts in crop productivity, especially for fruits and vegetables. A recent study found that the intensity of the heat and cold waves increased in the past 20 years which causes more risks for growers. Moreover, projected future temperature rises under climate change conditions are likely to increase crop-water requirements thereby directly decreasing crop-water use efficiency and increasing the irrigation demands of the agriculture sector (MSEA, 2010).

The increase in the reference crop-evapotranspiration (ET_0) in Egypt is projected to augment the national reference irrigation-demands by 7-12 percent during the 2100s. Under these projected changes, the crop-water demands are projected to face significant changes that may vary according to the crop type and the cultivation season (MSEA, 2010).

The Second National Communication of Egypt to the UNFCCC (MSEA, 2010) proposes some measures to adapt and cope with climate change namely; changing sowing dates to cooler months, changing cultivars, breeding of disease-tolerant cultivars, changing crop patterns, changing management practices, monitoring system for the current and new races of plant pests and diseases, improving surface irrigation efficiency, application of deficit irrigation measures.

2 NATIONAL STRATEGIES FOR WATER, AGRICULTURE AND ENERGY

This chapter focuses on the national strategies for water, agriculture and energy. This includes Egypt's overall development agenda, poverty reduction strategy, national food security programme, etc. Agricultural policy, irrigation policy, water development policy, and energy policy are highlighted in this chapter, as well.

Overall development strategies

In 2012, the Ministry of Planning (MOP) launched Egypt's overall development agenda guided by its Strategic Framework for Economic and Social Development Plan (SFESDP 2022). The country's goals are to double the national income and achieve full employment (MOP, 2012).

The SFESDP 2022 aims at securing a decent life for all Egyptians through (i) employment and poverty reduction, (ii) establishing a state based on responsible democracy along with national participation, (iii) shifting to a new economic system that depends on advanced technologies and knowledge, (iv) establishing an industrial structure of a high value added and balanced industries, (v) achieving consistent spatial development, (vi) developing an integrated transport system and a shift to decentralization, and (vii) promoting Egypt's regional role in the Arab, African and Mediterranean regions (MOP, 2012).

Poverty reduction is one of the key objectives of the long-term development plan of Egypt. Several policies were formulated and implemented targeting vulnerable and low-income population groups. Social protection mechanisms that aim at protecting individuals and families from unemployment and poverty are an important part of this social policies package.

The National Five-Year Plan for Socio-Economic Development targeted poverty reduction and social safety provision, improving the quality of life and standard of living through expanding basic services particularly in rural areas, female participation in development, creating new job opportunities, providing soft loans for small and microenterprises (SMEs) and increasing their access to bank finance and financial leasing (MOP, 2012).

The continuing dependence on food imports is quite alarming for many policy makers in Egypt. In response, the Ministry of Agriculture and Land Reclamation (MALR) is devoting substantial efforts to attain food security. The mission of the new Strategy for Sustainable Agricultural Development towards 2030 (SADS) developed by MALR (MALR, 2009) is "modernizing Egyptian agriculture based on achieving food security and improving the livelihood of the rural inhabitants, through the efficient use of development resources, the utilization of the geopolitical and environmental advantages, and the comparative advantages of the different agro-ecological regions" (MALR, 2009). Besides, Egypt is one of the first states to establish a system for in-kind food support for improving social safety nets.

Agriculture and irrigation

Under the framework of overall development policies (mentioned above) and the Comprehensive Africa Agriculture Development Programme (CAADP), Egypt has prepared different policy documents and investment plans regarding agriculture and food security.

In 2005, the Egyptian Ministry of Water Resources and Irrigation (MWRI) launched the National Water Resources Plan (MWRI, 2005) focusing on irrigation through improving overall water use efficiency in agriculture, improving water allocation and distribution of Nile water, preventing or reducing emissions, and treatment of wastewater (MWRI, 2005). Moreover, a lack of long-term strategic investment raises the importance of longer budget-planning-horizon concerns that the country may wish to consider.

The NWRP recommends continuing the Irrigation Improvement Project and the Integrated Irrigation Improvement Project, providing Irrigation Advisory Services, using controlled drainage during the cultivation of rice, using modern irrigation techniques, improving Operation and Maintenance (O&M) activities through private participation (Water Boards and Water User Associations), reducing irrigation supply after rainfall, using new crop varieties (e.g. early mature and salt tolerant varieties), shifting the cropping patterns to less water-consuming crops, replacement and rehabilitation of existing grand barrages and control structures on the Nile and main canals, improving drainage conditions using sub-surface drainage, and reusing of drainage water. However, there is lack of investments in O&M and a need to divergence the investment portfolio targeting the rehabilitation of irrigation schemes.

Later on, in 2009, Egypt prepared its Strategy for Sustainable Agricultural Development towards 2030 (SADS). The SADS main objectives with regard to agriculture and irrigation focused on two pillars namely; (i) achieve sustainable use of agricultural natural resources, and (ii) improve agricultural productivity.

The SADS recommends improving water-use efficiency in irrigated agriculture, sustainable expansion of reclaimed areas, sustainable development of land and water productivity, using improved water harvesting techniques to maximize rain-fed water use together with supplementary irrigation from groundwater sources, maintaining and protecting agricultural land and soil conservation, cultivating newly developed varieties with resistance to drought, salinity and pests, cultivating early maturing crop varieties, increasing clover productivity, developing long-medium staple cotton varieties with high economic returns, and paying greater attention to integrated farm management and improved cultural practices (MALR, 2009).

CAADP has the main goal of eliminating hunger and reducing poverty through agriculture. To achieve this goal, African leaders' agreed to increase public investment in agriculture by a minimum of 10 percent of their national budgets and to raise agricultural productivity. The CAADP is developed around four pillars: (i) Land & water management; (ii) Market access; (iii) Food supply and hunger; and (iv) Agricultural research.

The SADS aims to attain food security by promoting self-sufficiency in strategic food commodities, rationalizing local demand and consumption, improving consumption patterns in order to improve nutritional standards, reducing pre- and post-harvest food losses, improving food quality and safety, and improving social safety nets (MALR, 2009).

The priority strategic crops for achieving food security are wheat, faba bean, lentil, oil crops, sugar crops and maize. In this concern, the focus of SADS is to increase agricultural production; establish an Egyptian food and feed safety code of practice; establish Egyptian standards for maximum residues; establish Egyptian standards for food additives, preservatives, colors and flavor- enhancers; discontinue in-kind food support and switch to a direct financial support system or financial support through food coupons; and develop a media campaign to promote the proposed policy, and clarify its relevance and impact on the poor and low-income groups (MALR, 2009).

Water resources

Three main pillars within the policy of the MWRI focusing on water resources are: (i) development of additional water resources and cooperation with the Nile Basin Riparian countries; (ii) making better use of the existing water resources and increasing water use efficiency; and (iii) protection of water quality and the environment (MWRI, 2005).

This national plan of the MWRI describes how Egypt will safeguard its water resources. This plan tries to achieve the national objectives by developing new water resources, improving the efficiency of the present use and to protect environment and health by preventing pollution and by treatment and control of polluted water.

Many of these activities are carried out in cooperation with other ministries such as the Ministry of Agriculture and Land Reclamation, the Ministry of Housing, Utilities and New Communities, the Ministry of Health and Population and the Ministry of Environment (MWRI, 2005). The actions and measures to develop additional resources depend on continuing the co-operation with the riparian countries in the Nile Basin and investigate the possibilities to increase the supply of Nile water, deep groundwater development in the Western Desert, study the development potential of brackish groundwater for aquaculture and agriculture and increase management of shallow groundwater of the Nile aquifer, stimulating small-scale rainfall harvesting along the Mediterranean coast as well as carrying out feasibility studies on flash flood harvesting in Sinai in combination with flood protection, and increasing brackish/salt water desalination in line with demands (MWRI, 2005).

Energy and hydropower

Egypt has a national energy strategy focusing on the diversification of the energy mix, higher energy efficiency, and a reform of the electricity, oil and natural gas markets as well as a reduction of energy subsidies.

The renewable energy strategy is a fundamental part of the national energy strategy. In February 2008, Egypt's Supreme Council of Energy announced an ambitious plan within the framework of actions and efforts to implement the Egyptian Renewable Energy Strategy to generate 20 percent of the total energy generated in Egypt from renewable sources by 2020.

Besides based on the New and Renewable Energy Authority (NREA), wind, hydro and solar energies contribute for about 12 percent, 4 percent and 4 percent of the total energy generated, respectively by 2020 (NREA, 2014). This ambitious goal is expected to be achieved through two distinct project development approaches, one third will be implemented through public investments by the NREA in cooperation with different international financing institutions and the remaining two thirds by the private investments through three phases.

Phase one focuses on applying competitive bids approach through issuing tenders internationally requesting the private sector to supply power from wind energy projects. The second phase is concerned with applying feed-in-tariff system taking into consideration the prices achieved in phase one. Finally, in the third phase investors are allowed to build and operate renewable energy power plants to satisfy their electricity needs or to sell electricity to other consumers though the national grid (NREA, 2014).

