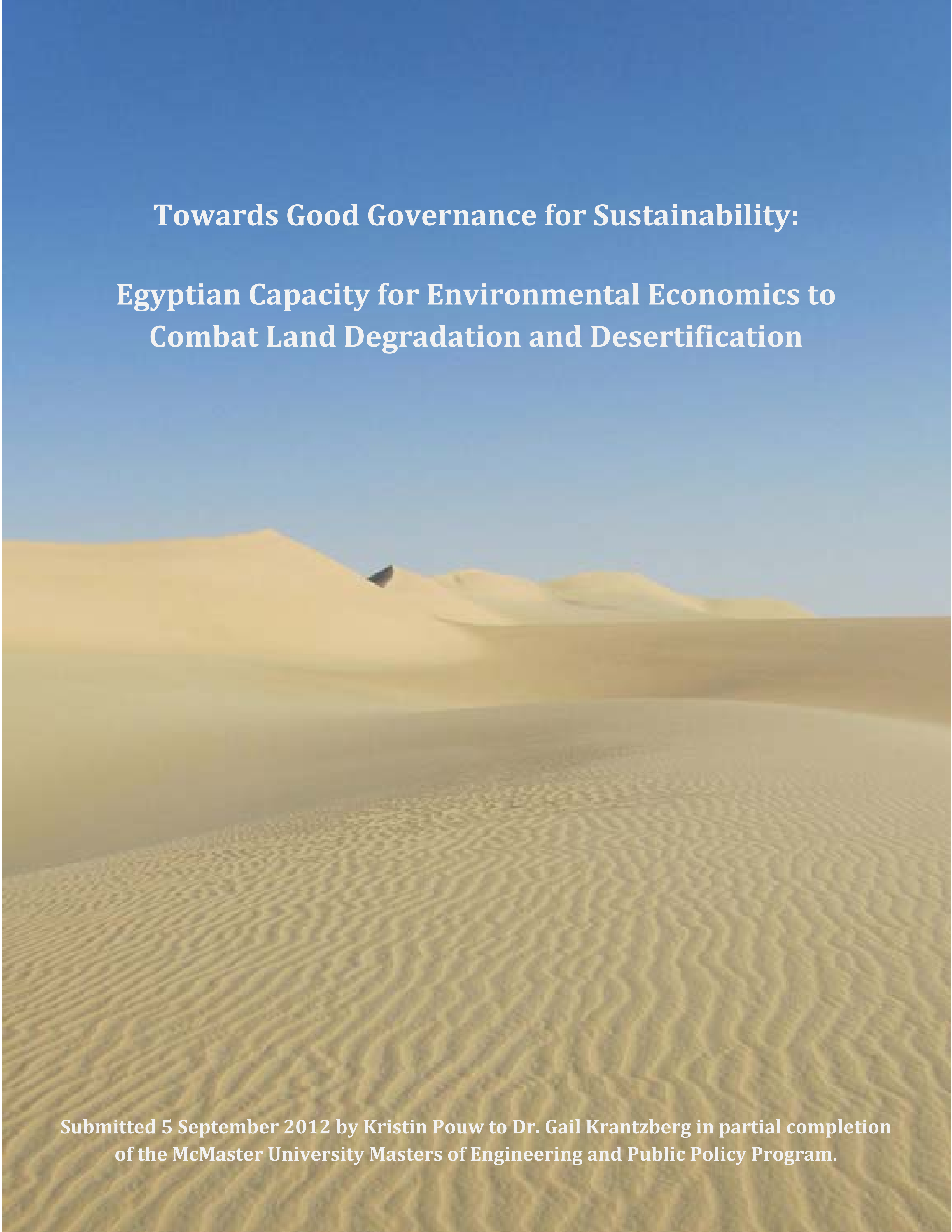

Towards Good Governance for Sustainability:

Egyptian Capacity for Environmental Economics to Combat Land Degradation and Desertification

Submitted 5 September 2012 by Kristin Pouw to Dr. Gail Krantzberg in partial completion of the McMaster University Masters of Engineering and Public Policy Program.

Contents

Abbreviations and Symbols

B	Prefix representing billion
CEDARE	Centre for Environment and Development for the Arab Region and Europe
E£	Egyptian Pound, currency of Egypt[1]
EC	European Commission
EEAA	Egyptian Environmental Affairs Agency
ELD	Economics of Land Degradation Initiative
ENCC	Egyptian National Competitiveness Council
ENGO	Environmental Non-Governmental Organization
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Project
GEF	Global Environment Facility
GNI	Gross National Income
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
M	Prefix representing million
MALR	Egyptian Ministry of Agriculture and Land Reclamation
MENA	Middle East and North Africa
MOU	Memorandum of Understanding
MSEA	Egyptian Ministry of State for Environmental Affairs
MWRI	Egyptian Ministry of Water Resources and Irrigation
NEAP	Egyptian National Environmental Action Plan
NWRP	Egyptian National Water Resources Plan
SEEA	System of Environmental Economic Accounting
SEI	Stockholm Environment Institute
TEEB	The Economics of Ecosystems and Biodiversity
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNSD	United Nations Statistics Division
UNU-INWEH	United Nations University – Institute for Water, Environment and Health
US$	United States Dollars, official currency of the United States of America[2]
WBG	World Bank Group
€	Euro, official currency of the European Union[3]

[1] For reference only, the current value of the Egyptian Pound in Canadian Dollars is roughly $0.17 (www.xe.com).
[2] For reference only, the current value of the United States Dollar in Canadian Dollars is roughly $0.99 (www.xe.com).
[3] For reference only, the current value of the Euro in Canadian Dollars is roughly $1.22 (www.xe.com).

Preface

For the first time in its long and storied history, Egypt freely and democratically elected a civilian president on June 24, 2012. With that, Egyptians served Mohamed Morsy of the Muslim Brotherhood's Freedom and Justice Party a mandate to reform and rebuild the country's institutions and economy in the best interest of its people. While it is acknowledged that more pressing priorities for the democratization and renaissance of Egypt are at hand (e.g., the recent dissolution of parliament by the military council and the current struggle to draft a new constitution, inter-religion violence), it is not too early to suggest that the Egypt's natural environment be given greater consideration in economic revitalization.

As a student of Engineering and Public Policy, President Morsy's background as an (electrical) engineer is of particular interest to me. However, it is too early to examine how President Morsy might use his engineering skills and knowledge to approach difficult public policy questions pertaining to the environment and the economy. There is hope that his engineering background will aid in promoting a rational and science-based approach to policy and decision-making.

This research was conceived during the turmoil of 2011 Egyptian Revolution and was completed within two months of the election. Although there was relatively little discussion of environmental issues during the parliamentary and presidential election campaigns, there was substantial discussion about implementing a system of Islamic Law or Shari'ah (Egyptian law is a hybrid of civil law, common law, and family law which includes Islamic law).[4] Despite myriad concerns about this proposed transition to an Islamic state, it presents some promise for the state of the environment, in that Islam and Islamic Law espouse the principles of sustainable development.

The 1983 Islamic Principles for the Conservation of the Natural Environment include the common right to use and benefit from ecosystem services and the common responsibility to protect, conserve, and develop the environment. The principles also advocate for the "consideration of all aspects of the environment, including both the aesthetic and sanitary points of view, during the study and adoption of

[4] The Al-Nour Party of the Islamist Alliance included environmental protection in its platform, focusing on pollution of the Nile River and heavily populated industrial areas, water-borne diseases, and clean energy (Baraka, 2011). The Islamist Alliance received 24.4% of the vote in the People's Assembly elections of 2011.

The Nationalist Progressive Unionist Party (Al-Tagammu' Party) under party leader Mohamed Reefat Al-Saeed cited raising awareness of environmental issues as one of its most important goals (European Forum, 2011). In 2011, the party listed regulating water consumption and investing in the development of sustainable energy sources as part of its platform on economics (No author, 2011). The party is a minor partner of the Egyptian Bloc Alliance, which received 6.7% of the vote in the People's Assembly elections of 2011 (European Forum, 2011).

The Freedom Egypt Party has released five policy papers towards the development of its long-term environmental program (Baraka, 2011). The party is a member of the Revolution Continues Alliance which received 2.8% of the vote in the People's Assembly elections of 2011 (European Forum, 2011).

Many independent candidates also included environmental issues in their political platforms during the People's Assembly elections of 2011.

any development project", which is consistent with the objectives of environmental economics discussed in this paper (Ba Kader *et al* 1983).

Later, in 1986, religious scholars were tasked by the World Wildlife Fund International to formulate perspectives on their respective religions and the environment. The perspectives became known as the Assisi Declarations. The Muslim Declaration stated that, "Shari'ah should not be relegated just to issues of crime and punishment, it must also become the vanguard for environmental legislation" (Nassef, 1986). The declaration focuses on three principles of Islam that pertain to conservation: *tawheed* (unity), *khalifa* (trusteeship), and *akhrah* (accountability of trustees). More recently, the World Bank's 2003 book, *Faith in Conservation - New Approaches to Religions and the Environment*, elaborated on these principles (Mahasneh, 2003). The principle of *tawheed* defines the subordinate relationship of man to *Allah* (God) and emphasizes God's ownership of the environment. The concept of k*halifa* is that each human is appointed as a guardian or trustee and must execute the duty to *Allah* and the environment with *mizaan* (reason), just and wise use of ecosystem services, and *fitra* (conservation).

There is hope that the renaissance of an Islamic state in Egypt could bring about positive change for the state of the environment in Egypt, as well as for the Egyptians and their neighbours that depend on the environment and ecosystem services for their livelihoods.

Abstract

Of late, burgeoning academic and political interest has been focused on the valuation of ecosystem services towards the good governance of natural resources for sustainability. This report explores Egypt's potential motivation for and capacity for environmental economics towards good governance of land and water resources to combat land degradation and desertification.

As a drylands jurisdiction, land and water resource degradation present serious social, environmental, and economic issues for Egypt. While the demand for Egyptian agricultural products rises to support the food security and development needs of Egypt's growing populace, land and water resources simply can't keep pace. Fertile land and irrigation systems are concentrated in the Nile River Valley and Delta, where agriculture is forced to compete with urban and touristic development for limited land resources, and where water resources are polluted by untreated domestic and industrial effluents. In more pastoral regions, overexploitation of common pool resources, such as rangelands and fuelwood/firewood, is threatening livelihoods and delaying development by accelerating land degradation and desertification.

Though surely motivated, Egypt is not necessarily capable of assessing the value of ecosystem services associated with its land and water resources. Opportunities for Egyptian capacity development in environmental economics exist within initiatives like TEEB and ELD, as well as through endeavours between international and domestic academic institutions, like the proposed twinning arrangement between the United Nations University – Institute for Water, Environment and Health (UNU-INWEH) Drylands Ecosystems Programme and Alexandria University. It is recommended that Egypt pursue a TEEB or TEEB-like national assessment by first evaluating the environmental economics of land degradation in Egypt through ELD.

1 Introduction

To begin, it is necessary to define the concept of environmental economics, specifically as applied to develop corrections to market failures that allow the unsustainable exploitation of ecosystem services. Such corrections may be made through policy instruments, but motivating the corrections requires an appreciation for the costs and benefits of doing so.

A review is also offered of the concept of drylands, the ecosystem services of drylands, the mechanisms of unsustainable exploitation of ecosystem services that results in land degradation and desertification, and the resultant environmental damages that are associated with more tangible economic costs, such as loss of agricultural productivity and livelihoods.

The final section of this introduction provides the salient background information on Egypt's economy, demographics, geography and climate, environment, and environmental governance that is required to appreciate Egypt as a drylands jurisdiction and the magnitude of its dependence on scarce land and water resources.

1.1 Economics and Ecosystem Services

Economics is "the study of how scarce resources, goods, and services are allocated among competing uses" (Hackett and Moore, 2011). Ecosystem services are the benefits that people obtain from ecological systems, and they represent a significant part of the global economy. The United Nations Convention on Biological Diversity (UNCBD) estimates that "at least 40% of the world's economy and 80% of the needs of the poor are derived from biological resources" (UNCBD, 2011). Essentially all natural resources and ecosystem services can be considered scarce due to the time scales associated with natural resource regeneration, the sensitive and not well understood nature of ecosystems to disturbances, and the ever expanding human population coupled with potentially infinite consumer demand currently associated with transitions to "higher" standards of living.

The Millennium Ecosystem Assessment divides ecosystem services into four categories: provisioning services, regulating services, cultural services, and supporting services (*Millennium Ecosystem Assessment*, 2005a). Provisioning services include food, fibre, fuel, genetic resources, biochemicals, natural medicines, pharmaceuticals, ornamental resources, and freshwater. Regulating services include air quality regulation, climate regulation, water regulation, erosion regulation, water purification and waste treatment, disease regulation, pest regulation, pollination, and natural hazard regulation. Cultural services include cultural diversity, spiritual and religious values, knowledge systems (both traditional and formal), educational values, inspiration, social relations, sense of place, cultural heritage values, and recreation and ecotourism. Supporting services include soil formation, photosynthesis, primary production, nutrient cycling, and water cycling.

