An Accounting Methodology for Measuring Agricultural Land Sustainability

Khalid Abdel Aziz Attia

Associate Professor of Accounting, College of Management Sciences and Planning, King Faisal University.

Email: kattiah@hotmail.com.

1. Introduction

In recent years Environmental Accounting (EA) has been developed as a relevant tool to include measures of depletion and degradation of natural resources in income accounts to provide better measures for sustainable income that will be useful for decision- making and long-run planning. Environmental accounts are gaining importance due to the fact that by ignoring the loss of natural resources, via degradation or depletion, in calculations of national product, the destruction of resources available to a country is masked by the false appearance of a growing national economy. Consider, on the one side, as an extreme hypothetical case, a country which lives simply by exporting its exhaustible resources and importing consumption goods with the export revenue. Also assume that resources are costless to extract and that, other than extraction, there is no domestic production. The domestic product of this country, as historically measured, could be large and it would even be seen to be rising. However, when measured as suggested in some of the ongoing studies, it would be nil. On the other side, it is argued that a country rich in natural resources is probably better positioned than a country without them. Indeed, there is no agreement on the way that environmental depletion and degradation should be taken into account. It is an open debate at this very moment. Economic history brings the perfect laboratory to test the validity of some of the tools and concepts of environmental evaluation and sustainability.

Therefore, this study develops an accounting methodology, which utilized two different cost accounting techniques, the average and marginal costs approaches, in estimating the cost of Egypt's agricultural land depletion. Since the study does not account for all the losses of other renewable natural resources such as air and water pollution as well as non renewable natural resources such as oil and gas, it is by no means an aggregate estimate of all environmental costs experienced by the Egyptian economy. However, besides the actual results the study does provide a (conservative) picture of the likely scale of such wider losses as well as exploring some of the methodological problems involved in their computation. Section 2 reviews previous attempts in establishing EA, and derives some lessons for Egypt. Section 3 applies this approach to the Egyptian case by developing an accounting methodology that aims at estimating the depletion for agricultural land loss. Finally, section 4 of the study presents conclusion and policy implications.

2. International Experience in Environmental Accounting

A growing number of case studies in developed and developing countries have begun to explore environmental accounting. Developed countries that have taken a lead include: Denmark, Finland, Germany, Italy, Sweden, Japan, Canada, France, Australia, Norway, and recently the UK and USA. They have carried out statistical work programs to compile accounts of natural resource stocks and stock changes. For example, France has established «patrimony accounts» which emphasize the development of physical accounts. Norway has established energy and materials accounts. The UK is now working on establishing its integrated System of Environmental and

Economic Accounts (SEEA) in line with the Revised System of National Accounting which was published by the UN in 1993 and Revised in 2003. Governments in developing countries, recognizing their natural resource dependence, have realized their urgent need for an adequate accounting framework that effectively integrates economic and environmental considerations. The World Resource Institute (WRI), World Bank, and the United Nations have taken the lead here, collaborating with government institutions and statistical agencies on pilot studies in Indonesia,, Mexico, Namibia, Costa Rica, Philippines, South Africa, and Papua New Guinea[1].

Despite this shared general perception, all developed and developing countries have responded to perceived inadequacies in their conventional accounting systems in different ways. In some of the cases this was because of their differences in scale of development objectives. Also, there were some important factors, such as their ability and differences in bearing the cost and efforts involved in gathering data and their dif-