Based on the “Strategic Framework for Economic and Social Development to year 2022” (SFESD), the energy policy, strategy and programmes in Egypt focus on two main pillars namely; the variation of power sources and expanding the use of renewable power, and the rational use of energy (MOP, 2012).

According to the Egyptian Electricity Holding Company (EEHC, 2014), the contribution of generated hydro-electricity to the total electricity generated in Egypt is estimated to be less than 3.5 percent by 2030 and based on the National Socio-economic Development Plan for 2015/2016 launched in 2015 by the Ministry of Planning (MOP, 2015 b), this contribution is estimated to be about 2.5 percent in 2015/2016.

The HPPEA and EEHC are coordinating in planning, preparation of feasibility studies, and the execution of New Assiut Barrage Hydro power plant with a total installed capacity of 32 MW and expected to be commissioned by the year 2017 (EEHC, 2014). According to (EEHC, 2014), it is planned to construct eleven small hydropower plants to be located at Rayah Tawfiki, Edfina, Assiut Regulator, Gamgara, Rayah Abbasi, Rayah Beheri, Bagouria Canal, West Nagaa Hammadi, Bahr Mouais, Sharkawia Canal, and Rayah Nassery. However, there is lack of investments in O&M and a need to divergence the investment portfolio targeting the rehabilitation of hydropower plants.

3 INVESTMENT ENVELOPE

The **investment envelope** is a matrix that presents current and planned investment in the development of water resources for agriculture and hydropower production in a given country.

The investment envelope is produced through the application of AgWA's **Financial Diagnostic Tool**. This tool processes project-based information to derive the investment estimates at country level. The fundamental project information to plug in the tool is: project description, project characteristics, funding partners, time-scale, total cost and type of project. The Financial Diagnostic Tool also incorporates a number of variables such as the project cost distribution over time and the relevance of the water component as a percentage of the total cost in order to develop a detailed analysis of investment. A currency conversion application (annual average and projection of growth of foreign exchange rates using exponential regression) is built in this model to present the output in a single currency.

Project types included in the tool are the following:

1. Small scale irrigation development[2]
2. Rehabilitation/modernization of irrigation
3. Large scale irrigation development
4. Small/medium scale hydropower development
5. Rehabilitation of hydropower plants
6. Large scale hydropower development
7. Others (drinking water supply, etc.)

This tool also supports conducting **complementary financial analyses** such as investment by type of project, investment by source of funding, investment by timespan of the project, hectares to develop or rehabilitate by crop, etc. These complementary financial analyses are presented in Figures 6 to 16.

The investment envelope (Table 2) presents investment estimates according to the project characteristics mentioned above and distributed over three time scales: short-term (less than 4 years), medium-term (between 4 and 8 years), and long-term (more than 8 years)[3].

Description of project portfolio

In the case of Egypt, the investment envelope has been calculated based on 36 on-going projects and 41 pipeline projects. These projects are presented in Annex 1 (table 1.1 for on-going projects and 1.2 for pipeline projects). The on-going projects range from a cost of about US$31 400 to a maximum of US$350 million (Table 1). The investment costs of pipeline projects range between a minimum of US$100 000 and a maximum of US$696 million. The average investment costs of on-going projects and pipeline projects are respectively US$43 million and US$92 million.

Table 1. Summary statistics of the Projects Portfolio

	On-going	Pipeline
Number of Projects	36	41
Min (million US$)	0,0314	0,1
Max (million US$)	350	696
Average (million US$)	43	92

A closer look at the distribution of costs among on-going projects (Figure 6) shows that five projects involve an investment of more than US$100 million. Eight projects (22 percent of on-going projects) cost between US$100 million and US$10 million; the remaining 64 percent requires an investment cost between US$8,367 million and US$31 400. It can be observed from Figure 6 that the distribution of investment cost per project is positively skewed, few projects such as the 'Management of water and salinity in the Nile Delta: A cross-scale integrated analysis of efficiency and equity issues' project (US$350 million) and the 'Integrated Irrigation Improvement and Management Project (IIIMP)' project (US$303 million) cover the major part of the investment envelope.

Figure 7 displays the distribution of investment costs of the 41 pipeline projects that will be implemented in Egypt. The Rehabilitation and Improvement of Irrigation & Drainage Systems at Delta Region phase (I) and (II) require the highest investment costs of the pipeline projects with respectively US$640 million and US$696 million. It can be observed that ten projects (24% of pipeline projects) have a planned investment cost exceeding US$100 million; nineteen of the pipeline projects (46 percent) are recognized by a planned investment between US$100 million and US$1 million. Figure 7 shows also the higher average investment cost of pipeline projects with US$92 million. The distribution of investment cost shows that the pipeline projects presumably have a higher spread throughout Egypt since this is more equal in investment cost throughout the pipeline projects.

The relevance numbers (relevance of the water component as a percentage of the total investment cost) were not taken into account when analyzing this project cost distribution since all components within infrastructure projects have proven to be interdependent.

Figure 6. Project Cost distribution – On-going Projects

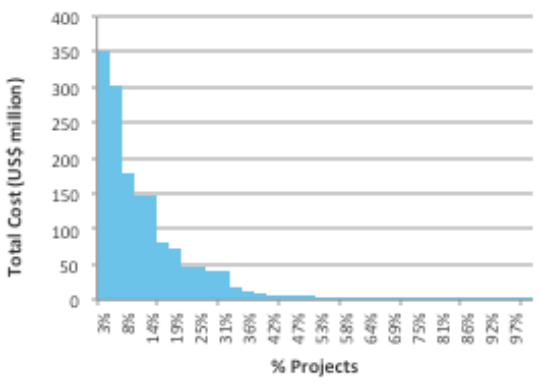
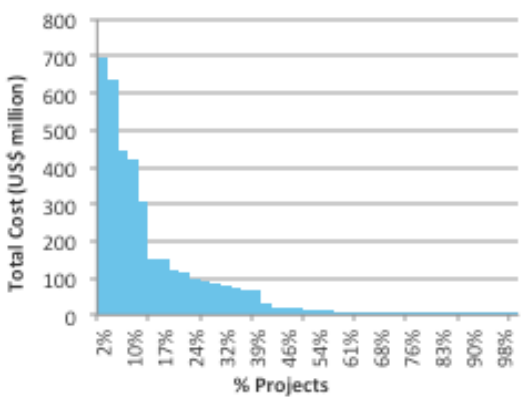


Figure 7. Project Cost distribution – Pipeline Projects



The investment envelope

The total investment envelope of on-going and pipeline projects for Egypt (Table 2) is estimated at US$4 257 million of which US$3 154 million is allocated to the rehabilitation and modernization of existing irrigation schemes, US$697 million to the development of large scale irrigation, US$351 million to the 'others' category (used for training, extension services and such activities), US$30 million to the development of small/medium scale hydropower projects and US$24.54 million to the development of small scale irrigation schemes. No funding is allocated to the rehabilitation of hydropower plants or the development of large scale hydropower projects. The last on-going project is scheduled to complete in 2023 (Construction of the New Dirout Group of Regulators) whereas the last pipeline project will be in full operation at the end of 2035 (Rehabilitation and Improvement of Irrigation & Drainage Systems at Upper Egypt (I)).

Table 2 shows that the vast majority (74 percent of total investment portfolio) of investment in water for agriculture and energy in Egypt is allocated to the rehabilitation and modernization of irrigation schemes. The main projects here are the Rehabilitation and Improvement of Irrigation & Drainage Systems at Delta Region phase (I) and (II). Only 16 percent is allocated for the development of new large scale irrigation schemes; and a meager 1 percent of the investment envelope is allocated for the development of small scale irrigation schemes (below 500 hectares).

Table 2. [4]Total Investment Envelope in US$ million and in percentage (On-going & Pipeline projects)

Time Frame	Short-term		Medium-term		Long-term		**Total**	
Size of project	M US$	%	M US$	%	M US$	%	M US$	%
Small scale irrigation development	21	0.5%	4	0%	0	0%	25	1%
Rehabilitation/ modernization of irrigation schemes	1 734	41%	1 352	32%	67	2%	3 154	74%
Large scale irrigation development	440	10%	242	6%	15	0.4%	697	16%
Small/medium scale hydropower	21	0.5%	9	0%	0	0%	30	1%
Rehabilitation of hydropower plants	0	0%	0	0%	0	0%	0	0%
Large scale hydropower development	0	0%	0	0%	0	0%	0	0%
Others	279	7%	71.7	2%	0	0%	351	8%
Total	**2 495**	**59%**	**1 679**	**39%**	**82**	**2%**	**4 257**	**100%**

The total amount of funding allocated to irrigation categories in Egypt is US$3 876 million (91 percent of the envelope) while the total amount of funding allocated to hydropower categories only amount to US$30 million (1 percent of the envelope).

[4] The investment envelope only accounts for costs to be invested with reference year 2014; costs that already have been invested before 2014 are therefore not taken into account. Relevance numbers (the relevance of the water component as a percentage of the total cost) have been used to develop this investment envelope.