Most often, human efforts to enhance provisioning services cause degradation of other ecosystem services. In fact, researchers at Stanford University found strong negative correlations between provisioning ecosystem services and most regulating and cultural ecosystem services (Raudsepp-Hearne, 2009). Consequently, no natural resource debit can occur without a correlated decline in ecosystem services. Furthermore, although natural resource scarcity may be ameliorated by investment in human capital for technological innovation in substitution, intensity-of-use reduction, and discovery of new resource reserves (often associated with technological advances in resource exploration techniques), humans have yet to find ways of ameliorating ecosystem services scarcity, with the exception of conservation. The primary explanation for this is that while many natural resources are market goods associated with price signals of scarcity, ecosystem services are not generally considered market goods and lack price signals otherwise associated with the scarcity of traditional goods traded in the market.

In economic terms, Hardin considered ecosystem services to be "common property" because they were subject to free riding because people could not be made to pay for them (Hardin, 1968). Hardin's "Tragedy of the Commons" identifies the "market failure" that occurs when individual economic actors are encouraged to overuse natural resources and ecosystem services because they do not have to pay for them, while they can internalize the profits gained through their use. When a cost (or benefit) is not calculated into an exchange between parties to an economic transaction (i.e., the user and the public), it is referred to as an "externality". Externalities can be both positive and negative. However, in general, environmental externalities occur as the negative externalities of resource degradation and pollution.

Since no party to the economic transaction is required to pay an economic price to avoid externalities, profiteering encourages overuse.

Since Hardin, Ostrom and others have clarified his “Tragedy of the Commons” idea to be the result not of “common property” (something owned by all) but rather *res nullius* (something owned by no one) (Ostrom, 1990). In any case, the driving features of the “tragedy” of unsustainable resource use are that such goods are rivalrous (scarce) but not excludable. This means that the use of ecosystem services by one person or party generally does result in diminishment for use by others, but that ecosystem services are generally available to all persons or parties free of charge and, therefore, lack a mechanism to ensure judicious or accountable use. When “common” goods are available free of charge, the normal market forces that efficiently allocate resources in the economy are absent. Because of this, common goods are often associated with what is known as the “open access problem”.

The open access problem occurs when free riders capitalize on the use of goods while externalizing the negative impacts associated with such use, including goods depletion through use as raw materials sources and goods degradation through use as waste products sinks. Governments may choose to address the “open access problem” market failure by imposing artificial signals of scarcity via “command and control” regulation. Thus, instead of a price signal, overuse or misuse of resources is associated with quasi-criminal punishments such as fines. This can be economically inefficient and, for many governments, practically ineffective. One problem with “command and control” regulation is that it depends on government capacity, firstly, to discern the scarcity of an ecosystem service(s) without price signals, secondly, to know what penalties will effectively incentivize efficient and/or sustainable use of the ecosystem service(s), and thirdly, to enforce such penalties. Thus, ecosystem services can be considered subject to market and government failures. For these reasons, ecosystem services have long been taken for granted and “overall, there are numerous signs that the capacity of ecosystems to continue to produce many of the goods and services we depend on is decreasing” (World Resources Institute, 2000).

Academic interest in environmental economics, and in particular, the valuation of ecological services, has surged since Costanza *et al*’s landmark study, which in 1997, estimated the average annual global value of ecosystem services and natural capital to be $33 trillion (Costanza *et al*, 1997). Value transfer or benefits methods have been developed at the nexus of environmental economics and geography to enable the adaptation of ecosystem service values between similar geographic and contextual settings (Troy and Bagstad, 2009). Moreover, many instruments for the management and internalization of environmental externalities have been identified, developed, implemented, and assessed. There has been mounting focus on managing ecosystem services as economic goods since the first Rio Conference in 1992.

Regrettably, inadequate or absent institutional capacity for environmental economics and ecosystem valuation has been recognized as a barrier to good governance in sustainable policy, regulation, project, and resource allocation decision-making (TEEB, 2009).

1.2 Drylands and Ecosystem Services

Drylands have been defined by the United Nations University as areas where "available soil water is limited because of low precipitation and high evaporation" (United Nations University, n.d.a). Low precipitation can be defined as both inadequate quantity and/or inadequate seasonal distribution of precipitation. Sub-categories of drylands include hyper-arid, arid, semi-arid, and dry subhumid regions. The sub-categories are defined by the aridity index, which is the ratio of mean annual precipitation to mean annual evapotranspiration, as shown in Table 1.

Table 1: Sub-Categories of Drylands by Aridity Index (United Nations University, n.d.a)

Sub-Category of Drylands	Aridity Index
Hyper-arid	<0.05
Arid	0.05 to 0.20
Semi-arid	0.20 to 0.50
Dry subhumid	0.50 to 0.65

While the direct utilization of ecosystem services by humans in hyper-arid and arid regions is limited to nomadic pastoralism, semi-arid and dry sub-humid areas can support both rangelands and croplands (United Nations University, n.d.a). The United Nations Development Programme (UNDP) estimates that over 50% of the Earth's area is comprised of drylands and that over one billion people directly derive their livelihoods from drylands (UNDP, n.d.). The ecosystem services derived from drylands have been described by the Millennium Ecosystem Assessment and are summarized in Table 2 below.

Table 2: Summary of drylands ecosystem services (Millennium Ecosystem Assessment, 2005b).

Category of Ecosystem Services	Primary Services
Supporting Services	• Soil formation and conservation by vegetation and microorganisms • Nutrient cycling by invertebrate macro-decomposers and livestock • Primary production of biomass
Regulating Services	• Water regulation • Climate regulation • Pollination and seed dispersal
Provisioning Services	• Food and fiber • Woodfuel • Biochemicals (plants with medicinal, cosmetic, and culinary value) • Freshwater • Energy (wind and solar)
Cultural Services	• Cultural identity and diversity • Cultural landscapes and heritage values • Servicing knowledge systems, both scientific and traditional • Spiritual services • Aesthetic and inspiration services • Recreation and tourism

Negative anthropogenic impacts to the provision of ecosystem services in drylands (land degradation in drylands is called "desertification") occur due to:

- Intensification of rangelands use: overgrazing causes the depletion of native vegetative cover which causes soil erosion, as well as sand erosion and deposition
- Conversion of rangelands into croplands: involves the removal of native vegetative cover (and associated loss of biodiversity) which causes soil erosion and decreased crop productivity;
- Intensification of croplands use: over-cropping can cause soil exhaustion; agricultural chemical application can degrade soil and water quality; cropland irrigation can cause soil salinization and decreased crop productivity, and can degrade water resources availability and quality
- Intensification of fuelwood/firewood exploitation: involves the removal of native vegetative cover which causes soil erosion, as well as sand erosion and deposition
- Global climate change may also cause a reduction in vegetative cover, crop productivity, and water availability and quality. Desertification and climate change are linked by a feedback loop: where climate change causes a reduction in vegetation cover and subsequent soil erosion, soil carbon sinks are depleted and atmospheric carbon is increased, causing further climate change (United Nations University, n.d.a; UNCCD, n.d.).

The downstream costs of the aforementioned negative impacts include increased frequency and severity of floods, landslides, sedimentation, and degraded water quality. Overtime, these impacts to ecosystem services reduce the opportunities for livelihoods in drylands areas, ultimately leading to food insecurity, poverty, and rural to urban migration. Drylands areas are associated with low GNP per capita and high infant mortality rates when compared to other regions. Drylands jurisdictions face unique challenges in achieving the Millennium Development Goals due to sociocultural aspects (nomadic lifestyles, gender roles and inequalities), low economic development due to inadequate infrastructure and limited markets, environmental constraints to productivity (flood, droughts, and vulnerability to climate change), and inadequate government and institutional capacity (UNDP, 2012).

Land degradation and desertification is considered to be an outcome of resource management failure due to the externalization of costs in land and water resource use (such as the aforementioned downstream costs) and the general lack of appreciation of the damage costs of land degradation and desertification, which include the loss of ecosystem services (Akhtar-Schuster *et al*, 2010).

At the Rio Earth Summit in 1992, desertification (along with climate change and loss of biodiversity) was identified as one the greatest challenges to sustainable development (UNCCD, 2012a). From this the United Nations Convention to Combat Desertification adopted in 1994 and came into force in 1996. The convention was ratified by Egypt in 1995 (UNCCD, 2012b).

1.3 Background Information on Egypt

Egypt, more properly known as the Arab Republic of Egypt, is a transcontinental nation situated in both North Africa and Southeast Asia (via Sinai Peninsula). The following sub-sections include details on Egypt's economy, demographics, geography, and environment that are relevant to this research.

1.3.1 Egyptian Economy

In 2011, the Egyptian Gross Domestic Product (GDP) was US$229,530,568,260 (CIA, 2012). The Egyptian economy is said to be the second largest in the Arab World (BBC, 2012). The Egyptian economy is dominated by agriculture (15%), industry (38%), and services (48%, including tourism). Trends in GDP and GDP per capita are shown in Figure 1 and Figure 2 below.

In 2007, the Egyptian agricultural sector employed approximately 27% of the total Egyptian workforce (or over 5.5 million workers) and generated approximately 15% of Egypt's gross domestic product GDP (ENCC, 2009). In contrast, the Egyptian tourism sector employs approximately 12% of the total Egyptian workforce and generates approximately 11% of Egypt's GDP (Egypt State Information Service, n.d.).

In the 6th Egyptian Competitiveness Report, the Egyptian Minister of State for Environmental Affairs noted that "Egypt's competitiveness depends largely on the quality and availability of natural resources and on the country's capacity to steward its environmental and natural resources" (ENCC, 2009). In the same report, the Egyptian Minister of Agriculture and Land Reclamation acknowledged that threats to the environment such as desertification and climate change must be met by gains in agricultural productivity and efficiency.

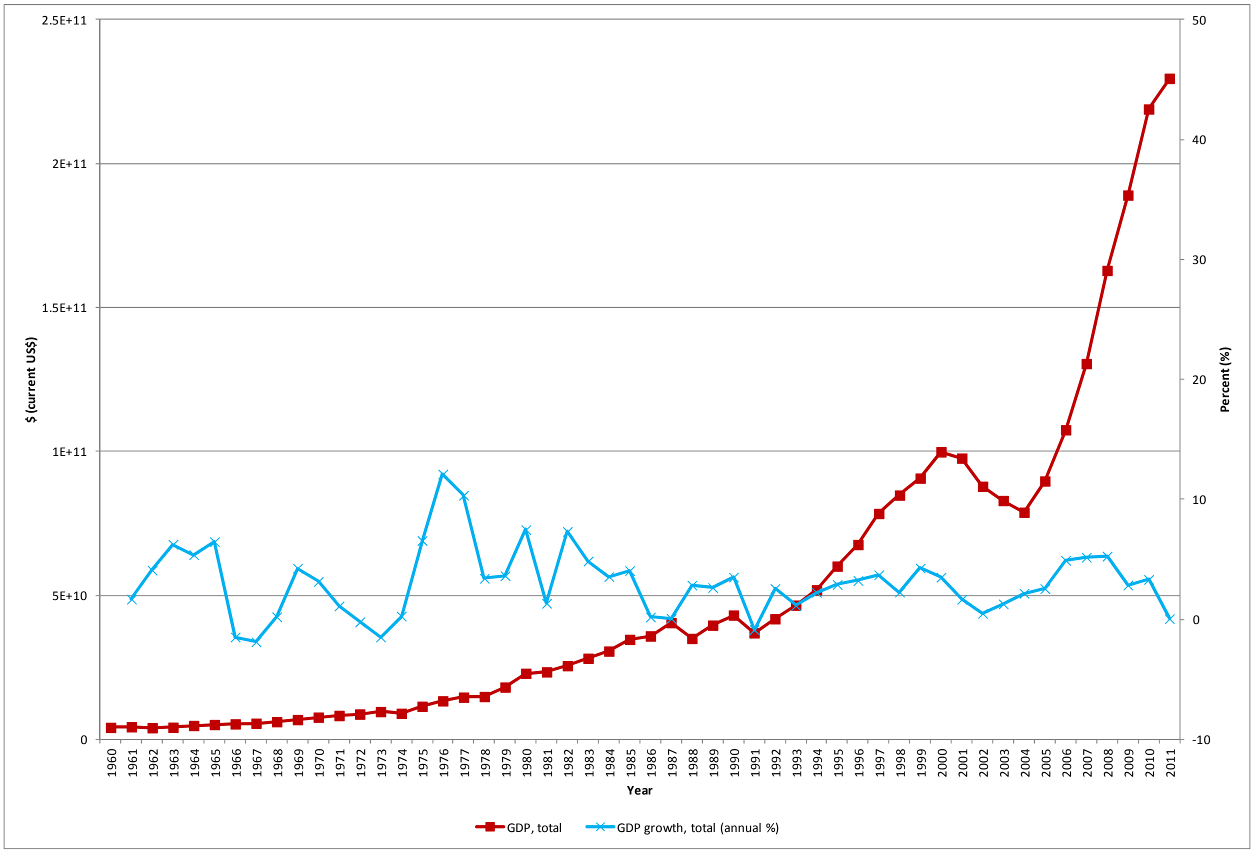

Figure 1: Egyptian GDP and annual GDP growth. Chart by author with World Bank data (WBG, 2012).