(1) For a detailed review of the methodologies and approaches, of cases studied presented in Table (1) below, See: Salah El Serafy, «The Environment As Capital,» in: Ernst Lutz, ed., *Toward Improved Accounting for the Environment: An Unstat-World Bank Symposium* (Washington, DC: World Bank, 1993); Salah El Serafy, «The Proper Calculation of Income from Depletable Resources,» in: Yusuf J. Ahmad, Salah El Serafy and Ernest Lutz, eds., *Environmental Accounting for Sustainable Development*, Unep-World Bank Symposium (Washington, DC: World Bank, 1989), pp. 10-18; Peter Bartelmus, Ernst Lutz and Stefan Schweinfest, *SEEA: A Case Study for Papua New Guinea*, Environment Working Paper; no. 54 (Washington, DC: World Bank, 1992); Peter Bartelmus, Ernst Lutz and Jan Van Tongern, «Environmental Accounting: An Operational Perspective,» in: Ismail Serageldin and Andrew Steer, eds., *Valuing the Environment: First Annual International Conference on Environmentally Sustainable Development* (Washington, DC: World Bank, 1994); J. Tongern [et al.], «SEEA: Case Study for Mexico,» in: Ernest Lutz, ed., *Toward Improved Accounting for the Environmen*t (Washington: DC: World Bank, 1993); H. Peskin and Ernest Lutz, «A Survey of Resource and Environmental Accounting in Industrialised Countries,» in: Ernest Lutz, ed., *Toward Improved Accounting for the Environment* (Washington, DC: World Bank, 1993); Ernest Lutz, « Toward Improved Accounting for the Environment: An overview,» in: Ernest Lutz, ed., *Toward Improved Accounting for the Environment* (Washington, DC: World Bank, 1993); United Nations, *Integrated Environmental and Economic Accounting*, Handbook of National Accounting Series; no. 61 (New York: Department of Economic and Social Division, 1993); Robert Repetto [et al.], *Wasting Assets: Natural Resources in National Income Accounts* (Washington, DC: World Resource Institute, 1989); Raul Solorzano [et al.], *Accounts Overdue: Natural Resource Depreciation in Costa Rica* (Washington, DC: World Resource Institute, 1991); K. A. Attia, «Developing An Environmental Accounting Model for Egypt,» *Journal of Arab Economic Research*, vol. 9, no. 21 (2000), pp. 21-64; K. A. Attia, «Greening Kuwait's National Accounts: Two Contrasting Methodologies and Conflicting Results,» *Arab Economic Journal*, vol. 11, no. 27 (2002), pp. 3-35; Glenn-Marie Lange, *Policy Applications of Environmental Accounting*, Environmental Economics Series; 88 (Washington, DC: World Bank Environment Department, 2003); Glenn-Marie Lange, «Wealth, Natural Capital, and Sustainable Development: Contrasting Examples from Botswana and Namibia,» *Environmental and Resource Economics*, vol. 29 (2004), pp. 257-283; Glenn-Marie Lange, Rashid Hassan and Alessandra Alfieri, «Using Environmental Accounts to Promote Sustainable Development: Experience in Southern Africa,» *Natural Resources Forum*, vol. 27 (2003), pp. 19-31; Matthew Clarke and Sardar Islam, «National Account Measures and Sustainability Objectives: Present Approaches and Future Prospects,» *Sustainable Development*, vol. 18, no. 4 (2007), pp. 55-82; World Bank, *Where Is the Wealth of Nations: Measuring Capital for the XXI Century*, International Bank for Reconstruction and Development (Washington, DC: The World Bank, 2006), and Jean Lewis Weber, «Land and Ecosystem Accounts in the SEEA Revision: Position paper for the London Group meeting,» Brussels, 29 September-3 October 2008.

ferences in the interests of individuals responsible for the development of applying the newly and different techniques. Probably the chief factor, however, was the view taken about the two main functions of conventional national accounts–i.e. whether to assist in performance measurement or to provide a more general data systems for better management of a modern economy.

Table (1)

Summary of International Experience in Environmental Accounting: 1989- 2008(*)

	Assets	Flow Accounts for pollutants & materials		Environmental Protection & Resource Management Expenditures	Macro Aggregates
		Physical	Monetary		
Developed Countries					
Australia	X	X		X	
Canada	X	X		X	
Denmark	X	X		X	
Finland	X	X		X	
France	X	X		X	
Germany	X	X	X	X	X
Italy	X	X		X	
Japan	X	X	X	X	X
Norway	X	X			
Sweden	X	X	X	X	X
United Kingdom	X	X		X	
United States	X			X	
Developing Countries					
Botswana	X	X	X[a]		
Chile	X		X[a]	X	
Korea, Rep. of	X	X	X	X	X
Mexico	X	X	X	X	X
Moldova		X[a]			
Namibia	X	X	X[a]		
Philippines	X	X	X	X	X
Partial Studies					
Russia	X	X	X		
Mauritania	X		X		
Chad	X	X	X		
Colombia		X	X	X	
Costa Rica				X	
Eu-15			X		
Indonesia	X				
Egypt	X	X	X		X
Kuwait	X	X	X		X
South Africa	X	X	X[a]		

Note: Eu-15: means European Union.