The significant difference between investment in irrigation and hydropower categories is, as mentioned before, mostly explained by the planned investment in the rehabilitation and modernization of irrigation schemes. This analysis thus displays the lack of diversity of investment in this envelope. However, the vast majority of Egypt's hydropower potential has already been exploited. As a result, NREA is actively pursuing other types of renewable projects, primarily solar and wind power, to diversify the country's energy mix.

Cost distribution

Figures 8 to 10 illustrate the distribution of project costs in time by type of project for those on-going and in the pipeline. It can be observed from Figure 8 that the distribution over time in the short- and medium-term is within limits of sustainability.

However, investment in the long-term is insufficient. The only significant project with a budget planning exceeding eight years is the Rehabilitation and Improvement of Irrigation & Drainage Systems at Delta Region phase (I). The distribution over short- and medium-term is more equal compared to other countries in Africa; this fosters the continuity of investment in irrigation and hydropower. The trend of underinvestment in the long-term is observed in many other countries and might be caused by governments that tend to plan their budget with a timespan no longer than eight years. Many projects in this portfolio, such as rehabilitation and modernization projects, are short-term but repeated continuously. The underinvestment in the long-term in this analysis therefore does not necessarily hold up in reality.

Figure 8. Cost distribution in time per typology – All Projects (US$ million)

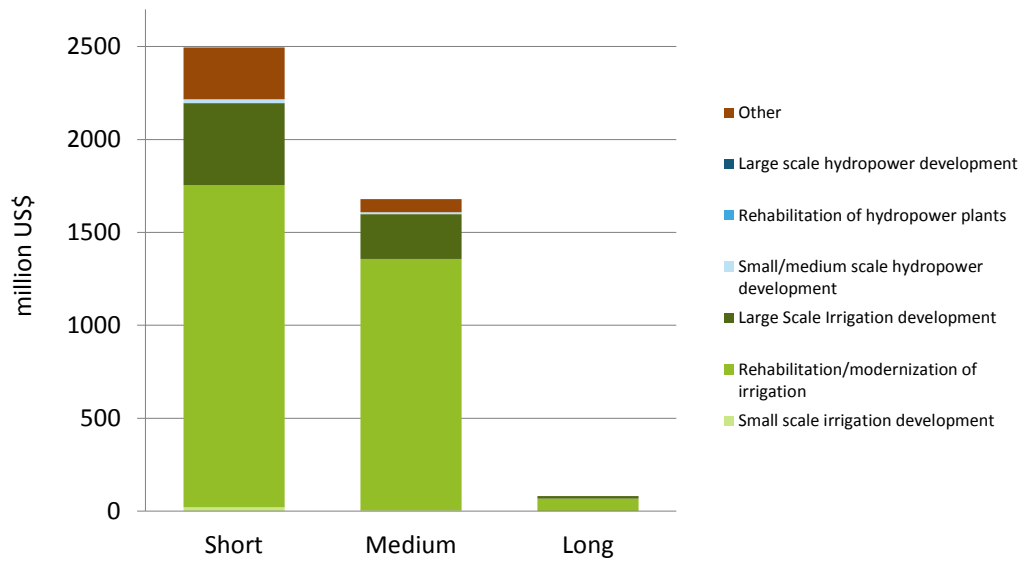


Figure 9. Cost distribution in time per typology – On-going Projects (US$ million)

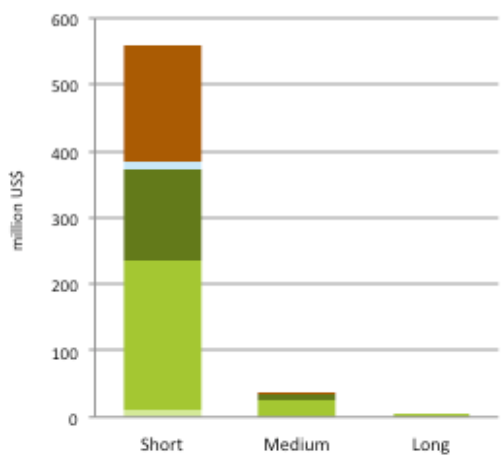
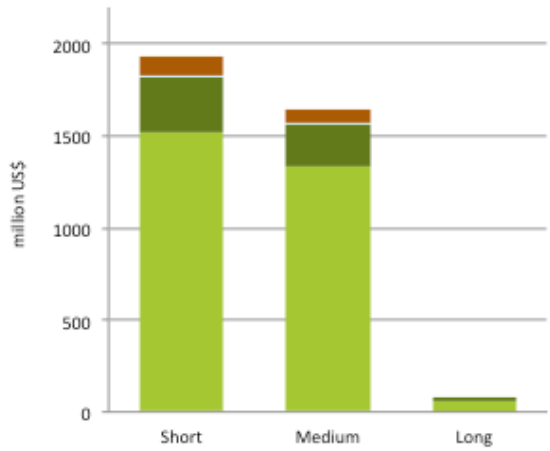


Figure 10. Cost distribution in time per typology – Pipeline Projects (US$ million)



The on-going projects of this envelope account for US$601 million (14 percent of total envelope) while the pipeline projects add up to US$3656 million (86 percent of total envelope). Investment in hydropower categories is insignificant in the on-going projects (only New Assiut Barrage and Hydropower Plant project and the Small Hydro power in Egypt project); a downward effect on this trend is identified in the pipeline where only 0.5 percent of all pipeline investment is allocated to hydropower categories. However, hydropower ranked third in terms of electricity generating, after natural gas and petroleum, contributing to about 8 percent of the total electricity generated on the national level in 2014(MOP, 2015 b).

Figure 9 shows a sharp negative relation between time and investment. This negative relation imposes an adverse effect on the sustainability of agricultural growth in Egypt for on-going projects. As mentioned before, governments appear to plan their budget no longer than 8 years; this might be the cause of this negative relation between time and investment. Nevertheless, a longer planning horizon is advisable.

Figures 11, 12 and 13 display the distribution of cost share per typology and clearly reveal the focus of investment on the rehabilitation and modernization of irrigation. It is observed in many African countries that a lack of investment in Operation and Maintenance (O&M) is a cause for irrigation schemes to be inoperative; this planned budget therefore is desirable. Nevertheless, a diversification of the investment portfolio also targeting the rehabilitation of hydropower plants and new irrigation schemes is recommended to foster sustainability of growth of irrigation land and hydropower development.

Figure 11. Cost share per typology – All Projects (%)

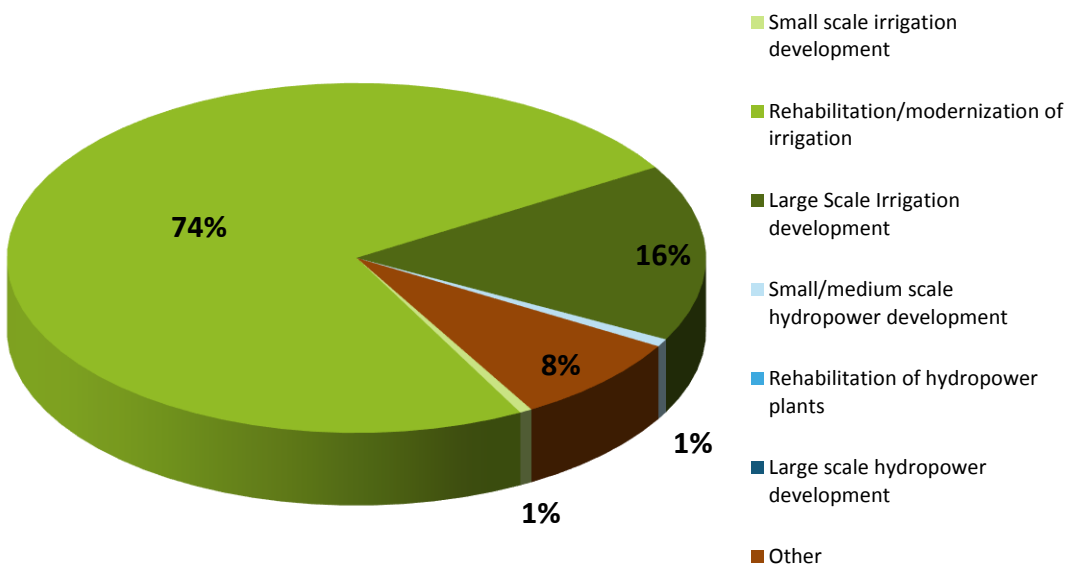


Figure 12. Cost share per typology – On-going Projects (%)

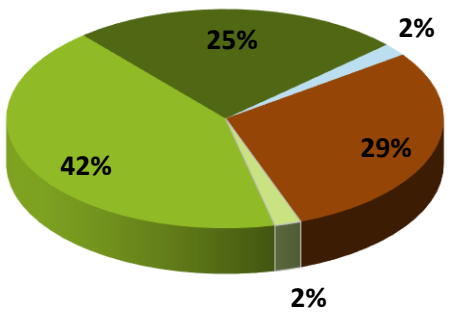
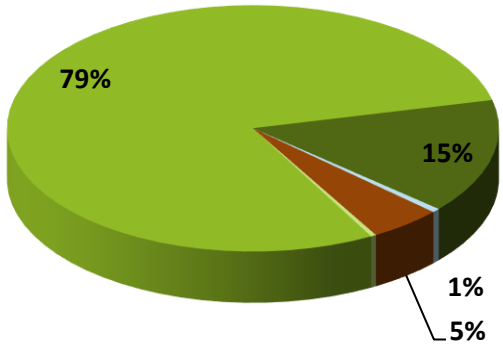