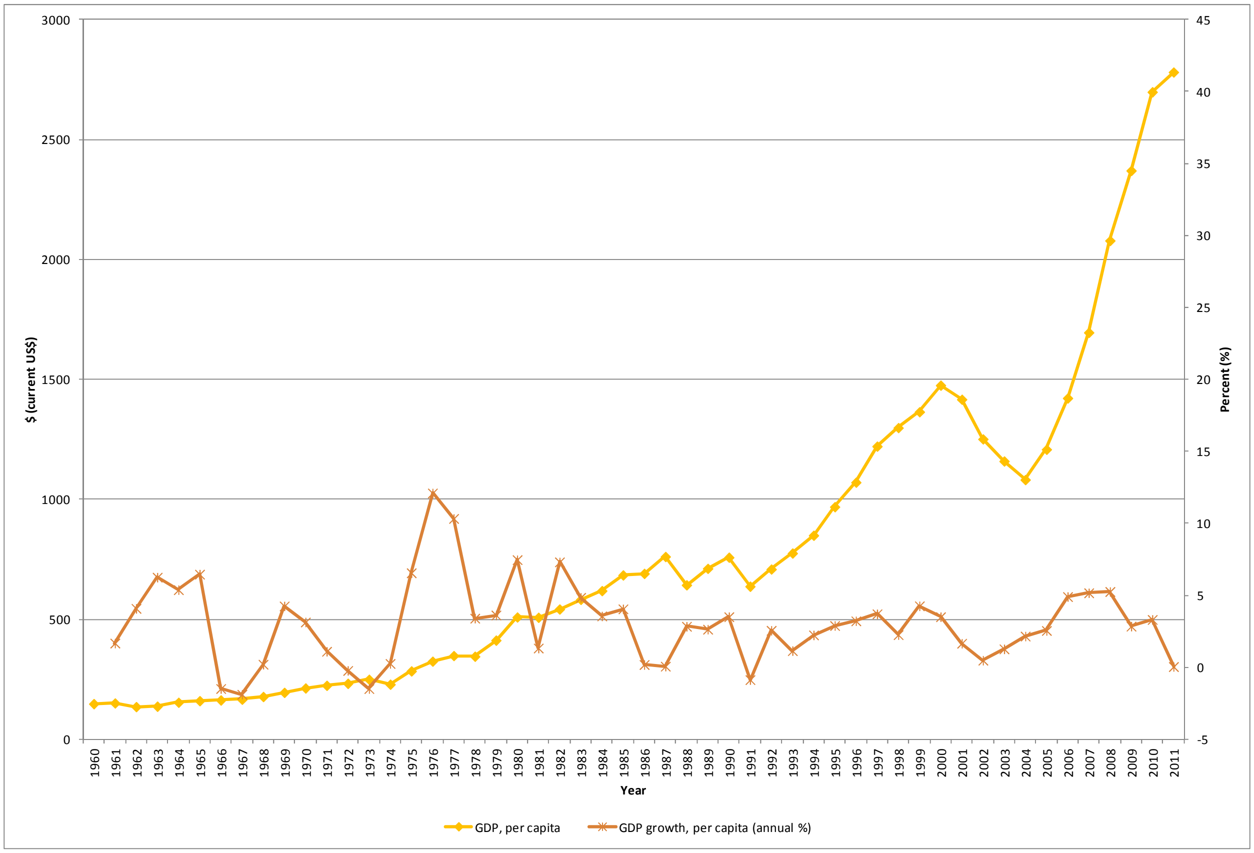

Figure 2: Egyptian GDP per capita and GDP per capita growth. Chart by author with World Bank data (WBG, 2012).

1.3.2 Egyptian Demographics

In 2011, the population of Egypt was 82,536,770 (CIA, 2012). In the same year, approximately 33% of the population was aged 0 to 14 years and 63% of the population was aged 15 to 64 years (CIA, 2012). In the past two decades, Egypt's rate of population growth (both total and urban) has stabilized at just under 2% annual growth. Egyptian population trends are illustrated in Figure 3 below.

The Egyptian population is heavily concentrated in the Nile River Valley, the Nile River Delta and the Suez Canal, as illustrated in Figure 4. These areas are also the most fertile in terms of agricultural productivity, as discussed in section "1.33 Egyptian Geography". Just under 43% of Egypt's population lives in urban centers, with about 20% living in urban agglomerations of at least 1 million persons (WBG, 2012). Most of Egypt's urban centers are situated in areas of high agricultural potential. Nearly 70% of Egyptian poor and food-insecure population lives in rural areas (Handoussa, 2010).

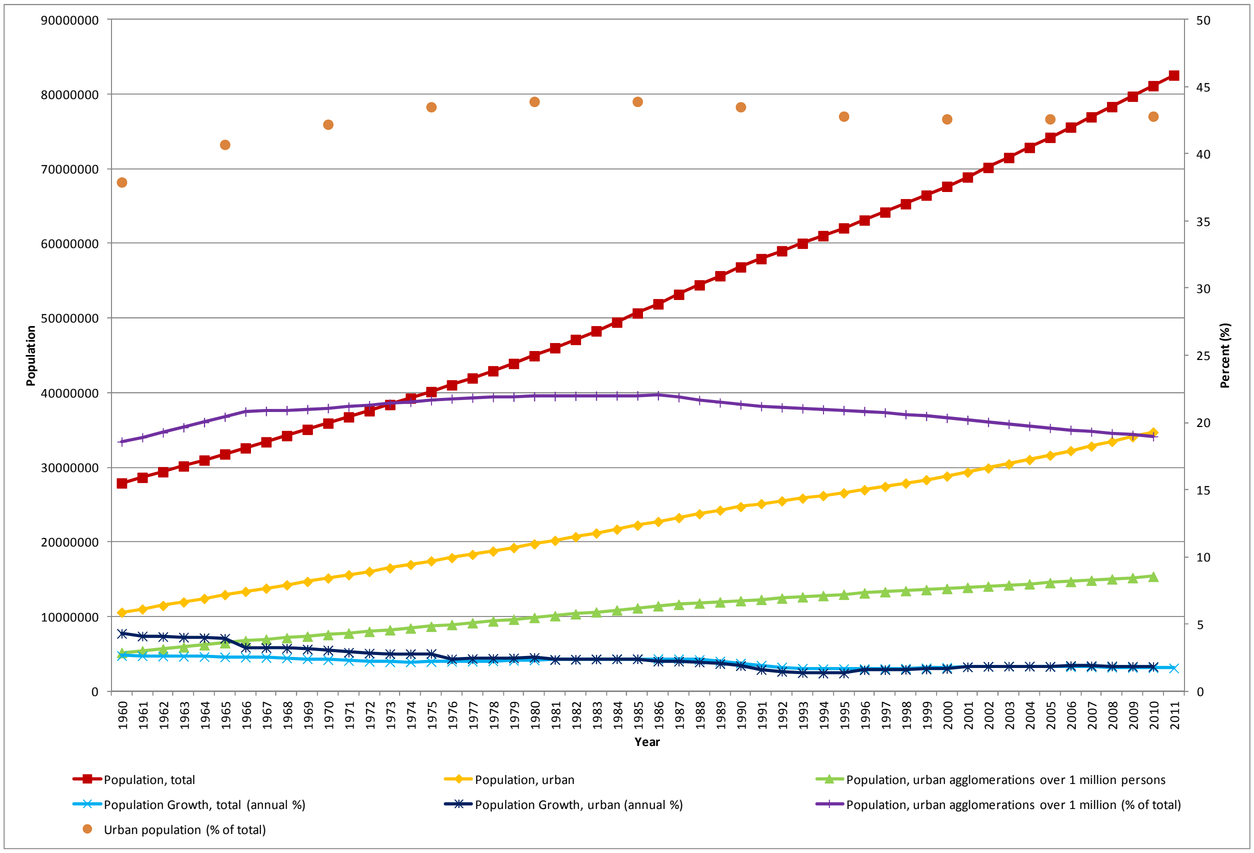

Figure 3: Egyptian population trends. Chart by author with World Bank data (WBG, 2012).

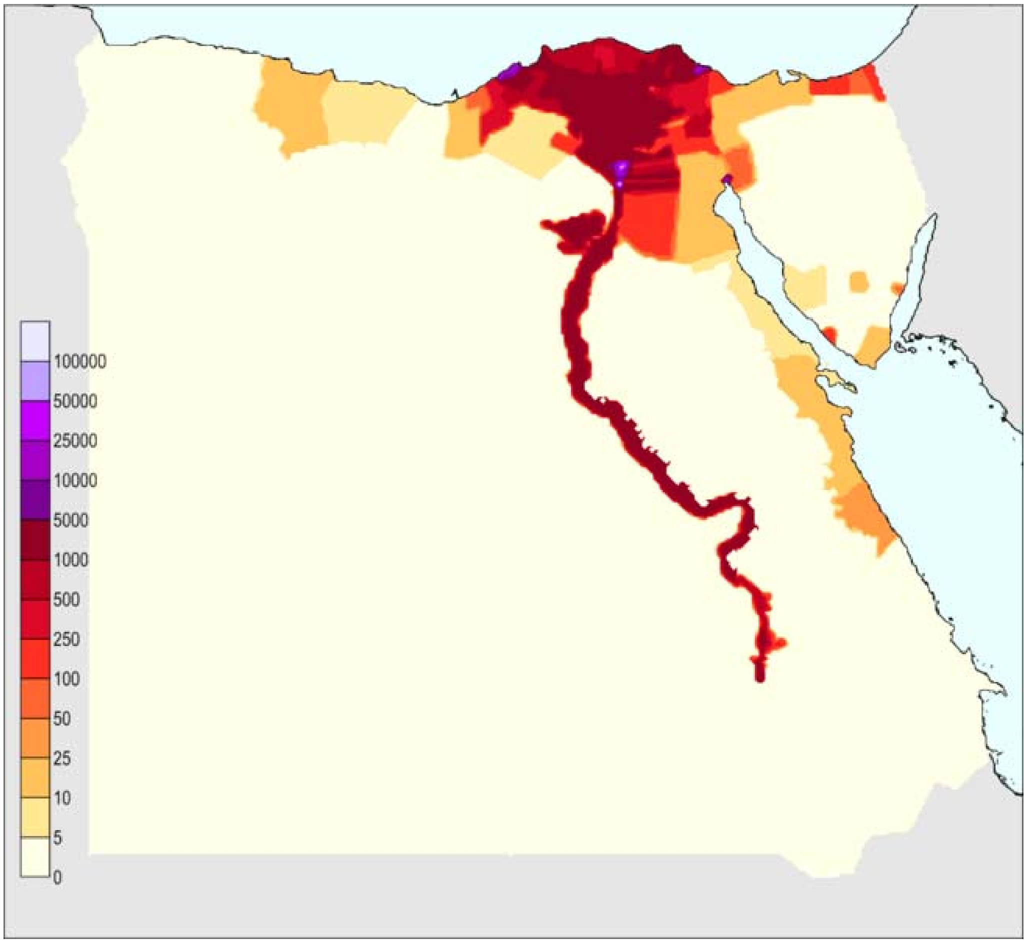

Figure 4: 2010 Egyptian population density in persons per square kilometer (SEDAC, 2012).

1.3.3 Egyptian Geography and Climate

Egypt has a total land area exceeding 1,000,000 km^2 (CIA, 2012). Of Egypt's total land area, only about 3.5% is agriculturally productive (IFAD, 2006). Most of the agriculturally productive land occurs in the Nile River Valley and Nile River Delta, as illustrated in Figure 5 below. Egypt can be classified as a drylands jurisdiction, as it is comprised of arid and hyper-arid regions; arid regions extend along the Mediterranean Coast and the Gulf of Suez, and hyper-arid regions occupy the remainder of the land (Hegazi *et al,* 2005). The arid and more northerly hyper-arid regions have winter rainfall regimes, with the rainy season extending from November to April and the bulk of rainfall occurring in December and January. The remaining hyper-arid regions are almost rainless. Evapotranspiration is lower in the arid regions than in the hyper-arid regions.

As in many drylands jurisdictions, desertification is a major issue in Egypt, as Egypt struggles to match its agricultural productivity to its ever-growing population. In 2005, the Egyptian Ministry of Agriculture and Land Reclamation identified the anthropogenic contributions to desertification in Egypt to be:

- Irrigation systems (utilizing both surface water and groundwater) causing soil salinization
- Unsustainable agricultural practices (cropping is too intensive or too frequent)

- Depletion of native vegetation cover from overgrazing, conversion of rangelands to croplands, and over exploitation of fuelwood/firewood, and encroachment of touristic, urban and peri-urban areas into rangelands and croplands (especially within the Nile River Valley and Nile River Delta regions)
- Development of stock watering points (via groundwater or hauled water) for grazing herds which facilitates overgrazing in areas where grazing was previously only possible during rainy seasons
- Chemical and biological degradation of soil quality due to irrigation with polluted water (the pollution stemming from untreated municipal and industrial effluents) and high rates of agrochemical application (fertilizers, herbicides, and pesticides)
- Depletion of soil fertility due to anthropogenic alterations to natural processes, such as the annual flood of the Nile River and the associated delivery of sediments and nutrients to the Nile River Valley, which was eliminated by the construction of the Aswan Dams. The dams have also altered the depth to groundwater, which has caused water logging and soil salinization (Hegazi *et al*, 2005).