(*) Adopted from United Nations, 2003 and updated till 2009 by the author of the study.

[a] = accounts for water only.

In the above mentioned case studies, that are currently applying, the conventional Systems of National Accounts (SNA) misstate income, and perhaps growth, because of their neglect of environmental deterioration and the depletion of natural resources. In the latter, the main function of applying national accounts is to provide a coherent database to support decision-making, economic policy, research, and modeling. This function can not be adequately performed without information that will better reflect environmental/economic/social interactions that is called Triple Bottom Line Approach (TBA)[2].

The above mentioned case studied, also, applied different approaches that differ in the degree to which they emphasize each of these two broad functions. Thus, for example, the responsible government agencies in Norway and USA have so far shown little interest in producing better (green) gross domestic product. Instead they have concentrated on developing better databases for policy analysis and economic modeling. In contrast, in developing countries such as Indonesia, Costa Rica, South Africa, Philippines, and Mexico have concentrated on the correction of conventional income indicators, i.e. estimating and calculating green macro and sectoral indicators proposed by the United Nations and World bank in their revised SEEA in 2003, such as Environmentally-adjusted gross Domestic Product (EDP) and Genuine Savings (GS), for the economic sectors and for the whole economy, that takes into consideration the depletion and degradation costs of their economic performance, to reflect their real growth rates[3].

(2) For more details see for example: R. Gray and Jan Bebbington, «Sustainable Development and Accounting: Incentives and Disincentives for the Adoption of Sustainability by Transnational Corporations,» *International Accounting and Reporting Issues* (Geneva): UNCTAD/DTCI/25. (1996); Jan Bebbington and John Tan, «Accounting for Sustainability,» *Chartered Accountants Journal of New Zealand*, vol. 75, no. 6 (1996), pp. 75-76; Jan Bebbington and John Tan, «Accounting for Sustainability,» *Chartered Accountants Journal of New Zealand*, vol. 76, no. 1 (1997), pp. 37-40; Frank Birkin and David Woodward, «Management Accounting for Sustainable Development: The Eco-balance Account,» *Management Accounting*, vol. 75, no. 9 (1997), pp. 50-52; Frank Birkin and David Woodward, «Management Accounting for Sustainable Development: Part 5: Accounting for Sustainable Development,» *Management Accounting*, vol. 75, no. 10 (1997), pp. 52-55; Jean Lewis Weber, «Implementation of Land and Ecosystem Accounts at the European Environment Agency,» *Ecological Economics*, vol. 61, no. 4 (March 2007), pp. 695-707, and Xiaoning Gong, Lars Gunnar Marklund and Sachiko Tsuji, «Land Use Classifications: Proposed to be Used in the System of Integrated Environmental and Economic Accounting (SEEA),» paper presented at: 14th Meeting of the London Group on Environmental Accounting, Canberra, 27-30 April 2009, <http://unstats.un.org/unsd/envaccounting/londongroup/meeting14. asp>.

(3) For more details See: Repetto [et al.], *Wasting Assets: Natural Resources in National Income Accounts*; Solorzano [et al.], *Accounts Overdue: Natural Resource Depreciation in Costa Rica*; Lange, Hassan and Alfieri, «Using Environmental Accounts to Promote Sustainable Development: Experience In Southern Africa;» Clarke and Islam, «National Account Measures and Sustainability Objectives: Present Approaches and Future Prospects;» World Bank, *Where Is the Wealth of Nations: Measuring Capital for the XXI Century*; M. Lang, «List of Issues- Valuation,» paper presented at: 14th Meeting of the London Group on Environmental Accounting, Canberra, 27-30 April 2009, <http://unstats.un. org/unsd/envaccounting/londongroup/meeting14.asp>, and Rocky Harris, «Environmental Accounting Applications for Sustainable Consumption and Production Policies,» paper presented at: 14th Meeting of the London Group on Environmental Accounting, Canberra, 27-30 April 2009, <http://unstats.un.org/unsd/ envaccounting/londongroup/meeting14.asp>.