Figure 13. Cost share per typology – Pipeline Projects (%)

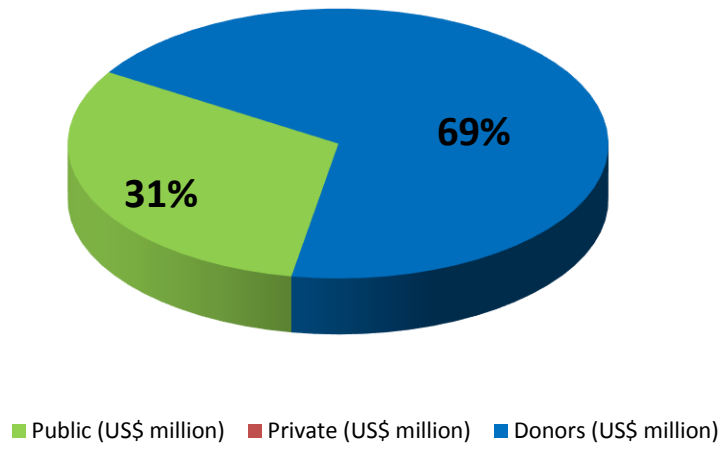


Source of funding

The disaggregation of investment cost over funding partner appeared unavailable for pipeline projects since the planned budgets have not been confirmed yet. The analysis of this subchapter therefore only focuses on the on-going projects due to limited data availability.

International donors and public funding partners finance the 36 on-going projects for respectively 69 percent and 31 percent. These donors are: the World Bank, KfW Development Bank, the OPEC fund for International Development (OFID), German Federal Ministry for Economic Cooperation and Development (BMZ), Japan Social Development Fund (JSDF), European Union (EU), ENPI CBC Med Programme, USAID, AUSAID, Australian Centre for International Agricultural Research (ACIAR), African Development Bank (AfDB), International Fund for Agricultural Development (IFAD), Global Environmental Facility (GEF), Japan International Cooperation Agency (JICA), Saudi Fund for Development (SFD). The public funding partners mentioned in Figure 14 include the Government of Egypt, Dutch Ministry of Economic Affairs, French Government and the Japanese Government. Figure 14 shows that donors dominate the investment portfolio of on-going projects and there is no involvement of the private sector. However, some amendments of the Investment Law 8/1997 were debated in the Cabinet of Ministers before Egypt enacted a new Investment Law (Presidential Decree 17 of 2015 on March 12, 2015). The main objectives of these amendments are attracting private sector investors, offering them incentives and simplifying procedures.

Figure 14. Cost share per funding partner for On-going Projects (%)



It is worth mentioning that the presence of private donors is always important as a source of financing in order to foster sustainability of funding. A high dependence on donor financing entails risks since withdrawal for any reason from financing these projects would mean an almost entire fallback of investment in irrigation and hydropower projects. An increase in public investment would also enhance the diversity of the source of funding in Egypt fostering sustainability of investment in irrigation and hydropower projects.

Hectares to develop/rehabilitate

The project portfolio is bringing changes to about 2 208 789 hectares of land in Egypt, 1 213 518 hectares originate from on-going projects and 995 271 hectares of the pipeline projects.

Once all projects in the portfolio are implemented, the additional area under irrigation would add up to 875 064 hectares (503 902 hectares by on-going, and 371 162 by pipeline projects), while the surface benefitting from the rehabilitation of irrigation schemes or dams would be 1 333 725 hectares (709 616 hectares by on-going, and 624 109 hectares by pipeline projects).

Due to a high variation in cropping pattern throughout cropping seasons it proved to be impossible to display the distribution of hectares per crop in this analysis. However, the focus is on the production of wheat, maize, faba bean, lentils, sugar beet, and oil seed crops.

4 CONCLUSIONS

Based on the information and analysis presented in this report, the following can be concluded:

a) Agricultural growth in Egypt has been fairly low but relatively stable, averaging 3.2 percent across the 2003-2012 period. The CAADP contributes towards the Egypt's efforts to develop the agriculture sector.

b) Water shortage is the main constraint and a major limiting factor to the implementation of Egypt's economic growth and development plans. This highlights the need to invest in projects targeting improved irrigation management, O&M and the rehabilitation irrigation schemes.

c) The crop-water demands in Egypt are expected to face changes caused by climate change. Therefore, there is a need to adapt and cope with climate change through improving surface irrigation efficiency, application of deficit irrigation measures, changing sowing dates to cooler months, changing cultivars, breeding of disease-tolerant cultivars, changing crop patterns, changing management practices, and monitoring system for the current and new races of plant pests and diseases.

d) It appears that Egypt's national strategies for water, agriculture and energy are in line with CAADP objectives. Both of the NWRP and SADS 2030 focus on sustaining the use of natural agricultural resources and increasing the productivity per units of both land and water. They propose increasing water-use efficiency in agriculture via improved field irrigation systems, which is fully in line with CAADP objectives. The SADS 2030 targets achieving higher rates of food security in strategic goods; improve opportunities for agricultural investment; improve livelihood of rural inhabitants. The CAADP compact contributes towards Egypt's efforts to improve food security, market access and to develop the agriculture sector. The SFESDP 2022's goal is "to secure a decent life for all Egyptians through poverty reduction". The CAADP contributes to the achievement of MDG1 on hunger and poverty reduction.

e) Egypt's Renewable Energy Strategy targets generating 20 percent of the total energy from renewable sources by 2020, of which 12 percent, 4 percent and 4 percent are generated respectively from wind, hydro and solar energies. To achieve this ambitious goal, there's a need for more cooperation with different international financing institutions.

f) The investment envelope shows that Egypt is mainly investing in the rehabilitation and modernization of existing irrigation schemes (74 percent) as opposed to investing in the development of new irrigation projects (17 percent), with US$3 154 million investment for the former and US$722 million for the latter. Therefore, measures should be put in place to ensure paying more attention to the development of new irrigation schemes, especially for smallholders.

g) This report analyzed that only one percent of the total amount of on-going and planned funding is invested in hydropower categories, and no investment is allocated to the rehabilitation of hydropower plants or to the development of large scale hydropower projects. This portrays a lack of diversity of investment; measures should be put in place to ensure the diversity of these investments. More budget should be allocated to the rehabilitation and modernization of existing plants, taking into consideration that the vast majority of Egypt's hydropower potential has already been exploited and Egypt's main focus is on pursuing other types of renewable projects (e.g. solar and wind power) to diversify the country's energy mix.

h) It appears that most of the investment for irrigation projects will take place in the short- and medium-terms, but it is important to note that investment in the long-term is insufficient. This highlights a lack of long-term strategic investment in the country and raises the importance of longer budget-planning-horizon concerns that the country may wish to consider.

i) The envelope shows that there is lack of investments in Operation and Maintenance (O&M). Therefore, a diversification of the investment portfolio targeting the rehabilitation of hydropower plants and irrigation schemes is recommended to foster sustainability of growth of irrigated land and hydropower development. However, O&M investments are traditionally borne by the Ministry of Water Resources and Irrigation, adding more financial burden to its budget. To reduce this financial burden, a good institutional structure with strong Water Boards and Water Users Associations is needed to assist private investor in taking over O&M activities.

j) The analysis of sources of funding in the Egyptian investment envelope focuses only on the on-going projects due to limited data availability. International donors dominate the investment portfolio of on-going projects and lack involvement of the private sector is observed. The high dependence on international donors financing entails risks due to risk of withdrawal from financing the projects. Therefore, the presence of private donors is important to foster sustainability of funding. However, Egypt enacted a new Investment Law to attract private sector investors whereas, mechanisms should be put in place to reverse this trend. Increasing the public investment would also enhance the diversity of the source of funding in Egypt fostering sustainability of investment in irrigation and hydropower projects.

k) Irrigation projects are mostly targeting the production of wheat, maize, faba bean, lentils, sugar beet, and oil seed crops to enhance the food self-sufficiency and security.