These causes are consistent with those listed and discussed in the section “1.2 Drylands and Ecosystem Services.”

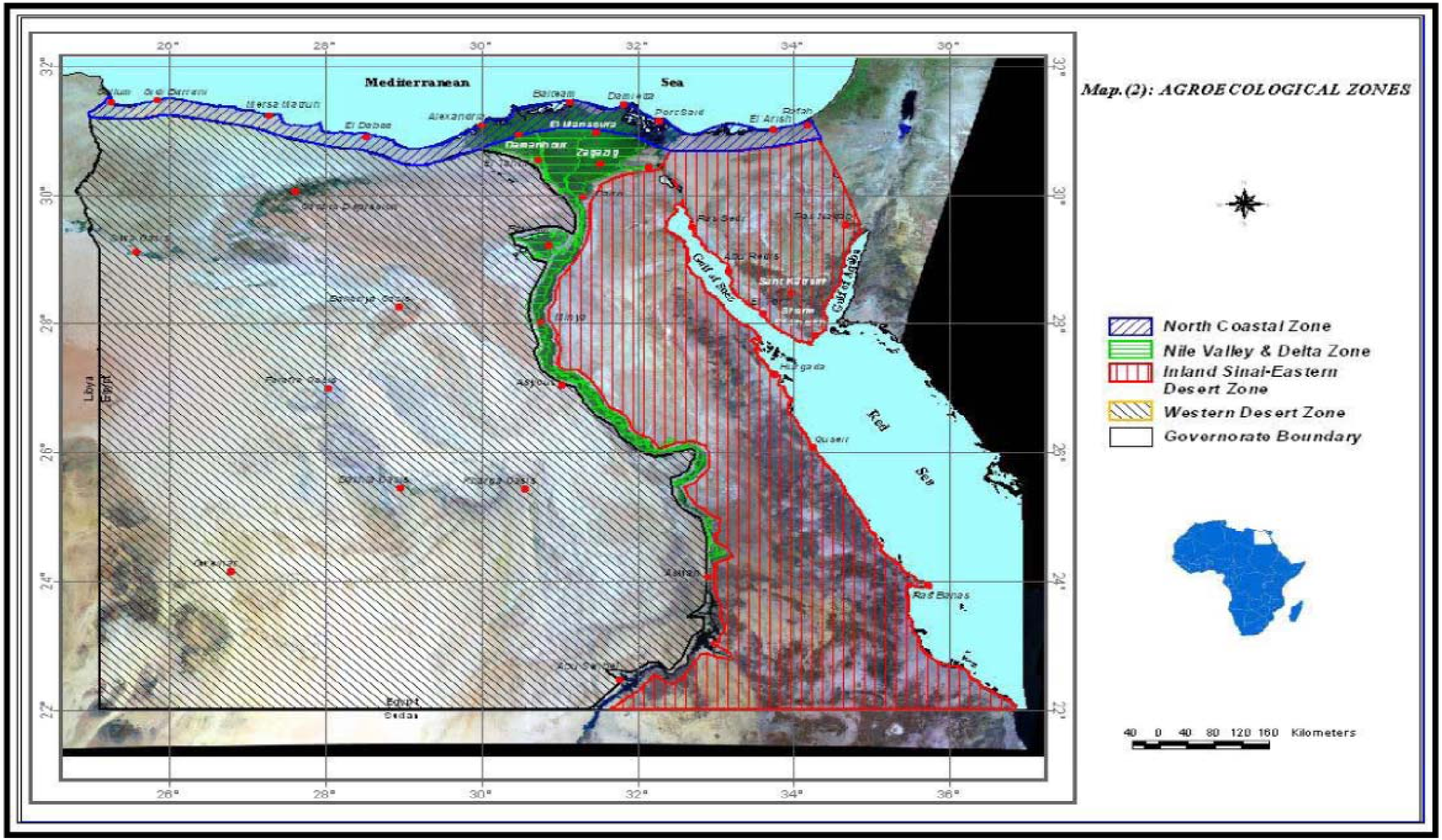

Figure 5: Egypt's agroecological zones (Hegazi *et al,* 2005).

1.3.4 Egyptian Environment

Land and water resource availability and quality are major environmental concerns in Egypt. A large and growing population paired with limited arable land has resulted in intense utilization of both land and water resources to generate agricultural products both for domestic consumption and for the export economy. The CIA World Factbook argues that land and water resource degradation contributed to the 2011 Egyptian Revolution by contributing to serious risk of food insecurity (CIA, 2012; Breisinger *et al*, 2012). It has been postulated that food insecurity was a major factor in many nations involved in the so called "Arab Spring" (see Figure 6; Breisinger *et al*, 2012).

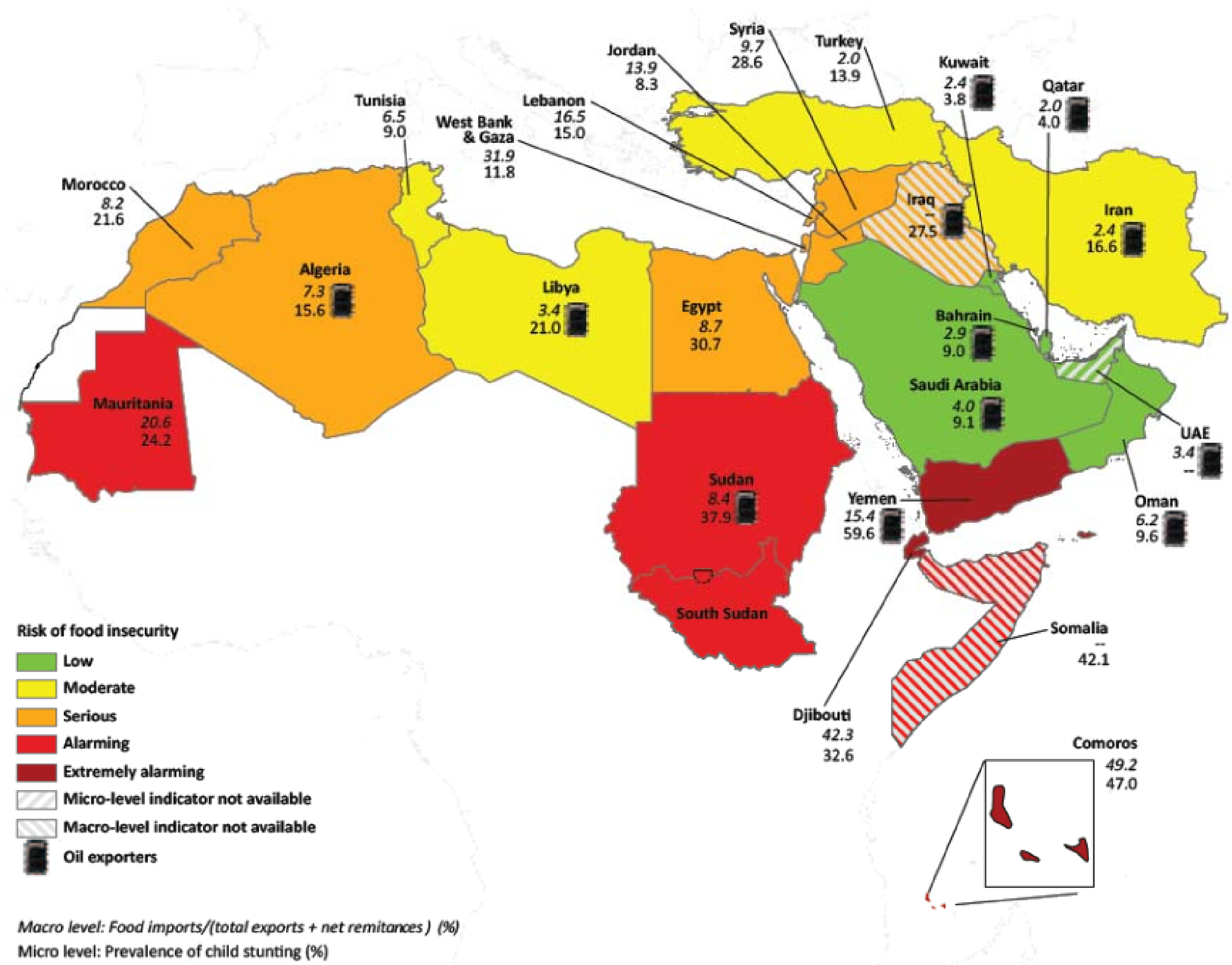

Figure 6: Risk of food insecurity in Arab League Countries plus Turkey and Iran (Breisinger *et al*, 2012).

Egypt has taken considerable effort to increase the area of agricultural land available to reduce food insecurity through land reclamation (gains in agricultural land area are shown in Figure 7) and to implement policy and regulation to limit the encroachment of urban development into areas with high agricultural potential. However, while the population nearly doubled from 1961 to 2009 (178% increase), the area of agricultural land increased by only 44%, such that the per capita area of agricultural land has declined dramatically, as shown in Figure 8. The productivity of available agricultural land has been artificially enhanced through irrigation, the application of agrochemicals, and the intensification of cropping (e.g., shorter fallow periods and continuous cropping). All of these productivity enhancing techniques contribute to land degradation and desertification (EEAA, 2001).

Agriculture is both the largest user of water and the main source of non-point source pollution in Egypt (Hecht, 2004; IFAD, 2006). Farmers are not directly charged for their use of water in agriculture, leading to inefficient irrigation practices because of inadequate price signals for water resources. As part of land taxes, farmers pay a fixed area-based tariff that is independent of crop type or volume of water used (Hellegers and Perry, 2004). While the average return to agricultural water has been estimated to be $0.08/m^3, the implicit price of agricultural water based on the fixed tariffs has been estimated to be just $0.0004/m^3. Impediments to volumetric charges for water are many due to the nature of water delivery infrastructure, especially in the old lands where the infrastructure is highly fragmented and no measurement devices and mechanisms (i.e., record keeping) are utilized.

Egypt's long-term average renewable water resources total 57.3 km^3/year, comprised of 1.8 km^3/year internal renewable water resources (precipitation plus renewable groundwater resources) and 55.5 km^3/year external water resources from the Nile River (CIA, 2012). Egypt is almost completely reliant on Nile River water that originates outside of its borders ("transboundary water") with a dependency ratio of almost 97% (World Bank, 2007). The Food and Agriculture Organization (FAO) of the United Nations estimates that, in 2002, 68.3 km^3 of water was withdrawn for domestic (5.3 km^3), industrial (4 km^3), and agricultural (59 km^3) purposes (FAO, 2005). This water was comprised of 7 km^3 renewable groundwater, 54.26 km^3 surface water, 3 km^3 treated wastewater, and 0.1 km^3 desalinated water. Thus, the amount of water withdrawn for agriculture alone exceeded the long-term average renewable water resources in Egypt. Currently, Egypt is considered to be water scarce, with per capita renewable water resource of 706.4 m^3/capita/year. The threshold for water scarcity is 1000 m^3/capita/year as defined by the United Nations (UNDESA, n.d.). Projections estimate that Egypt will reach absolute water scarcity of 500 m^3/capita/year or less by 2025 (MWRI, 2010).

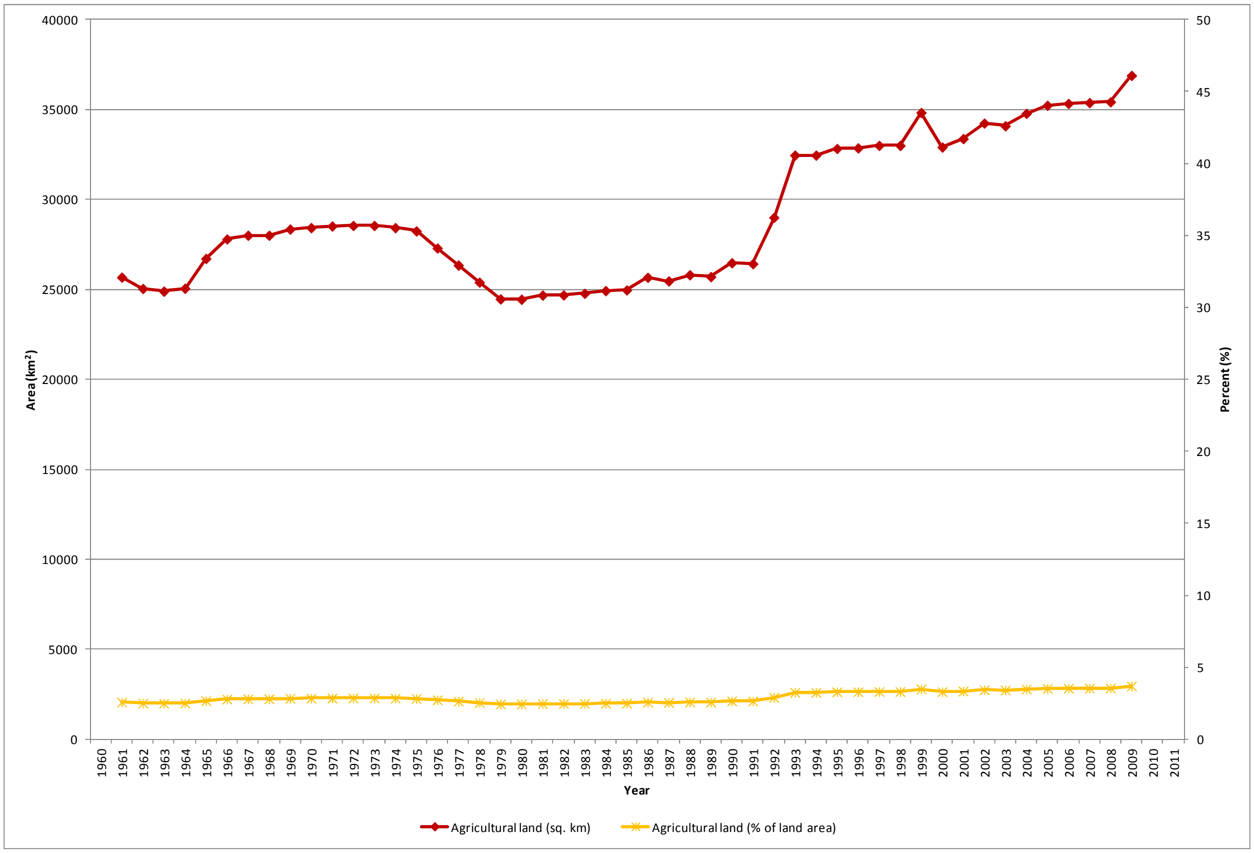

Figure 7: Egyptian trends in agricultural land. Chart by author with World Bank data (WBG, 2012). Increases in agricultural land area are largely due to government land reclamation initiatives. Declines in agricultural land area are associated with land degradation and desertification and urban and infrastructure expansion.