The approaches also differ significantly in their complexity and coverage. The US approach is narrowly focused on expenditure data, whereas the French approach covers a wide range of data reflecting environmental-economic interaction and resource depletion. However, Indonesian and Costa Rican approaches fall between the two extremes. Such differences in complexity and coverage reflect not only the particular degree of emphasis on the two major functions of national accounts but also different policy objectives. The Norwegian system is well suited to support the Norwegian desire to manage their natural resources such as petroleum, timber, hydrocarbon, and fish. The US approach, with its emphasis on expenditure data, supports the analysis of the macroeconomic effects of environmental policy. The Repetto and his colleagues approach, applied in Indonesia, Philippines and Costa Rica case studies, addresses issues relevant to developing countries sustainability.

Finally, however, although these approaches may have different structures in accordance with their different concerns and policy objectives, their data requirements are often quite similar. Thus the Norwegian and the Repetto et al frameworks appear to differ substantially on the surface. Yet similar data could be used for both of them. This means that efforts at implementation in developing countries could begin before a final decision is taken as to which approach will better suit the country needs. And since the conditions for success in resource and environmental accounting are likely to be country-specific, there is little point in waiting for broader experience in developed countries before a developing country decides to embark on its own studies. Given the relative severity of resource and environmental problems in the developing countries and therefore the relative seriousness of the deficiencies in the ability of standard economic accounts to reflect these problems, a productive strategy for developing nations might be to initiate their own, low cost, pilot studies.

The following analysis of Egypt's national accounts is very much in this spirit. It focuses on aggregated rather than disaggregated data, monetary rather than physical measurements, and only considers the depreciation of land. The current system of national accounts in Egypt, as in most countries, is an implementation of the conventional United Nations system (1968) that is revised in 1993, however still ignores the contribution of natural resources to current income. As a result, there is no treatment of the depletion and degradation of natural assets analogous to the depreciation treatment of man-made capital. Although several policies have been formulated for sustainable development of Egypt, none of these policies has addressed the need for an adequate and accurate National Accounting System. What follows is an attempt at a partial remedy.

3. Measuring Agricultural Land Sustainability

Egypt is a country with limited reserves of depletable resources (i.e., oil and gas) and with serious environmental problems such as air and water pollution, and land depletion and degradation. This section provides an accounting estimate of the capital consumption allowance for agricultural land losses resulting from urbanization. Two different accounting approaches (average and marginal cost) have been developed and used to estimate annual physical land loss functions first. From these the loss of agricultural land in monetary terms is evaluated using the present value method second. Therefore, this section is divided into six parts. The *first* part provides an overview of the main environmental issues in Egypt. The *second* part presents the current situation of agriculture lands in Egypt; the *third* part describes urban and rural expansion, as the result of high population growth and construction developments, as a major threat for old agricultural land in Egypt. The *fourth* and the *fifth* parts of section *three* present an estimate of the annual land loss using average and the marginal cost approaches in physical terms; this is followed by presenting the monetary value of the physical land loss using the present value method in *sixth* and final part of this section.

A - Environmental Issues in Egypt

Egypt's high rate of population growth and density along the Nile valley and delta, coupled with industrial activities concentrated primarily along the river Nile and in the large cities of Cairo and the Delta, has resulted in an increased burden on the country's limited natural resources, and has adversely affected public health. The main environmental problems faced by the country are[4]:

* Acute water scarcity: Per capita water availability is expected to fall from the current 900m^3 for all purposes to about 670m^3 in the year 2017. The causes are due to the use of 85 percent of Nile water for irrigation, high network losses in potable water and poor service water coverage in rural areas;