ANNEX 1. PROJECT PORTFOLIO

Table 1.1. ON-GOING PROJECTS

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
1	Farm-Level Irrigation Modernization Project (FIMP)	• A loan from the World Bank of US$100 million • A loan from AFD of US$50 million • Local funding of US$30 million	2011-2016	180.00	The objective of this is to increase agricultural profitability and improve equity in access to higher-quality water for up to 140,000 small-scale farmers in the command areas of Mahmoudia, Manaifa, and Meet Yazid located in the Nile Delta. There are two components to the project. The first component of the project is marwa and farm-level irrigation improvements. This component supports marwa and farm-level irrigation modernization in this command area. The second component of the project is farm-level technology modernization. '30% rehabilitation and modernization of irrigation scheme, 50% large scale irrigation development, and 20% others'
2	Integrated Irrigation Improvement and Management Project (IIIMP)	• A loan from World bank of US$120 million • A loan from KFW of EUR38.8 million • A supplemental loan from KFW of EUR25 million • A grant from the Netherlands of EUR7.2 million • a grant from KfW of EUR2 million	2006-2016	200	This project is designed to achieve integrated planning, management, and execution of all interventions needed at the command level. The objectives of the IIIMP are to: Develop the framework for an integrated water, management plan and program in selected command areas and combine water quantity and quality management through interagency and stakeholder consensus; improve the institutional, financial, and environmental sustainability of water services through the decentralization of water management, intensive user and private sector participation in the investment, operation, and maintenance at the district/branch canal level and below, and improved water quality management practices; Establish and expand the WUAs and water boards in line with the government policy of integrated irrigation and drainage water management. This would include support for WUAs at the tertiary level, their extension to branch canal level, and their incorporation into water boards at the district level. '100% others'
3	New Assiut Barrage and Hydropower Plant	• A loan from KFW of US$39.943 million (phase 1)	2009-2017	147.94	Construction of new barrage and the attached power plant behind the current Assiut barrage in Assiut Governorate. '80% large scale

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
		• A grant from KFW of US$3 million • Local funding of US$105 million			irrigation development, and 20% small-and medium-scale hydropower'
4	On-Farm Irrigation Development Project (OFID)	• A loan from OPEC of US$35 million • Local funding US$6 million	2012-2017	41.00	To modernize irrigation infrastructure in four governorates to improve water efficiency, increase yields and boost incomes of smallholder farmers. The project proposes to support the Government's efforts to modernize farm-level irrigation through the implementation of the following components: rehabilitation and modernization of marwa and farm-level irrigation in the areas of El-Behira, Kafr El-Sheikh, Dakahlia and Sharkeya, procurement of equipment and vehicles, capacity building to enhance farmer knowledge and the uptake of improved irrigation and associated land improvement and crop production techniques, and project implementation unit. This will, in turn, help reduce poverty levels and increase food security for about 70,000 people. '100% rehabilitation and modernization of irrigation scheme'
5	Support to the National Water Resources Plan (NWRP), Egypt	US$2.15 million	2015-2017	2.15	The specific objectives of the project are (1) to update the existing NWRP (2005-2017) and extend it in the framework of the 2050 vision, (2) develop regional Water Resource Plans in six Governorates, representative of the different contexts in the country i.e. the Nile Valley, Delta, Fayoum, Sinai and coastal zones, (3) manage water resources in a sustainable way, (4) protect public health and the environment and (5) maximize the economic activity benefits for all Egyptian people. '100% others'
6	Water Development Resources Opportunity Policies for the water management in semi-arid areas	ENPI CBC Med Programme contribution:US$2.15 million	2014-2016	2.15	The main objective of the Project is to develop an integrated water cycle management approach at the Mediterranean Sea Basin level for managing the related cross-sector issues through the enforcement of multi-stakeholder partnerships, in particular with public and private actors. '100% others'
7	Water Sector Reform Programme – Phase II (WSRP-Phase II)	German Federal Ministry for Economic Cooperation and Development (BMZ) US$2.58 million	2012-2015	2.58	Measures are concentrated in selected project regions in the Nile Delta and Upper Egypt. GIZ is working in five different areas of activity, including support for institutional reforms and the development of participatory water management plans. Efforts are also being made to improve the quality of water in drains in order to increase the general availability of water. Finally, the project provides gender-specific advisory services intended to

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
					strengthen the position of female water users. '100% others'
8	Buhiyyah Canal Irrigation Improvement	OFID (US$15 million) and GOE (US$4.35 million)	2006-2015	19.35	This project aims at increasing irrigation efficiency and agricultural production. This will be done by rehabilitating and modernizing irrigation infrastructure. In addition, over 600 engineers and 1,500 farmers will receive training courses, workshops and on-site demonstrations. The project will also eliminate the use of open irrigation ditches. Pollution levels in the project area will also decline, as the irrigation network will use electric instead of diesel-driven water pumps. '80% rehabilitation and modernization of irrigation scheme, and 20% others'
9	North Sinai Development by Reclamation of 400000 fed	• A loan from Kuwait of US$147.82 million	2001-2015	147.82	The project contributes to strengthening and consolidating the agricultural policy of Egypt to increase agricultural production and create new communities and the exploitation of human resources for development purposes and provide new job opportunities. '30% rehabilitation and modernization of irrigation scheme, 60% large scale irrigation development, and 10% others'
10	Construction of the New Dirout Group of Regulators	• A soft loan from Japan of US$47.53 million	2015-2023	47.53	The Project's objective is to construct new regulators in Dirout city and install water distribution system to develop capacity for efficient water distribution, and thereby, contribute to increasing agricultural productivity in Upper Egypt. '100% rehabilitation and modernization of irrigation scheme'
11	Feasibility Study for the Reconstruction/ Rehabilitation of Zefta Barrage	A grant from AFDB of US$0.93 million	2010-2015	0.93	Conduct a study to evaluate the condition of Zefta Barrage and the reached recommendation regarding the decision either to renovate and repair the barrage or to establish a new barrage. Evaluate the condition of old hydraulic establishments to take the necessary decision to improve water distribution and provide irrigation water. '100% others'
12	SWIM-Sustainable Water Integrated Management Demonstration Project (Network of demonstration activities for sustainable integrated wastewater treatment and reuse in the Mediterranean countries)	German Federal Ministry for Economic Cooperation and Development (BMZ) and the European Union (EU) US$3.76 million	2012-2015	3.76	The objectives of this Project are to improve the sustainable integrated management of non-conventional water resources; enhance the capacity of national organizations and consortium partners in sustainable management of non-conventional water resources; and disseminate best practices on sustainable integrated wastewater management and reuse. The main activity of this Project is to demonstrate the socio-economic and environmental benefits of decentralized wastewater management and conduct training courses on managerial aspects as well as on

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
					operation and maintenance of the demonstration plants/systems. '100% others'
13	Agricultural Water Productivity as a Way of Adapting to Climate Change (AWP-ACC)	GIZ (US$4.29 million)	2013-2017	4.29	The programme implements strategies to improve the ability of farmers to adapt to a changing climate. The project aims to initiate changes in the political framework and in political strategies, to implement instruments and measures to change decision-making processes and to prevent or minimize potential damage from climate change. The project focuses on providing information and training for farmers on the topics of effective and resource-efficient farming and irrigation methods, selection of the right crops, fertilizer use and crop rotation; developing guiding principles for recycling agricultural wastewater and reuse of domestic wastewater in farming; facilitating knowledge transfer and disseminating information to improve planning and management of adaptation processes; and raising general awareness about adapted sustainable waste management. '100% others'
14	Second Phase of the Multi-country Regional Coordination on Improved Water Resources Management and Capacity Building Program (APL 2) Project	• A grant from Environment Facility (GEF) (US$1.050 million)	2012-2016	1.05	The objective of this Project is to improve water resources and agricultural management and planning within and across beneficiary countries based on quantitative and spatial-based decision making tools. There are two components to the project. The first component of the project is improved local water resources and agricultural management. The second component of the project is capacity building and project management. '100% others'
15	Middle East Water and Livelihoods Initiative (WLI): Improving Rural Livelihoods through Sustainable Water & Land-Use Management in Middle East Countries (Egypt, Iraq, Jordan, Lebanon, Palestine, Syria and Yemen)	USAID (US$20 thousand/year) an Local funding from ARC (in kind US$15 thousand/year)	2009-2018	0.35	WLI aims to improve the livelihoods of rural households and communities in areas where water scarcity, water quality deterioration, land degradation, food insecurity and health problems are prevalent in the Middle East. '100% others'
16	Improving Irrigation, Drainage and Plant Nutrition	Local funding from ARC (US$1.24 million)	2009-2017	1.24	The project is mainly research and its outputs are applied in farmers' fields by extension agents. '100% others'