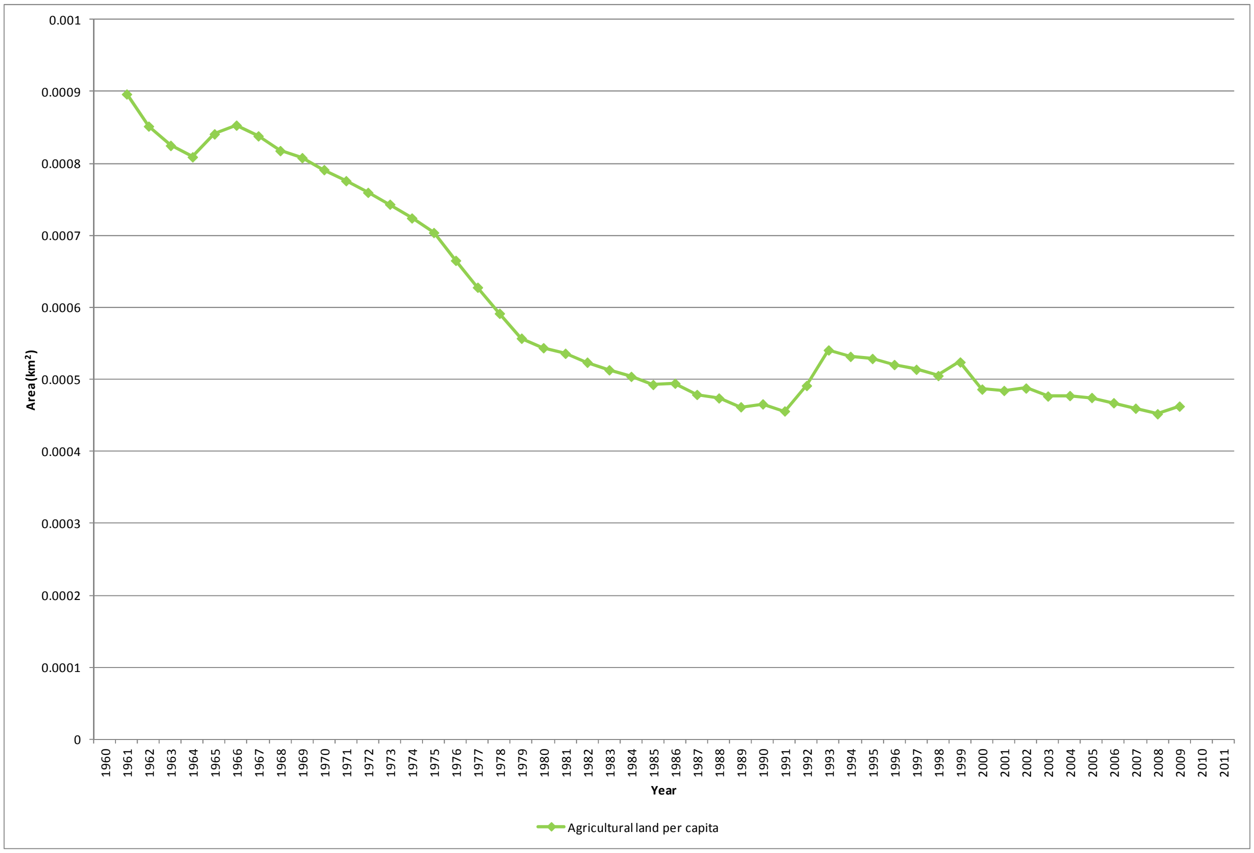

Figure 8: Egyptian trend in per capita agricultural land. Chart by author with World Bank data (WBG, 2012).

1.3.5 Domestic Environmental Governance

Figure 9 illustrates selected aspects of environmental governance in Egypt. The departments, sectors, and centers shown are of particular relevance to this study, as described in the figure's caption.

In Egypt, the Ministry of State for Environmental Affairs (MSEA) is primarily responsible for the governance of the environment. The role and responsibilities of the Ministry of State for Environmental Affairs were first defined in 1997 by Presidential Decree no. 275/1997 (MSEA, n.d.). The Egyptian Environmental Affairs Agency (EEAA) was first established in Law 48 of 1982 and then restructured under Law 4 for the Protection of the Environment of 1994. MSEA and EEAA are principally responsible for formulating environmental policies, planning and implementing environmental protection and development projects, and promoting environmental relations with regional and international organizations. Capacity for economic assessments of environmental degradation and biodiversity largely lies within the MSEA-EEAA Departments of Environmental Management and Nature Protection (see Figure 9). The EEAA is responsible for the National Environmental Action Plan (NEAP).

The Egyptian Ministry of Water Resources and Irrigation (MWRI) is responsible for providing water in adequate quantity and quality to all sectors (MWRI, 2009). The MWRI bears all costs of management, maintenance, and operations of water utilities and infrastructure. The Regional Center for Training and

Water Studies is responsible for water resources management capacity building. The MWRI is responsible for the National Water Resources Plan (NWRP).

The Egyptian Ministry of Agriculture and Land Reclamation (MALR) is responsible for all aspects of agriculture and land reclamation policy. The Desert Research Center is responsible for capacity building in drylands agriculture and land degradation and desertification. The MALR is also responsible for the Egyptian Strategy for Sustainable Agricultural Development.

The MSEA and EEAA, MWRI, and MALR have mandates that intersect in many areas, especially pertaining to land and water resource management for agriculture and combating land degradation and desertification.

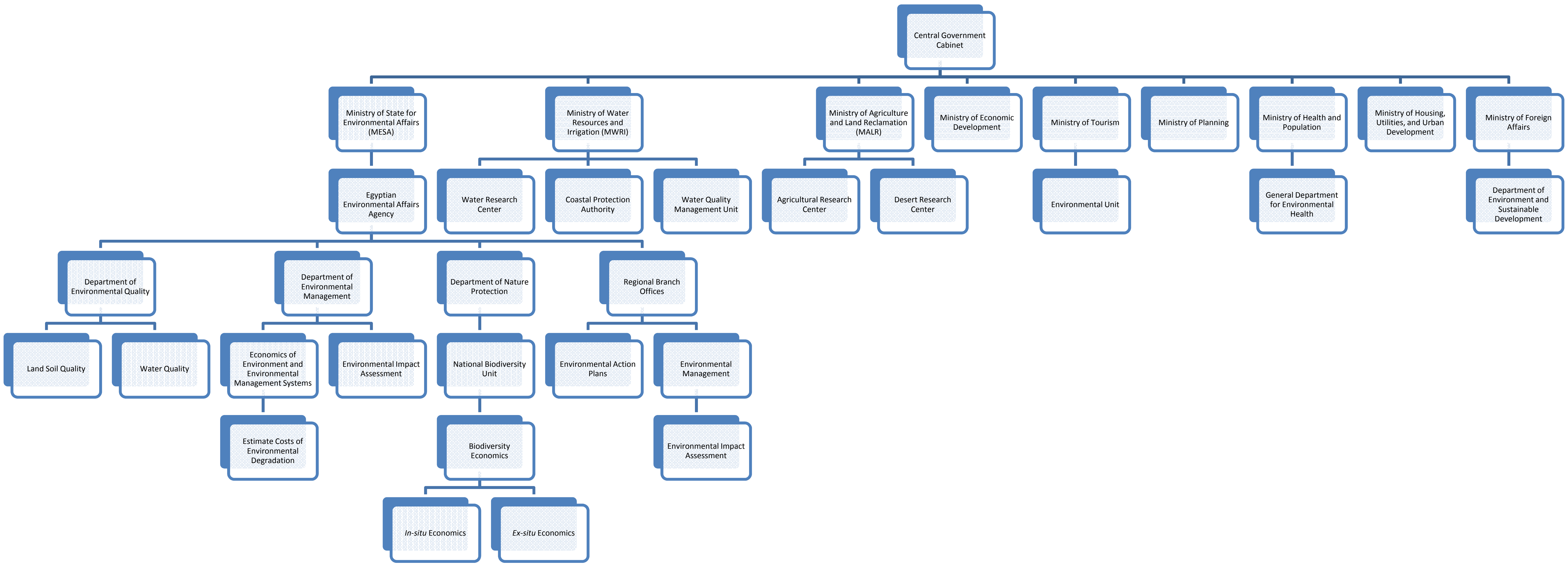

Figure 9: Selected aspects of an organizational chart of environmental governance in Egypt (adapted in part from MSEA, 2011). The Ministry of Agriculture and Land Reclamation organizational structure is not available in English. The Ministries of Economic Development, Tourism, Planning, Health and Population, and Housing, Utilities, and Urban Development are shown here because they interface closely with the Ministries of State for Environmental Affairs, Water Resources and Irrigation, and Agricultural and Land Reclamation. The Ministry of Foreign Affairs is shown here as it is responsible for international environmental agreements and cooperation through the Department of Environment and Sustainable Development Affairs. Other relevant departments of the Egyptian Environmental Affairs Agency that are not shown here include the Department of Organization, Management, and Training, which plays a role in capacity development planning and execution, and the Department of Finance and Administration, which sets investment budgets for the agency.

2 What Capacity does Egypt have for Environmental Economics?

It has already been established in that the evaluation of ecosystem services economics can provide valuable input to land and water resource policy and allocation decision making. To ascertain Egypt's capacity for environmental economics, a wide review of Egyptian government documentation, literature, Egyptian academia, and Egyptian environmental non-governmental organizations (ENGOs) was undertaken.

The review of Egyptian government documentation focused mainly on national plans and strategies pertaining to the environment including the National Environmental Action Plan, the National Framework for Sustainable Development, and the National Capacity Self Assessment and National Strategy and Action Plan for Capacity Development.

The literature search included a review of the Egyptian National Agricultural Library catalog, a review of the McMaster University Library catalog, and a Google Scholar search, each using the following keywords: "Egypt", "ecological economics", "environmental economics", "land degradation", "desertification", "ecosystem services", and "sustainable development".

The reviews of academic and ENGO capacity and expertise in environmental economics began with a general internet survey of all higher education institutions in Egypt and all ENGOs in Egypt but was unfortunately limited by the lack of information available in English. Thus, the information on academia and ENGO capacity presented below is mostly limited to that available from existing capacity reviews.

2.1 Government Documentation

2.1.1 National Environment Action Plan

Perhaps the best example of government documentation that identifies and discusses Egyptian capacity for the use of environmental economics in policy and decision making is the second Egyptian National Environment Action Plan (NEAP) of 2002/17. The document was intended to be a framework to coordinate domestic and international funding of environmental activities towards sustainable development (EEAA, 2001). The report indicates, but does not elaborate on, an understanding of the social and economic returns from investments in ecosystem services, such as the values of rehabilitating degraded irrigated areas and more wisely utilizing agricultural land. The report also indicates a high-level understanding (i.e., qualitative understanding) of the costs of environmental degradation via water pollution, air pollution, and solid waste management to human health, cultural resources (such as the Sphinx), environmental resources (such as tourist destinations on the Red Sea coast and South Sinai), and the economy (e.g., through non-competitive agricultural export products). The report indicates a good understanding that the costs of environmental degradation in Egypt are largely ignored and natural resources are used inefficiently due to market and policy failures. The report acknowledges the following gaps in environmental economics capacity:

- Lack of application and enforcement of economic instruments in pollution prevention and lack of application of the "polluter pays principle". Removing subsidies on agrochemicals and implementing water fees for not following government-designated regional cropping patterns are just two potential examples of the application of economic instruments. Removing subsidies on agrochemicals would allow market price signals to encourage their judicious use and could reduce surface and groundwater pollution associated with the excessive and inefficient application of agrochemicals. Implementing water fees for inefficient use of water in agriculture, such as for growing water-intensive crops like rice or for utilizing cropping patterns that are more water-intensive than government-designated regional cropping patterns, would introduce operating costs that could encourage farmers to adopt more sustainable crops and cropping patterns.

- Lack of application of economic incentives for natural resource and biodiversity conservation and sustainable use and lack of application of the "beneficiary pays principle". No examples of payments for ecosystem services (PES) economic incentive schemes could be found in Egypt.
- Knowledge deficiency in pricing environmental resources.
- Lack of consideration of natural resources in national accounts such as via a System of Environmental Economic Accounting (SEEA).

Interestingly, the report specifically proposes an independent economic evaluation by the EEAA of nature-based tourism and natural resources in Egypt, including costs of environmental degradation and mitigation. However, no evidence that such an evaluation was ever conducted could be found in the review of existing government documentation and literature available in English.

Regarding the purported lack of consideration of natural resources in national accounts, from World Bank data, it appears that Egypt does track natural resources depletion (as a % of gross national income (GNI)) as well as carbon dioxide and particulates damage as part of its Standard National Accounts. According to the World Bank, natural resources depletion is the sum of net forest depletion, net energy depletion (coal, crude oil, natural gas), and mineral (tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate) depletion (World Bank, 2012). On average, natural resources depletion contributes just under 11% of Egypt's GNI (WBG, 2012).

Also, Egypt planned on piloting water resources accounts in 2009 with assistance from the United Nations Statistics Division (UNSD) (Sakmar *et al*, 2011). The accounts would be consistent with the UNSD SEEA for Water (SEEA-Water; see UNSD, 2012).

2.1.2 National Framework for Sustainable Development

The 2007 National Framework for Sustainable Development in Egypt recommended for all government ministries two principles that are directly related to environmental economics, Principle #12: Polluters Pay and Principle #13: Users Pay (MSEA, 2007). These principles are not complementary, but represent two different economic principles that work towards sustainable development of natural resources. However, the report did not suggest the level of existing or required capacity in ministries to implement these principles in Egypt. While the polluters pay principle incentivizes compliance with environmental regulation through the risk of fees, the users pay principle incentivizes conservation and rehabilitation through the reward of payments.

2.1.3 National Capacity Self Assessment (NCSA) and National Strategy and Action Plan for Capacity Development

The Egyptian National Capacity Self Assessment and National Strategy and Action Plan for Capacity Development was implemented by UNDP and funded by the Global Environment Facility (GEF) (MSEA, 2007). Its purpose was to identify and analyze national needs and priorities for capacity development to implement the three Rio Conventions: the United Nations Convention to Combat Desertification (UNCCD), the United Nations Convention on Biological Diversity (UNCBD), and the United Nations Framework Convention on Climate Change (UNFCCC). The assessment findings on capacity needs and priorities for the implementation of the UNCCD and UNCBD are of particular relevance to this paper. The assessment found that there is a "limited presence of instrumental processes to evaluate the national economic value of biodiversity and land degradation". However, the assessment did not develop any explicit action plan for addressing this capacity constraint.

2.1.3.1 National Action Plan for Combating Desertification

Disconcertingly, the 2002 Egyptian National Action Plan for Combating Desertification (Provisional) does not specifically mention any capacity development requirement for environmental economics although it does express a high-level appreciation for the economic damages associated with the degradation/desertification of land resources (Hegazi and Bagouri, 2002). It lists economics based priority setting for action plans to combat desertification as one of its guiding principles, which means that some capacity in (environmental) economics would be required prior to the development of non-provisional action plans.

The 2005 Egyptian National Action Program to Combat Desertification expresses an appreciation for the economic impacts of degraded land and water resources to health, fish and livestock production, and road access[5] (Hegazi *et al*, 2005). The report also briefly mentions domestic capacity for socio-economic studies at the Desert Research Center. A Desertification Assessment and Monitoring programme is proposed which includes as a main objective: "providing decision makers with relevant analyses of the desertification process from biophysical and socio-economic angles, and to provide a basis for work on appropriate development of public policies in the areas affected by desertification...". Also, a proposed project on environmental pollution in the Wadi El-Rayan depression includes the "evaluation of the impact of reused agricultural drainage on the economic value of water and soil units". A proposed project on experimental cloud seeding under Egyptian conditions includes economic studies on the environmental and health impacts of the artificial rain process. Finally, a proposed project on erosion control includes an "economic evaluation of efficient soil erosion control on farm and national levels in rainfed agriculture."

2.1.3.2 National Strategy and Action Plan for Biodiversity Conservation

The 1998 Egyptian National Strategy and Action Plan for Biodiversity Conservation includes the establishment of economic incentives that support conservation and sustainable use of natural resources as one of its Principal Goals. It includes the economic value of biodiversity as one of its

[5] The report notes that sandstorms may generate road blockage damages worth several million Egyptian pounds each year.

Principles (MSEA, 1998). The "economics of conservation of nature, protection of the environment and development of its resources" is cited as a possible element to be included in Programmes of Research, Monitoring and Assessment to support biodiversity conservation. The programmes would include research into the economic value of biodiversity in deserts and the economic value of eco-tourism. The research would be executed through the mobilization of academic resources and research institutes to capitalize on existing capacity in environmental economics, where possible.

The 2004 report on the implementation of the Egyptian National Strategy and Action Plan for Biodiversity Conservation stated that the development of economic incentives for conservation and sustainable use of biological diversity was in its early stages. Unfortunately, more recent implementation reports published in 2005 and 2009 were only made available in Arabic.

2.2 Literature Search

Egyptian ecosystem services valuation findings from the literature search of the Egyptian National Agricultural Library catalog, the McMaster University Library catalog, and Google Scholar are summarized below in Table 3. Egyptian capacity may be indicated by Egyptian participation and authorship, which is noted in the "Notes" column. With the exception of, "Ecosystem services contribution to human well-being in El Maghara, Northern Sinai, Egypt", which is largely a qualitative assessment of ecosystem services, the reports discovered have a non-Egyptian lead author. Some of the reports appear to not have involved Egyptian contributors at all. Thus, the reports seem to reinforce the conclusions of the review of government documentation, that there is little domestic capacity for environmental economics in Egypt.

Table 3: Studies evaluating Egyptian ecosystem services (listed in chronological order).

Cost/Value	Quantification	Source	Notes
Mean damage cost of environmental degradation	L£14.5B or 4.8% of GDP in 1999	World Bank, 2002	The report notes that Egypt's damage costs of environmental degradation are roughly two times higher than other industrialized countries. Notably, the report estimates that remediation benefits would exceed remediation costs in most environmental sectors. The stated objective of the report was to improve domestic capacity to use environmental damage cost assessments to integrate the environment into policy making for economic development and environmental management. Many of the report's contributing authors are Egyptian.
Soil degradation (erosion and salinity)	L£3.6B or 1.2% of GDP in 1999		
Water degradation	L£2.9B or 1.0% of GDP in 1999		
Estimated total economic value of mangroves at Ras Mohammed and Nabq	US$182,000/y and US$1,290,000/y, respectively	Spurgeon, 2002	The report examined direct use values, indirect use values, and non-use values of mangroves in Ras Mohammed and Nabq.
Total economic value of Red Sea coral reefs	US$6.7B net present value in 2003	Cesar, 2003	Total economic value included values associated with tourism, fisheries, coastal protection, research, biodiversity, and bio-prospecting for genetic resources.
Mean damage cost of water degradation	L£5.35B or 1.8% of GDP in 2003	World Bank, 2005	Includes costs associated with health, land productivity, and fisheries damages. The report notes that this estimate of water degradation damage costs substantially exceeds that reported by the World Bank in 2002 due to the inclusion of damages to land productivity and fisheries, whereas, the 2002 estimate only included damages to health. Many of the report's contributing authors are Egyptian.
Value of non-timber forest products	€104/ha	Croitorou, 2007	Non-timber forest products including firewood, grazing materials, cork, mushrooms, honey, and others.
Value of natural terrestrial coastal areas	US$211M/year	Martínez *et al,* 2007	Ecosystem services product of natural terrestrial coastal areas in Egypt.
Value of artificial ecosystem services provided by the High Aswan Dam	E£7.1B/year	Strzepek *et al*, 2008	Does not consider economic impacts (costs) to ecosystem services.
Value of natural pollination services	US$2.4B in 2003	Brading *et al*, 2009	Impacts to pollinator biodiversity are caused by changes in land use. Two of the four contributing authors are Egyptian.
Value of water transfer from Nile River to West Delta	€500M/year	Slootweg, 2010	The West Delta Water Conservation and Irrigation Rehabilitation Programme (WDWCIRP) considered non-quantified ecosystem services impacts of surface water transfer from the Nile River to the West Delta as part of a Strategic Environmental Assessment. The project proposed the utilization of Nile River surface water to offset unsustainable groundwater abstractions for export agriculture worth approximately €500M/year. The Strategic Environmental Assessment was executed by the Egyptian government and World Bank. This example was used as a case study for The Economics of Ecosystems and Biodiversity (TEEB) initiative which is discussed later in this report.
Ecosystem services contribution to human well-being in El Maghara, Northern Sinai, Egypt	Qualitative with some values associated to provisioning services, e.g., E£20-24/kg for *Juniperus phoenicea* leaves and fruits for folk medicine	UNEP, 2010	The Arab Region Millennium Ecosystem Assessment included an assessment of ecosystem services, primarily related to water and land resources and medicinal plants, in El Maghara, which is located in the Sinai Peninsula, Egypt. The stated outputs of the project were regional and site-specific assessment reports, capacity building strategies, and training in order to "provide the scientific information and knowledge for sound management of [these] resources." The vast majority of the report's contributing authors are Egyptian.

2.3 Academic Capacity and Expertise

As previously mentioned, a review of academic capacity and expertise for environmental economics began with a general internet survey of all higher education institutions in Egypt. However, due to the vast number of higher education institutes in Egypt, and the lack of information available in English, the review was not productive.

According to the 2005 World Bank Country Environmental Assessment for Egypt, many universities have environment departments, and research institute and university involvement in government consultation is increasing.[6] However, no academic institution offers a degree in environmental policy analysis or environmental economics (World Bank, 2005).

In 2006, a plan for the development of an Environmental Economics Diploma at Alexandria University was circulated by the Centre for Environment and Development for the Arab Region and Europe (CEDARE).[7] However, no evidence of implementation of the plan could be found on Alexandria University's website. An older plan for the integration of energy and environmental considerations, including environmental economics, into engineering education was presented to UNESCO in 1997.[8] Again, no evidence of plan implementation could be found on Alexandria University's website.

The United Nations University – Institute for Water, Environment and Health (UNU-INWEH) Drylands Ecosystems Programme is working on a twinning arrangement with Alexandria University in Egypt (United Nations University, n.d.b). A Memorandum of Understanding (MOU) which serves as a basis for joint research activities and collaborative academic programs was signed in October 2011.

Environmental Non-Governmental Organization Capacity and Expertise

The World Bank estimates that there are more than 270 environmental non-governmental organizations (ENGOs) in Egypt. The EEAA provides a list of ENGOs working in the environment field in Egypt, but only in Arabic (EEAA, n.d.). Thus, a review of ENGO capacity and expertise could not be undertaken at this time. It is recommended that any capacity and expertise within Egyptian ENGOs for environmental economics be elucidated in future research and that plans for Egyptian environmental economics capacity building capitalize on existing capacities within ENGOs.

3 What has been done to develop global capacity in the valuation of ecological services?

3.1 The Economics of Ecosystems and Biodiversity

The Economics of Ecosystems and Biodiversity (TEEB) is by far the largest international initiative to raise awareness of and capacity for determinations of the total economic value of ecosystem services. TEEB is hosted by UNEP with financial support from European States and Japan. TEEB focuses on a set of distinct

[6] For example, Suez Canal University was the lead institution for the previously mentioned report on ecosystems and human well-being in El Maghara, Northern Sinai, Egypt.
[7] See http://www.eaere.org/files/education_egypt.pdf.
[8] See http://www.alexu.edu.eg/FILES/Profile/engineering/Marine/MShama/EEdu.pdf.

end-users including ecologists and economists, international and national policy makers, local and regional policy makers, businesses, and citizens. TEEB for policy makers focuses on developing knowledge on the economic value of ecosystem services and translating that knowledge into sound policy and economic tools to correct market failures that lead to the degradation of natural resources (TEEB, 2011).

The first phase of the TEEB initiative culminated in the presentation of preliminary findings in an interim report released in 2008 and the second phase of the initiative culminated in a synthesis report released in 2010 (Hill, 2012). The third phase is ongoing and is focused on facilitating sectoral, local, regional, and national assessments of the economics of ecosystems and biodiversity.

As part of its third phase, TEEB has hosted sub-regional workshops on environmental economics for Eastern Europe and Central Asia, South America, Africa, and North Africa and the Middle East. One senior official from the Egyptian Ministry of Foreign Affairs Department of Environment and Sustainable Development and one Senior Environmental Economist from the Egyptian Environmental Affairs Agency attended the sub-regional workshop for North Africa and the Middle East (TEEB, 2012). National TEEB studies have been conducted, are ongoing, or are planned in the following countries: Brazil, Japan, India, Georgia, Portugal, Belgium, the Netherlands, Germany, Denmark, Norway, Sweden, and Finland (Hill, 2012). Recently, in July 2012, China announced its support for a TEEB-based assessment of its ecosystem services and biodiversity values (UNEP, 2012). The United Kingdom completed a TEEB-like National Ecosystem Assessment in 2011 (UK National Ecosystem Assessment, 2011).