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
	Methods in Old and New Lands				
17	Improving sugarcane productivity	Local funding from ARC (US$3.60 million)	2007-2017	3.60	A research project aiming at providing the farmers with the production package for optimum sugarcane yield. '100% others'
18	Use of green houses in optimizing water and fertilizer use in the new land	Local funding from ARC (US$3.10 million)	2007-2017	3.10	The project helps in constructing the greenhouses. Provides training on the new technologies. Establishment of nurseries to produce seedlings free from diseases. '100% others'
19	Improvement of the uses of soil conditioners	Local funding from ARC (US$1.37 million)	2009-2018	1.37	Research with some on-farm applications. '100% others'
20	Deltas, Vulnerability, and Climate Change: Migration as an Adaptation	International Development Research Center, Canada "IDRC" (US$13,394,200)	2014-2018	13.39	The project area covers four deltas: the Ganges-Brahmaputra-Meghna delta in Bangladesh and India, the Nile delta in Egypt, the Mahanadi delta in India, and the Volta delta in Ghana. A consortium of five institutions with expertise in the different regions will conduct the research. They will study migration in deltas in Africa and South Asia to inform policy on the potential role it can play in promoting sustainable options to adapt to a changing climate. '100% others'
21	On-farm Irrigation Development Project in the Oldlands (OFIDO)	• A loan from IFAD of US$46 million • A grant from IFAD of US$1 million • Local funding of US$25 million	2010-2017	72.00	The techniques of improvement will be: 1 - Renovation of mesqas and marwas by converting them to pipes and using controlling valves water entrances in the field at Assuit, Sohage and Qena. 2 - Renovation of of marwas at Kafer El-Sheikh and El-Behira 3 - Using improved on-farm irrigation systems and modified practices for better surface irrigation. 4 - Applying localized irrigation in fruits and vegetables fields. 5 - Applying crop water requirements based on climate conditions. 6 - Improving irrigation management and scheduling on farm level. '100% rehabilitation and modernization of irrigation scheme'
22	Irrigation and Drainage Pumping Stations	A loan from the Saudi Fund for Development (SFD) (US$80 million)	2013-2017	80.00	This project aims to increase the capacity of the pumping stations by increasing their number, in addition to improving the efficiency of the old ones. In this manner, the project can fulfil the demand for irrigation water and afterwards drain the excess water, thus protecting the agricultural land from uncultivation or drowning. The project involves three tasks; 1) the construction of new pumping stations and replacement of other current ones in Upper and Lower Egypt, 2) supplying and installing submersible pumps,

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
					various electric motors and weed cleaning machines, and 3) provision of 4 x 4 vehicles, training and consultancy services. '90% rehabilitation and modernization of irrigation scheme, and 10% others'
23	Project for Strengthening Water Management Transfer (SWMT)	JICA (US$0.324 million)	2012-2015	0.32	The overall goal of this project is management of the branch canal is transferred to BCWUAs nationwide and the project purpose is implementation structure for water management transfer nationwide is established in MWRI. '100% others'
24	Establish and Capacity Building of Water Users Organizations	GOE (US$3.6 million)	2009-2017	3.60	Participation is one of the main pillars of water policy. Water user's organizations represent the civil society participation in water resources management. Participation strategy has been prepared by IRU. It is planned to organize all WUOs by year 2017. CDIAS has prepared a plan to organize and capacity building of BCWUAs and DWBs all over Egypt. '100% others'
25	Field Irrigation Project	France (US$45.85 Million)	2012-2019	45.85	Modernizing field irrigation in the areas surrounding El-Mahmoudia, Menoufia and Meet Yazid in the Nile Delta area, where means of irrigation have improved, whether they are natural ones or institutional. WUA was established for ensuring sustainable irrigation operation, maintenance and management and is working with full capacity. The development goal of the Project is to increase profit from agriculture and improve shares (stocks) to secure high quality water to around 140,000 small farmers for irrigating 84,000 ha. '100% large scale irrigation development'
26	Grant for Developing Field Irrigation (Participatory Farm-level Irrigation Modernization)	A loan from World Bank (US$2.75 Million) and a grant from Japan Social Development Fund (JSDF) (US$2.998 million)	2011-2015	5.75	The project aims to attempt more participatory methods for developing field irrigation and harvest crop practices, and targets some 5 thousand small farmers in the irrigation area, which covers approximately 2,800 hectares. Project areas include Mahmoudiya, Manayfa and Mit Yazid, located in the Nile Delta; while analyzing impediments, available opportunities for expanding the scope of these methods and disseminating lessons learned. '100% small-scale irrigation development'
27	Master Plan for the Rehabilitation of Control Structure (Nile)	• AWF (US$1.46) • AFDB (US$0.71) • Local funding (US$0.54)	2011-2015	2.70	The proposed study consists of three main components: (i) Site Investigations and Development of a Geographic Information System (GIS) database, including inspections and data collection for 200 hydraulic structures in 75 locations; (ii) Safety Evaluations

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
					and Development of a Decision Support System, including undertaking a Strategic Environmental Assessment (SEA) and socio-economic cost-benefit analysis for the structures; and (iii) Development of a Master Plan and Preparation of a capital investment project for the top priority major structure identified under the study. The objective of the study is to assess and design improvements of major hydraulic facilities and thus contribute to the implementation of Egypt's Integrated Water Resources Management (IWRM) plan. '100% others'
28	The Second National Drainage Project - Phase II (NDPII)	• A loan from the World Bank: US$50 million • A loan from KFW: US$52,8 million • A grant from EIB US$53.65 million • Local funding US$190 million	2001-2015	346.45	Component 1): Drainage works including 1. providing subsurface drainage in the old cultivated lands, 2. renewal and rehabilitation of old malfunctioning subsurface drainage on areas already provided with earlier types of drainage systems, and 3. deepening and remodelling of open surface drains. Component 2): Equipment and material including 1. emergency pumping equipment for the regional emergency centers, 2. spare parts for heavy machinery and equipment, 3. spare parts for factories equipment, and 4. Machinery for support the drainage maintains centers. '100% rehabilitation and modernization of irrigation scheme'
29	Management of water and salinity in the Nile Delta: A cross-scale integrated analysis of efficiency and equity issues	AusAid and Australian Centre for International Agricultural Research (ACIAR) US$2.647 million	2012-2016	2.65	The main objectives of this Project are: 1) Identify and develop strategies that address institutional and technical barriers associated with the management of main and branch canals and assess the effectiveness of collective action in the functional operation of water user associations (WUAs) at the mesqa (tertiary) and branch (secondary) canal levels, 2) Develop and assess marwa- and farm-level interventions that improve the productivity of diverse farming systems, and that contribute to increased water productivity under conditions of salinity, while assessing the economic and social dimension of crop choice and water management, 3) Build an understanding of the temporal and spatial dynamics of salt at several nested and successive scales (farm, meso, main canal/drain levels, fishpond area, lake) to understand the linkages between water management practices and salt movements/accumulation, 4) Develop an understanding of the implications of these cross-scale interactions through the

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
					modelling of the whole central delta, and assess the fraction of water that could potentially be 'saved' and used in the New Lands under constraints of salt management and sustainability of current uses (rice, aquaculture, fisheries). '100% others'
30	Enhanced Water Resources Management	Global Environment Facility (GEF) (US$6.682 million), and GoE (US$1.685 million)	2013-2016	8.37	The development objectives of the Project are to pilot Integrated Water Resources Management (IWRM) in the Nile Delta and to enhance the knowledge and capacity of water sector institutions for IWRM in Egypt. The project has three components: 1) pilot schemes: develop synergy between on-going water sector projects through demonstration activities in pilot areas; 2) capacity building for surface water and groundwater management and monitoring; and 3) project management: support to the project coordination unit (PCU) in project implementation, monitoring and evaluation and management, and establishment of a results-based monitoring and evaluation system. '100% others'
31	Setting up M&E Framework for the Institutional Reform and Integrated Management Central Unit of the Ministry of Water Resources and Irrigation, Egypt	GIZ (US$2.68 million)	2013-2015	2.68	The overall objective of the program is to improve the capacities of MWRI, MALR and water users for implementing integrated water resources management at various levels (national, regional and local). The program covers 3 working areas namely 1) institutional development, 2) training and human resource development for integrated water resources management (IWRM) and 3) improving process flows in the field of irrigation. '100% others'
32	Adaptation to the Impacts of Sea Level Rise in the Nile Delta Coastal Zone	International Development Research Center, Canada "IDRC" (US$710.800)	2009-2016	0.71	This project aims to demonstrate the value of stakeholder participation in evaluating the trade-offs between adaptation options in the stretch between Ras El Bar and Gamasa on the northern coast of Egypt. Researchers will carry out environmental assessments, investigate the socioeconomic and institutional aspects of vulnerability, deliberate with stakeholders on adaptation strategies, and build capacity through technology transfer, awareness raising, workshops, and training. '100% others'
33	Clima South: Support for Climate Change Mitigation and Adaptation in the ENPI	European Union (EU) US$5.37 million	2013-2016	5.37	The project seeks to enhance regional cooperation between the EU and its southern Mediterranean neighbours and among the partner countries themselves (South–South) on climate change

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
	South region				mitigation and adaptation. '100% others'
34	Institutional Capacity Building Project to Develop Agricultural Production Methods in Dry and Saline Conditions In Sinai.	A grant from Ministry for Foreign Affairs of Finland of US$0.03 thousand	2013-2015	0.03	The project aims to improve Egypt's Field Crop Research Institute's (FCRI) capacity to implement research and develop technologies on water use efficient crops. '100% others'
35	Improving productivity in farming systems of the Nile Delta	AusAid and Australian Centre for International Agricultural Research (ACIAR) US$2.45 million	2013-2017	2.45	The project will analyse current and future production and marketing constraints for different farmer groups. Working with women and men on-farm, it will investigate technologies and management practices to see how an increase in crop and livestock productivity can be achieved, with an associated improvement in income. The outcome will be better productivity and income opportunities for smallholder farmers in the region. '100% others'
36	Enhanced Water Resources Management Project (EWRMP) in Egypt	A grant from the Global Environmental Facility (GEF) of US$6.7 million + US$34.4 million from on-going investments (mainly the IIIMP, NDP, and West Delta)	2011-2016	41.10	The Nekla pilot area is situated in the Mahmoudia district, in the upstream part of the Mahmoudia main canal in the Nile delta. The pilot area covers about 13,000 feddan in the command areas of the Hamad Menesi, Nekla, Ganabiet Hamad Menesi, Ganabiet Sharaf and Ganabiet El-Babli branch canals. Drainage is provided by the El-Atf main drain and El-Babli and Edko Sharaf secondary drains. The project has two components: (i) improved surface water availability and quality; and (ii) improved groundwater management. '40% small-scale irrigation development, and 60% others'

Table 1.2. PIPELINE PROJECTS

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
1	Coverage of Canals and Drains sections streaming in urban areas	NA	2017-2024	93.13	The Project targets pollution control in water streams and use the covered canals and drains as green landscapes. '100% others'
2	Completion of the National Project of Development of the southern valley (TOSHKA)	NA	2017-2024	120.0	The Project aims at the rehabilitation of 226891 ha. '100% rehabilitation and modernization of irrigation scheme'
3	Completion of the National Project of El Salam Canal Area	NA	2017-2024	150.0	The Project aims at the completion of the national infrastructure for the whole project and rehabilitation of 190952 ha. '100% rehabilitation and modernization of irrigation scheme'
4	Protection of the Egypt Coastal zones "Study"	NA	2017-2023	2.0	The Project aims at the protection of the coastal urban and rural areas from sea level rise. '100% others'
5	Desalination of the brackish groundwater "Study"	NA	2017-2023	1.0	The Project targets the desalination of the salty groundwater in the desert communities. '100% others'
6	Small Hydro power in Egypt	NA	2017-2023	19.3	The Project aims at the construction of small hydro power stations at Rayah Tawfiki, Edfina , Assiout Regulator, Gamgara, Rayah Abbasi, Rayah Beheri, Bagouria Canal, West Nag Hammdi, Bahr Mouais, Sharkawia Canal, and Rayah Nassery. '100% small- and medium-scale hydropower'
7	On-farm Irrigation Development Project in the Old Land (OFIDO II)	NA	2017-2023	69.4	The techniques of improvement used in this Project will be: 1. Renovation of mesqas and marwas by converting them to pipes and using controlling valves water entrances in the field. 2. Using improved on-farm irrigation systems and modified practices.3. Applying localized irrigation in fruits and vegetables fields. 4. Applying crop water requirements based on climate conditions. 5. Improving irrigation management and scheduling on farm level. '100% rehabilitation and modernization of irrigation scheme'
8	On-farm Irrigation Development Project in the Old Land (OFIDO III)	NA	2020-2027	80.0	The techniques of improvement used in this Project will be: 1. Renovation of mesqas and marwas by converting them to pipes and using controlling valves water entrances in the field. 2. Using improved on-farm irrigation systems and modified practices.3. Applying localized irrigation in fruits and vegetables fields. 4. Applying crop water requirements based on climate conditions. 5. Improving irrigation management and scheduling on farm level. '100% rehabilitation and modernization of irrigation scheme'
9	Rehabilitating and	NA	2017-	150.0	The technical and economic studies in this Project include: 1. redesigning the

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
	Improving the Management of On-Farm Irrigation in the Newly Reclaimed Lands		2023		pressure irrigation networks according to the local conditions of each province, region, and location, and the technical specifications of the equipment, and 2. improving monitoring and evaluating through the preparation of progressive reports and assessments within the planned schedule. '100% rehabilitation and modernization of irrigation scheme'
10	On-farm irrigation research development, training and extension farms in old and new lands for Egyptian sustainable agriculture project	NA	2017-2024	74.0	The project will establish six research development, training and extension pilot farms; two represent old land and four represent new lands. Each farm will be fully equipped to develop and test on-farm irrigation systems, agronomic practices and soil/plant/water relationships for the cultivated crops in each area. These farms will provide intensive training to farmers, graduates, non-graduate settlers, new settlers and extension agents in mechanized operations incorporated with modern irrigation methods, agronomic practices and extension services. '100% others'
11	Control and Rehabilitation of Natural Resource Degradation of Arid Land in Egypt: An Integrated practices for dry land management in North East Coast of Egypt	NA	2016-2021	2.0	The methodology of this project include: 1. Development of water harvesting techniques for sustainable agro-ecosystem through the integration of up-to-date technologies represented by GIS, RS and modeling to build up geo-referenced database at multi space scale in order to characterize and evaluate the available land resources, quantify the changes of land use; 2. Selection of pilot project sites and suitable on–farm water harvesting techniques; 3. Prevent flash-flood and damages through construction of water catchments/small stoned earth dams and pipelines for irrigation. 4. Identification of local participation of plant (shrub) species to be used. 5. Conducting field trials on techniques for soil surface management. 6. Training engineers, technicians and farmers. '100% others'
12	Solar Water Desalination Systems Application for Bedouin Settlements	NA	2016-2021	0.805	The water desalination unit includes the following components: 1. Solar desalination system. 2. Water distribution system. 3.Salt collection and process unit. 4. Heat exchanger and distribution unit. '100% others'
13	Sustainable Management of Soils and Water as an Adaptation Strategy to Reduce Climate Change Risks on Crops in Egypt	NA	2016-2021	2.0	The project will be conducted in 22 governorates with different soil types and different crop patterns (field crops, fruits and vegetables). Trials at farmer's fields will be done at each location using improved agricultural management practices to save irrigation water and to increase crops production. Field data will be used to calibrate and validate three simulation models and site specific prediction equations will be developed for crops not included in these models. '100% others'
14	Precision Crop Water Requirements in New Extension Reclaimed Areas	NA	2016-2021	30.0	The Project targets yield monitoring and mapping, weeds mapping and salinity mapping. Variable rate fertilizer and spraying. Topography and boundaries guidance systems. Records and analyses. Introduce high technology. Field Surveys in precision farming places by using satellites image, In the (CIPA) project the survey concerning the estimation of yield for the major crops will be carried out by cutting small

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
					samples in the field. The sample covers the whole Nile valley and the delta, the observed area is about 35000 km² and the distance from South to North is about 1000 km. Using Expert System in precision farming: Precision farming technology which introduced in the mega projects zones including modern irrigation systems Using modern technology and expert Systems in precision farming, to transfer the agricultural knowledge from researchers to the extension officers and growers, Expert Systems Implemented at The Central lab of Agri. Expert Systems (CLAES) around 15 systems. Also, CLAES has the mechanism which transfers information and knowledge this mechanism is implemented Through computer network which is known as Rural Development Communication Network (Radcon). '100% others'
15	Matching Irrigation Supply and Demand Program (MISD)	NA	2016-2021	16.0	The Project targets creating a real time information system on actual / anticipated crops grown in the field which will in turn be used to estimate water requirements at every canal. To obtain information from the farmers on which crops they are growing. To obtain information from the farmers on which crops they are intending to grow. To deliver the obtained information to the MALR, which in turn will provide that data to the MWRI. To build on a successful collaboration among different ministries to improve water resources management. To rationalize the used water for irrigation that could consider the core objective for launching this program. '80% small-scale irrigation development, and 20% others'
16	Technical Support for Citrus Growers in New Lands	NA	2016-2021	12.0	The Project targets installing and evaluation of 3 weighing lysemeters. Cooperate with the training centers in different Governorates to apply the training programs. Preparing a movable lap to serve the soil and water analysis in site for the new lands and give the perfect decision in time for farmers. Prepare a movable unit to evaluate and maintain the modern irrigation system and give the advice to farmers. '100% others'
17	Use of Insects for Biological Control of Water Hyacinth	NA	2016-2021	5.0	The Project targets the use of Insects for Biological Control of Water Hyacinth. '100% others'
18	Integrated Crops and Soils Management Using Low Quality Water	NA	2016-2020	20.0	The project consists of 5 components: 1. Site selection will be done to insure that these sites are representative of the studied problem. 2. Demonstration fields will be established at these site and several cropping patterns will be tested. 3. Soil salinity, alkalinity, fertility build up and heavy metals accumulation will be monitored. 4. Development of the proper integrated management of crops and soils under the use of mixed irrigation water. 5. Socio-economic assessment of the project innovations. 6. Dissemination of the findings to farmers at the selected areas. '100% others'
19	Using Water Drainage in Jatrova Planting and Bio-	NA	2016-2020	2.0	The Project targets the establishment of an experimental farm of Jatrova in the Governorate of 6th October, studying the economic, environmental and social