3.2 The Economics of Land Degradation

The Economics of Land Degradation Initiative is a relatively new endeavour focused on drawing scientific, political, and private sector attention to the global economic benefits of sustainable land management and the growing costs of land degradation (ELD, 2012a). The initiative is a partnership of the United Nations Convention to Combat Desertification (UNCCD), the European Commission (EC), the German Federal Ministry for Economic Cooperation and Development, the Korea Forest Service, the International Food Policy Research Institute (IFPRI), the Stockholm Environment Institute (SEI), the University of Bonn Center for Development Research, and the United Nations University Institute for Water, Environment, and Health (UNU-INWEH) (ELD, 2012b). The lead personnel for the initiative both worked for TEEB in the past (ELD, 2012c).

4 Capacity Building for Egyptian Environmental Economics

The consensus definition of “capacity building” is, “the actions needed to enhance the ability of individuals, institutions, and systems to make and implement decisions and perform functions in an effective, efficient, and sustainable manner” (GEF, 2001). Capacity building is typically aimed at multiple levels: individual, institutional, and systemic. Capacity building at the individual level involves specific training and mandates that promote accountability and responsibility. Capacity building at the institutional level involves clarification of missions and mandates, structures, responsibilities, and accountabilities. Capacity building at the systemic level involves the creation of policy, economic, and accountability frameworks to enable the execution of individual and institutional mandates.

As demonstrated in this report, Egypt should have sufficient motivation to invest in environmental economics capacity building. In short, Egypt has a steadily growing population paired with a waning economy that is heavily dependent on agriculture. Agriculture is, in turn, entirely reliant on the ecosystem services associated with increasingly degraded and diminished land and water resources. Studies have shown that environmental degradation has cost as much as 5% of Egypt's GDP, which is double the cost of environmental degradation in industrialized countries.

Egypt also has the rare opportunity to capitalize on an unfortunate crisis: the Egyptian Revolution of 2011 that brought about free democracy. Egyptians have demanded socio-economic improvements (including improved food security) which require investments in the rehabilitation, conservation, and sustainable and equitable development and use of land and water resources. To understand the costs and benefits of such investments and fulfill its mandate to the Egyptian people, it is imperative that the newly elected Egyptian government improve its capacity for environmental economics.

Egypt does suffer from many impediments to capacity development, including:

- Ministerial silos that impede the type of interdisciplinary action required to assess, develop, and exercise capacity for environmental economics
- Poorly developed networks of socio-economic and environmental information/data required to support environmental economics assessments of policy alternatives or resource allocation decisions

Egypt has already assessed at a high level its general requirements for capacity development to fulfill its obligations under the UNCCD, UNCBD, and UNFCCC. However, it is recommended that the EEAA conduct a further assessment of its capacity for environmental economics in particular. The assessment should include an examination of all ministries that play a role in environmental governance as illustrated in Figure 9 and should attempt to identify all individuals and departments with capacity in environmental economics, to classify the capacity by expertise or subject matter, and to evaluate the level of capacity (e.g., "theoretical knowledge" vs. "applied"). Gaps in expertise/subject matter and experience could then be clearly identified. This gap analysis could be used to develop a strategy for environmental economics capacity building that could include interdepartmental and interministerial transfers of knowledge and expertise. It is recommended that Egypt also perform a similar survey of academic and environmental non-governmental organization (ENGO) capacity to see where extra-governmental capacity could be leveraged to improve governmental capacity.

It is presumptuous to develop a capacity building strategy based on research conducted from abroad with limited access to government information and insights. However, this author believes that Egypt should seriously consider undertaking a TEEB or TEEB-like national economic assessment of ecosystems and biodiversity. The initiative should strive to involve governmental, academic, and ENGO actors to the maximum possible extent to capitalize on the synergies of simultaneous capacity development and knowledge transfer. Focus areas for the assessment should be prioritized based on existing valuations (for example, the World Bank established that air pollution, land degradation, and water degradation comprise the majority of damage costs in Egypt) and existing capacity.

It is important that grassroots demand for a sustainable development mandate be exercised by citizens/farmers and ENGOs to further motivate the appropriate/responsible government actors to develop capacity for environmental economics. Moreover, grassroots understanding of valued ecosystem components and their direct and indirect uses must be incorporated into any assessment of the economics of ecosystem services.

Egypt should utilize its existing capacity in land degradation and desertification (through the Ministry of Agriculture and Land Reclamation's Desert Research Center) and environmental economics (through the Egyptian Environmental Affairs Agency's Department of Environmental Management and Department of Nature Protection) to inform the twinning process between the University of Alexandria and the UNU-INWEH by establishing priorities for collaborative research in environmental economics for drylands ecosystems. Then, the UNU-INWEH's partnership in the Economics of Land Degradation initiative could be leveraged to kick-off Egypt's national TEEB or TEEB-like assessment by focusing on the issue of land degradation. Capacity built in the focus area of drylands ecosystems economics could then be leveraged to augment and complete the assessment with the complement of other focus areas. As land and water resources are so intimately connected in Egypt, it is likely that the Ministry of Water Resources and Irrigation would play an important role in the assessment. This scheme is symbolically represented in Figure 10.

Such an arrangement would allow capacity for environmental economics to be developed at the individual level (citizens/farmers, students, and staff), at the institutional level (ENGOs, ministries, and universities), and at the systemic level (a network of domestic government, academic, and ENGO actors).

Egypt should engage nations that have completed or are completing TEEB or TEEB-like assessments in knowledge sharing initiatives, as Egypt would be the first nation within the North Africa and Middle East TEEB sub-region to attempt such an assessment. In particular, Egypt should survey those nations that would have evaluated or will evaluate drylands ecosystem services in their national assessments (e.g., Brazil and India). TEEB and/or ELD should endeavour to facilitate such knowledge sharing initiatives to the maximum possible extent, as doing so would be consistent with their mission statements.

The funds required to complete a TEEB or TEEB-like assessment are considerable. However, a funding strategy is considered to be outside of the scope of this research.

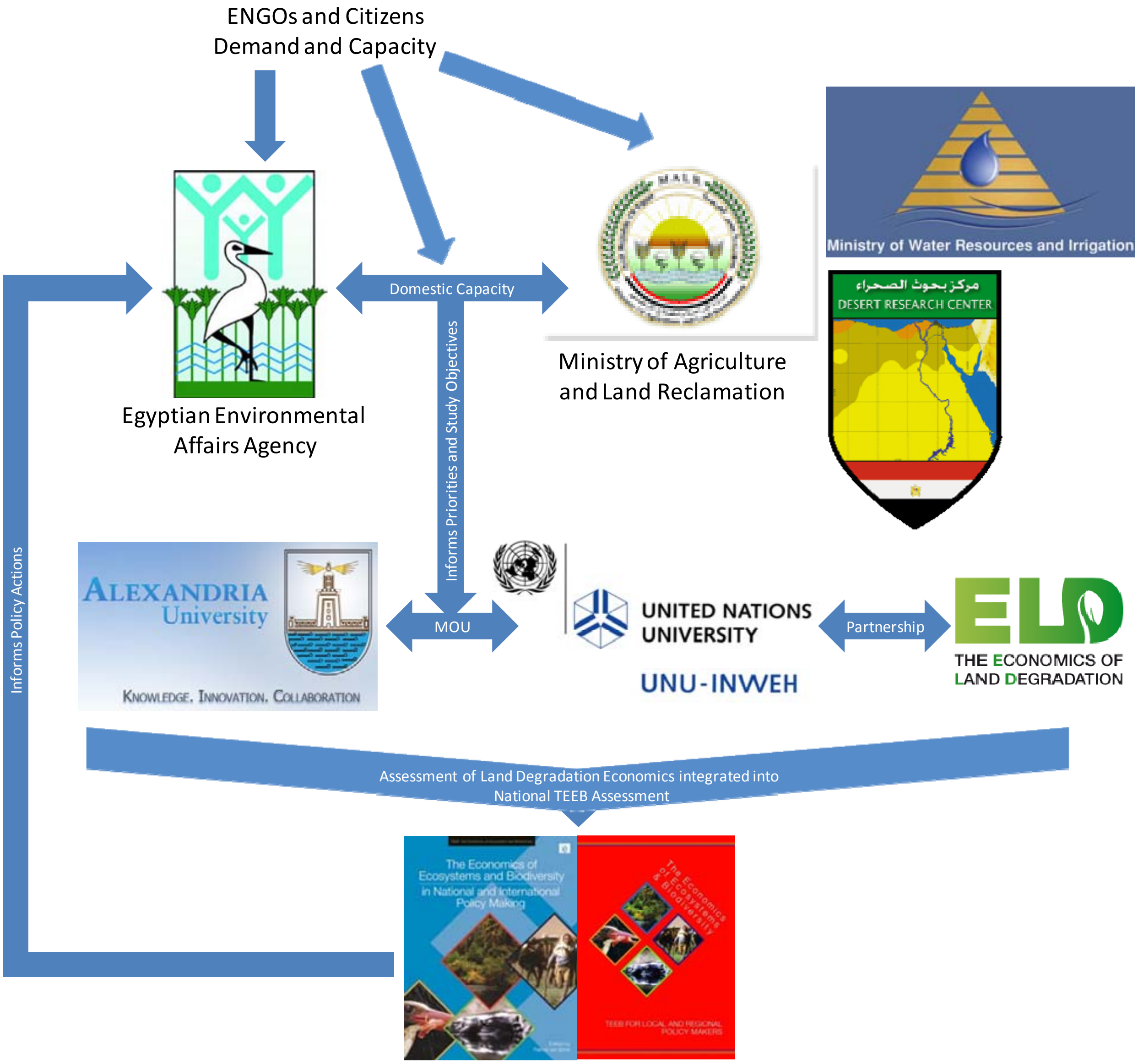

Figure 10: Symbolic map of environmental economics capacity building and national TEEB assessment execution plan for land resources. Logos taken from Google Images search.

Grassroots demand for a sustainable development mandate, grassroots capacity for environmental economics, and grassroots understanding of valued ecosystem components should interface with government actors. Existing ministerial capacity in land degradation and desertification and environmental economics should inform the twinning process between the University of Alexandria and the UNU-INWEH. The UNU-INWEH's partnership in the Economics of Land Degradation initiative could be leveraged to kick-off Egypt's national TEEB or TEEB-like assessment by focusing on the issue of land degradation. Capacity built in the focus area of drylands ecosystems economics could then be leveraged to augment and complete the assessment with the complement of other focus areas. The results of the national assessment would then inform policy actions.

5 Conclusion

To fulfill its mandate to the Egyptian people, Egypt's government must ensure the good governance of its natural resources. In particular, Egypt must take action towards the rehabilitation, conservation, and sustainable and equitable development and use of land and water resources, as these resources and associated ecosystem services play a crucial role in Egypt's socio-economic well being.

Evidence of Egyptian governmental, academic, and ENGO capacity for environmental economics is scant. Government assessments of capacity to fulfill the obligations of multilateral environmental agreements have identified deficiencies in environmental economics knowledge and application.

It is recommended that a focused assessment of Egyptian capacity for environmental economics be conducted by the EEAA to clarify capacity gaps and identify opportunities to leverage existing capacity. It is also recommended that Egypt develop its capacity for ecosystem services valuation through the execution of a national assessment of the economics of ecosystems and biodiversity, beginning with the economics of land degradation. The assessment should involve domestic government, academic, and ENGO actors as well as international partners such as the UNU-INWEH Drylands Ecosystems Programme, the Economics of Land Degradation Initiative, TEEB, and other nations that have undertaken or are undertaking similar assessments.

Although the development of Egyptian capacity for environmental economics to combat land degradation and desertification is a substantial undertaking, the Egyptian government is unquestionably motivated by its mandate and by Egypt's socio-economic realities. There is promise that an appreciation for the true value of ecosystem services associated with land and water resources will lead to policy instruments that greatly benefit present and future generations of Egyptians.

6 References

Akhtar-Schuster, M., H. Bigas, and R. Thomas (2010). “Monitoring and Assessment of Desertification and Land Degradation: Knowledge Management, Institutions and Economics”. White Paper of the Dryland Science for Development (DSD) Consortium Working Group 3. DesertNet International and UNU-INWEH. Print.

Ba Kader, A.B.A., *et al* (1983). “Basic Paper on the Islamic Principles for the Conservation of the Natural Environment”. International Union for the Conservation of Nature and Natural Resources and Kingdom of Saudi Arabia Meteorology and Environmental Protection Administration. Web. <http://data.iucn.org/dbtw-wpd/edocs/EPLP-020.pdf>.

Baraka, H. (2011). “Environment on the electoral agenda: Some parties, candidates play the green card to seduce voters”. *Egypt Independent*. 27 November 2011. Web. <http://www.egyptindependent.com/news/environment-electoral-agenda>.

BBC (2012). “Egypt Profile”. BBC News. Web. <http://www.bbc.co.uk/news/world-africa-13313370>.

Brading, P., A. El-Gabbas, S. Zalat, and F. Gilbert (2009). “Biodiversity Economics: The Value of Pollination Services to Egypt”. *Egyptian Journal of Biology*. 11:46-51.