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
	fuel production in Egypt				impacts of plant Jatrova trees on the surrounding society, and assessing the overall experiment so as to generalize it in a large scale. '100% others'
20	Precision On-Farm Irrigation Management for Crops Grown in Middle and Upper Egypt	NA	2016-2020	15.0	This project will introduce a new sustainable irrigation management system using irrigation modeling, soil scanning and remote sensing to achieve efficient water use. In addition, a comparison will be made between the traditional irrigation management and the new, improved techniques. The fields of the farm will be analyzed by specific sensor that reflects the soil type and characteristics. The tube shapes sensor was mounted on a tractor and readings were stored based on GPS coordinates. Maps of the three fields will compiled to show different soil parameters that influence the irrigation management, such as water retention, organic matter and particle size. Remote sensing with satellite images will be used to detect in-field differences in biomass and crop water use. In each farm, one soil moisture station installed to measure the water content on different depths in and below the root zone. The stations are equipped with a rain gauge to measure the input of water. Software for irrigation management, where the data from soil and remote sensing have been integrated using Google maps will use by farm engineers. Maps with important parameters related to water management such as actual evapotranspiration, biomass growth, potential ET and soil moisture are created with the SEBAL algorithm (Surface Energy Balance Algorithm for Land). '100% others'
21	Application of Precision Farming to Increase Crops Production	NA	2016-2020	20.0	The methodology includes: 1. Automated sensors and controllers could be used to collect information (GPS represents the one primary key factor that has allowed precision irrigation technology to progress to its current stat). 2. Laser land leveling using GPS. 3. Influence of soil moisture and applications of variable irrigation. 4. To use a computer and software is essential for soil moisture mapping to be stored using GIS software. 5. The use of RS images is still an emerging piece of precision irrigation technology. 6. Improved crop production decisions are through assessment of yield variation and narrowing the potential causes. '100% others'
22	National Drainage Project - phase III (NDPIII)	NA	2017-2024	321.9	The Project aims at the provision with subsurface drainage; improvement the hydraulic efficiency of open drains; rehabilitation of subsurface drainage in the Nile Delta; development of information Systems. '80% rehabilitation and modernization of irrigation scheme, and 20% large scale irrigation development'
23	Rehabilitation of Irrigation and Drainage Pumping Stations " Second Stage till 2017"	NA	2018-2022	66.2	The Project targets to modernize irrigation infrastructure to help boost food security and reduce poverty levels for 215,000 people residing near Cairo by the construction and equipping of a new pumping station in Kafr El-Sheikh, provision of spare parts for 10 existing pumping stations, installation of 10 weed-cleaning machines to raise efficiency of pumping stations, and provision of mobile electrical labs. '80%

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
					rehabilitation and modernization of irrigation scheme, and 20% large scale irrigation development'
24	Pumping Stations Rehabilitation Project " Future Stage till 2020"	NA	2017-2020	87.5	The Project targets to improve the efficiency of operation and maintenance of the pumping stations; improve the efficiency and reliability of irrigation water delivery; and strengthen further planning and O&M capacity of the Mechanical and Electrical Department to enhance the sustainability of the irrigation and drainage system. '60% rehabilitation and modernization of irrigation scheme, and 40% large scale irrigation development'
25	Rehabilitation and Improvement of Irrigation & Drainage Systems at Delta Region (I)	NA	2019-2027	640.0	The aim of this project is to 1) Improve the irrigation and drainage systems and all the hydraulic structure within the governorate command area; 2) Improve the water distribution methodology; 3) Improve and increase the efficiency of water management system in view of practical alternatives; and 4) Implement the improvements according to the priority list of water management development. '80% rehabilitation and modernization of irrigation scheme, and 20% large scale irrigation development'
26	Rehabilitation and Improvement of Irrigation & Drainage Systems at Delta Region (II)	NA	2023-2030	696.0	The aim of this project is to 1) Improve the irrigation and drainage systems and all the hydraulic structure within the governorate command area; 2) Improve the water distribution methodology; 3) Improve and increase the efficiency of water management system in view of practical alternatives; and 4) Implement the improvements according to the priority list of water management development. '80% rehabilitation and modernization of irrigation scheme, and 20% large scale irrigation development'
27	Rehabilitation and Improvement of Irrigation & Drainage Systems at Delta Region (III)	NA	2027-2032	422.0	The aim of this project is to 1) Improve the irrigation and drainage systems and all the hydraulic structure within the governorate command area; 2) Improve the water distribution methodology; 3) Improve and increase the efficiency of water management system in view of practical alternatives; and 4) Implement the improvements according to the priority list of water management development. '80% rehabilitation and modernization of irrigation scheme, and 20% large scale irrigation development'
28	Rehabilitation and Improvement of Irrigation & Drainage Systems at Upper Egypt (I)	NA	2030-2035	310.0	The aim of this project is to 1) Improve the irrigation and drainage systems and all the hydraulic structure within the governorate command area; 2) Improve the water distribution methodology; 3) Improve and increase the efficiency of water management system in view of practical alternatives; and 4) Implement the improvements according to the priority list of water management development. '80% rehabilitation and modernization of irrigation scheme, and 20% large scale irrigation development'

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
29	Improving Crop Water Productivity for some Major Crops under Future Climatic Change Conditions	NA	2017-2021	1.0	The Project aims at investigating the potential impact of climate change on productivity of some main crops and their water consumption; and mitigating the potential effects of climate change on the selected crops through analysis and evaluation of adaptation strategies as well determining the effective ones to reduce the adverse impacts and improve opportunities of the expected climate change on the agriculture sector. '100% others'
30	Modernization of Irrigation and Drainage Pumping Stations	NA	2018-2025	100.0	The Project aims to improve the efficiency of operation and maintenance of the pumping stations and thereby save public expenditures on O&M; improve energy efficiency of the pumping stations; strengthen further planning and O&M capacity of the Mechanical and Electrical Department to enhance the sustainability of the irrigation and drainage system. '100% rehabilitation and modernization of irrigation scheme'
31	Rehabilitation of Open and Subsurface Drainage (for 92437 ha)	NA	2019-2025	115.0	Improve the efficiency of agricultural drainage of irrigated land in the Delta and Nile Valley. '100% rehabilitation and modernization of irrigation scheme'
32	Developing and Disseminating Improved Technologies for the Use of Mixed Water in Agriculture	NA	2016-2022	1.0	The Project targets increasing the agricultural production at the selected communities in El Salam Canal Area using mixed water; disseminating the technology relevant to cropping pattern and water regimes; reducing the environmental risks. '100% others'
33	Appropriate Technology to Improve the Welfare of Poor Farmers through Rationalization of Input and Irrigation Water	NA	2017-2021	0.75	The Project aims at introducing new and simple technology to increase and enhance community's skills of sustainable water and soil management; and training farmers, extension staff and members of WUAs on raised-seed bed (wide furrows) as an irrigation water saving technology. '100% others'
34	Actual Crop Water Consumption for the Main Fruit Trees under Different Pruning Systems for all Climatologically Zones in Egypt	NA	2016-2021	2.0	Installing and evaluation of 3 weighing lysemeters. '100% others'
35	Adaptation Strategies to Improve Sunflower Yield Tolerance to Climate Change Stress in Egypt	NA	2017-2021	0.75	The Project aims at developing knowledge through field experiments on irrigation water administration and sunflower production in relation to the climate; and capacity building for the staff to understand post climate models and crop simulation models to be applicable for both water resources and agriculture sector in Egypt. '100% others'

#	Project title	Funding Partners	Time Scale	Total Budget (million US$)	Description
36	Development of Sustainable Food Production Strategies under Climate Change Risks in Less Fertile Soils in Egypt	NA	2017-2021	1.0	The objectives of the Project are capacity building for the working staff to understand and run post climate models, crop simulation models and ecosystem models; downscaling for GCM models from coarse resolution to local resolution for four locations at Nubaria, Bustan, El-Srew and North Sinai; and conducting field trials at the same four locations to make sure that the developed adaptation strategies in theory will have the same efficiency in the field. '100% others'
37	Improving Water and Fertilizers Productivity through Injecting all Agro-Chemicals and Bio-fertilizers through Irrigation Water	NA	2018-2022	0.80	Installing and evaluation of injection devices in a revolving fund to small landholders in the newly reclaimed lands. '100% others'
38	Role of Improving Furrow Irrigation Performance in Sustainable Agriculture	NA	2019-2022	0.75	The Project targets improving water productivity in three governorates at Delta Region and two governorates at Middle Egypt, conserving soil and water resources, and enhancing land and fertilizer use efficiencies, as well. '100% others'
39	Rationalization of Irrigation Water through Applying Modern Irrigation Technology at Delta and Nile Valley	NA	2016-2020	1.0	The Project aims at introducing an integrated crop and water management program to farmers for more efficient use of water, improving the delivery system in a way that reduce seepage losses thereby increasing water supply; and training the farmers regarding efficient use of irrigation water; training extension stuff in water management techniques. Such training leads to build up subject matter specialist more specialized in the field of water control. '100% others'
40	Improving Surface Irrigation Management by Using Perforated Plastic Films	NA	2016-2018	0.10	The Project aims at the provision of irrigation water added and reducing the amount of evaporation and transpiration of water conservation and soil by using perforated plastic films. '100% others'
41	Increasing the Water Use Efficiency and Maximizing Yield for Water Unit by Using the Technology Senses to Improve the On-Farm Water Precision Management	NA	2019-2021	0.9	The Project targets increasing the efficiency of irrigation systems and increasing productivity in various agricultural crops based on water unit in Beheira, Qalioubeya and El-Fayoum governorates using irrigation modeling, soil scanning and remote sensing. '100% others'

ANNEX 2. MAP OF Egypt

FAO - AQUASTAT, 2005

EGYPT

Disclaimer

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

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