Breisinger, C., O. Ecker, P. Al-Riffai, and B. Yu (2012). “Beyond the Arab Awakening: Policies and Investments for Poverty Reduction and Food Security”. IFPRI Food Policy Report. Web. <http://www.ifpri.org/sites/default/files/publications/pr25.pdf>.

Cesar, H. (2003). “Economic Valuation of the Egyptian Red Sea Coral Reefs”. Cesar Environmental Economics Consulting for the Egyptian Environmental Policy Program Executive Committee and USAID/Egypt. Print.

CIA (2012). “Egypt”. CIA World FactBook. Web. <https://www.cia.gov/library/publications/the-world-factbook/geos/eg.html>.

Convention on Biological Diversity (2011). “Living in harmony with nature.” Web. <http://www.cbd.int/doc/newsletters/satoyama/cbd-satoyama-3-en.pdf>.

Costanza, R. *et al* (1997). “The value of the world’s ecosystem services and natural capital”. Nature. 387:253-260. Print.

Croitoru, L. (2007). “Valuing the non-timber forest products in the Mediterranean region”. *Ecological Economics.* 63(4):768-775.

EEAA (n.d.). “NGO List”. Web. <http://www.eeaa.gov.eg/arabic/main/ngolist.asp>.

EEAA (2001). “National Environmental Action Plan of Egypt 2002/2017”. Egyptian Environmental Affairs Agency. Informal draft. Web. <http://www.eeaa.gov.eg/english/reports/neap/Neap_Eng-last.pdf>.

Egypt State Information Services (n.d.). "Introduction". Web. <http://www.sis.gov.eg/En/Story.aspx?sid=1042>.

ELD (2012a). "Background". Web. <http://eld-initiative.org/index.php?id=30>.

ELD (2012b). "Partners". Web. <http://eld-initiative.org/index.php?id=33>.

ELD (2012c). "Personnel (The ELD Team)". Web. <http://eld-initiative.org/index.php?id=31>.

ENCC (2009). "The 6th Egyptian Competitiveness Report". Egyptian National Competitiveness Council. Web. <http://www.encc.org.eg/Reports/English/ENCC_EN%2009.pdf>.

European Forum (2011). "Egypt Country Update". *European Forum*. Web. <http://www.europeanforum.net/country/egypt>.

FAO (2005). "Egypt". FAO AQUASTAT. Web. <http://www.fao.org/nr/water/aquastat/countries_regions/egypt/index.stm>.

GEF (2001). "A Guide for Self-Assessment of Country Capacity Needs for Global Environmental Management". Web. <http://www.thegef.org/gef/sites/thegef.org/files/documents/document/Guide-Self-Assesment-Country-Capacity-Needs-2001.pdf>.

Hackett, S.C. and M.C. Moore (2011). *Environmental and Natural Resources Economics: Theory, Policy, and the Sustainable Society*. Print.

Handoussa, H . (2010). "Situation Analysis: Key Development Challenges Facing Egypt". Web. <http://www.un.org.eg/docs/101100%20SA%20Report%20final%20pdf%20version.pdf>.

Hardin, G. (1968). "The Tragedy of the Commons." Science. 162(3859):1243-1248.

Hecht, J.E. (2004). "Environmental Statistics Accounting in Egypt: Challenges and Opportunities". Study carried out for the USAID DATA Project with the Arab Republic of Egypt Ministry of Planning. Web. <http://www.joyhecht.net/professional/papers/jhecht-Egypt-envtl-stats&accts-aug04.pdf>.

Hegazi, A.M., M.Y. Afifi, M.A. El Shorbagy, A.A. Elwan, S. El-Demerdashe (eds.) (2005). *Egyptian National Action Program to Combat Desertification.* Arab Republic of Egypt Ministry of Agriculture & Land Reclamation, UNCCD, and Desert Research Center.

Hegazi, A.M., and I.H. El Bagouri (eds.) (2002). "Arab Republic of Egypt National Action Plan for Combating Desertification". Provisional. Web. <http://www.egyptchm.org/chm/convention/pdf/action_plan_desertification.pdf>.

Hellegers, P.J.G.J., and C.J. Perry (2004). "Water as an economic good in irrigated agriculture: Theory and Practice". Agricultural Economics Research Institute (LEI), The Hague.

Hill, C. (2012). "TEEB Phase III; Towards Implementation". Presentation on behalf of UNEP at the TEEB Capacity-building Workshop for North Africa and the Middle East. Beirut, Lebanon. 21-23 February 2012. Web. <https://www.cbd.int/doc/?meeting=WSCBTEEB-MENA-01>.

IFAD (2006). "Arab Republic of Egypt Country Strategic Opportunities Paper". International Fund for Agricultural Development Executive Board – 87th Session. EB 2006/87/R.10. Web. <http://www.ifad.org/gbdocs/eb/87/e/EB-2006-87-R-10.pdf>.

Mahasneh, M.H.I. (2003). "Islam". *Faith in Conservation - New Approaches to Religions and the Environment.* M. Palmer and . Finlay (Eds). The World Bank. Washington, DC. Print.

Martínez, M.L., A. Intralawan, G. Vázquez, O. Pérez-Maqueo, P. Sutton, and R. Landgrave (2007). "The coasts of our world: Ecological, economic and social importance". *Ecological Economics*. 63(2-3):254-272.

Millennium Ecosystem Assessment (2005a). *Ecosystems and Human Well-being: A Framework for Assessment*. Chapter 2: Ecosystems and Their Services. Web. <http://www.maweb.org/documents/document.300.aspx.pdf>.

Millennium Ecosystem Assessment (2005b). *Ecosystems and Human Well-being: A Framework for Assessment*. Chapter 22: Dryland Systems. Web. <http://www.millenniumassessment.org/documents/document.291.aspx.pdf>.

MSEA (2011). "Organization structure of the EEAA". Web. <http://www.eeaa.gov.eg/English/reports/OrgStructure/OrgStructureEnglish.pdf>.

MSEA (2007). "Egypt National Capacity Self Assessment: National Strategy and Action Plan for Capacity Development". Web. <http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Integrating%20Environment%20into%20Development/ncsa/final%20report%20and%20action%20plan/english/ncsa-egypt-fr-ap.pdf>.

MSEA (1998). "Egypt: National Strategy and Action Plan for Biodiversity Conservation." Web. <http://www.egyptchm.org/chm/convention/pdf/egyptian_national_plan.pdf>.

MSEA (n.d.). "About MSEA-EEAA". Ministry of State for Environmental Affairs Egyptian Environmental Affairs Agency. Web. <http://www.eeaa.gov.eg/English/main/about_detail.asp>.

MWRI (2009). "Background". Ministry of Water Resources and Irrigation. Web. <http://www.mwri.gov.eg/En/background.html>.

MWRI (2010). "Water Challenges in Egypt". Ministry of Water Resources and Irrigation. Web. <http://www.mwri.gov.eg/En/pdf_files%20english/Brochure%20%20Eng.pdf>.

Nasseef, A.O. (1986). "The Muslim Declaration on Nature". Alliance of Religions and Conservation. Page 10. Web. <http://www.arcworld.org/downloads/THE%20ASSISI%20DECLARATIONS.pdf>.

No author (2011). “Tagammu Party”. *Bikyamasr*. Web. <http://www.bikyamasr.com/egypt-elections-2011/tagammu-party>.

No author (n.d.). “The Assisi Declarations”. Alliance of Religions and Conservation. Page 2. Web. <http://www.arcworld.org/downloads/THE%20ASSISI%20DECLARATIONS.pdf>.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press. Print.

Raudsepp-Hearne, C., *et al* (2009). “Ecosystem services bundles for analyzing tradeoffs in diverse landscapes”. *Proceedings of the National Academy of Sciences of the United States of America.* 107(11):5242-5247. Print.

Sakmar, S.L., M. Wackernagel, A. Gall, and D. Moore (2011). “Sustainable Development and Environmental Challenges in the MENA Region: Accounting for the Environment in the 21st Century”. Economic Research Forum Working Paper No. 592. Web. <http://www.footprintnetwork.org/images/uploads/Sakmar_et_al_2011.pdf>

SEDAC (2012). “Gridded Population of the World and the Global Rural - Urban Mapping Project”. Socioeconomic Data and Applications Center. Columbia Univeristy. Web. <http://sedac.ciesin.columbia.edu/gpw>.

Slootweg, R. (2010). Water transfer project influenced by ecosystem services valuation, Egypt. TEEBcase. Web. <www.eea.europa.eu>.

Spurgeon, J. (2002). “Rehabilitation, Conservation and Sustainable Utilization of Mangroves in Egypt: Socio-economic assessment and economic valuation of Egypt’s mangroves.” FAO. Consultancy Report TCP/EGY/0168(A). Web. <ftp://ftp.fao.org/docrep/fao/007/ae212e/ae212e00.pdf>.

Strzepek, K.M., G.W. Yohe, R.S.J. Tol, and M.W. Rosegrant (2008). “The value of the high Awan Dam to the Egyptian economy”. *Ecological Economics*. 66(1):117-126.

TEEB (2012). “List of Participants”. <http://www.teebtest.org/wp-content/uploads/2012/07/List-of-Participants_Beirut.pdf>.

TEEB (2011). *TEEB in National and International Policy Making*. Print.

TEEB (2009). *TEEB – The Economics of Ecosystems and Biodiversity for National and International Policy Makers – Summary: Responding to the Value of Nature*. Print.

Troy, A. and K. Bagstad (2009). *Estimating Ecosystem Services in Southern Ontario*. Web. <http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@lueps/documents/document/279512.pdf>.

UK National Ecosystem Assessment (2011). “UK National Ecosystem Assessment Synthesis Report”. Web. <http://uknea.unep-wcmc.org/>.

UNCBD (2011). "Living in harmony with nature." Web. <http://www.cbd.int/doc/newsletters/satoyama/cbd-satoyama-3-en.pdf>.

UNCCD (2012a). "About the Convention". UNCCD. Web. <http://www.unccd.int/en/about-the-convention/Pages/About-the-Convention.aspx>.

UNCCD (2012b). "Update on the Ratification of the UNCCD as at 29 May 2012". UNCCD. Web. <http://www.unccd.int/Lists/SiteDocumentLibrary/convention/ratification-eng.pdf>.

UNCCD (n.d.). "Healthy soil is set to become the next <<hot commodity>>". Web. <http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/DrylandsSoilUNCCDBrochureFinal.pdf>.

UNDESA (n.d.). "Water Scarcity". Web. <http://www.un.org/waterforlifedecade/scarcity.shtml>.

UNDP (2012). "The Millennium Development Goals in Drylands". UNDP Sustainable Land Management. Web. <http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/sustainable_landmanagement/the_millennium_developmentgoalsindrylands>.

UNDP (n.d.). "What are the Drylands". UNDP Drylands Development Centre. Web. <http://web.undp.org/drylands/what-are.html>.

UNEP (2012). "China Voices Support for National Study on Value of Ecosystem Services". UNEP News Centre. Web. <http://www.unep.org/newscentre/default.aspx?DocumentID=2691&ArticleID=9238>.

UNEP (2010). "Ecosystems and Human Well-Being El Maghara, Northern Sinai, Egypt". Web. <http://www.earthprint.com>.

UNSD (2012). "System of Environmental-Economic Accounting for Water". Web. <http://unstats.un.org/unsd/envaccounting/seeaw/seeawaterwebversion.pdf>.

United Nations University (n.d.a). "Lesson 9: drylands". *Introduction to Integrated Water Resources Management.* United Nations Water Virtual Learning Centre. Web. < http://ocw.unu.edu/international-network-on-water-environment-and-health/introduction-to-iwrm/modules/lesson9.pdf>.

United Nations University (n.d.b). "Dryland Ecosystems". United Nations University Research Programs. Web. < http://unu.edu/research/dryland-ecosystems.html#outline>.

World Bank (2012). "Adjusted savings: natural resources depletion (% of GNI)". Web <http://data.worldbank.org/indicator/NY.ADJ.DRES.GN.ZS>.

World Bank (2007). "Making the Most of Scarcity: Accountability for Better Water Management in the Middle East and North Africa". MENA Development Report 41113. Web. <http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2007/10/10/000310607_20071010141136/Rendered/PDF/411130was390400Englishoptmzd.pdf>.

World Bank (2005). “Arab Republic of Egypt Country Environmental Analysis (1992-2002).” Web. <http://siteresources.worldbank.org/INTRANETENVIRONMENT/3635842-1175696087492/20467129/CEAEgyptFullDoc2005.pdf>.

World Bank (2002). “Arab Republic of Egypt Cost Assessment of Environmental Degradation Sector Note”. Report No. 25175 - EGT. Web. <http://lnweb90.worldbank.org/caw/cawdoclib.nsf/0/740898E4ACAE819385256CAF00729DFB/$file/25175.pdf>.

WBG (2012). World DataBank(BETA). <http://databank.worldbank.org/data/Home.aspx>.

World Resources Institute (2000). *A Guide to World Resources 2000-2001: People and Ecosystems: The Fraying Web of Life.* Web. <http://pdf.wri.org/world_resources_2000-2001_people_and_ecosystems.pdf>.