* Declining water quality: Water quality in the River Nile and the canals deteriorates in a northward direction due to the disposal of municipal and industrial effluents and agricultural drainage as well as the decreasing flow. Drainage canals are heavily polluted, with average Biological Oxygen Demand (BOD) values reaching 300 mg/l and mean probable number (MPN) of total coliforms being in the range of 800010,000 compared to the Egyptian environment guidelines of 20-40 mgll and 500-1000 (MPN), respectively. While sanitation coverage has been estimated at 97% for urban and 70% for rural households, only a fraction of households with access to sanitation are actually connected to the sewerage system, with rural areas having coverage of less than 5%. As a result, public health is seriously affected. Waterborne diseases are major causes of deaths;

* Land depletion and degradation: annual loss of agricultural land due to urban encroachment is estimated between 15,000 and 30,000 acres. The major causes of land degradation are poor irrigation drainage, soils salinization; inadequate crop rotation and selection, fragmented land tenure and soil erosion. Approximately 35% of agricultural land suffers from salinity resulting in the inability to meet rising food demand;

* Increasing pollution and untreated urban and hazardous waste disposal: The cause of outdoor pollution are hazardous air emission and water discharges from

(4) See: World Bank, *Country Environmental Analysis (1992-2002)* (Washington. DC: Water and Environment Department, the Middle East and North Africa Region, World Bank, 2005).

the heavy metallurgical industries, refineries, cements and power plants as well from an aging transport sector. In addition, 15.3 million tons of municipal solid waste are generated annually of which almost 2.5 million remain uncollected and no appropriate sanitary landfills exist for their disposal. Hazardous waste, agricultural and hospital waste are also mixed with municipal waste in open dumps where burning is the most used method for elimination. Air pollution and water pollution are sources of respiratory and allergic ailments, especially among children.

* Poorly Protected Cultural and Natural Heritage: Air pollution, wastewater, uncontrolled urban encroachment and tourist development as well as large influx of tourists are the major causes of the poorly preserved cultural and historical monuments[5].

Natural resources play two basic roles in development: the *first*, mostly applicable to the poorest countries and poorest communities, is the role of local natural resources as the basis of subsistence. The *second* is the role of natural resources as a source of development finance. Commercial natural resources can be important sources of profit and foreign exchange. Rents on exhaustible, renewable, and potentially sustainable resources can be used to finance. Land resources are potentially sustainable if managed well. Land is particularly important in the poorest countries because it is a direct source of livelihood and sustenance for many poor households. As stated in the World Bank Study 2005, the cropland and pasture land make up 70 percent of natural wealth in low- income countries, and 18 percent of their total wealth estimates. Based on the above discussions, it is important to undertake a qualitative and quantitative assessment of any deteriooperations that might occur to such main production pillars and to translate such depletion/depreciation in the form of economic and social quantitative and qualitative estimates whenever possible. Thus, the next section will focus on discussing the productive role of land resources in Egypt.

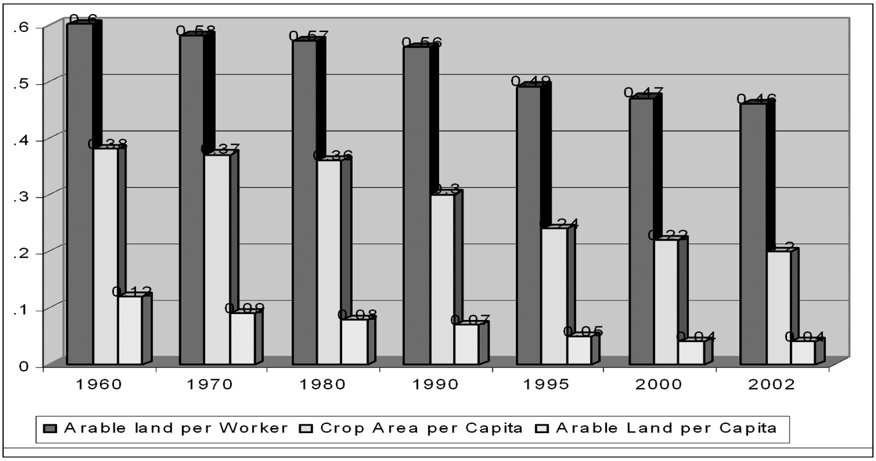
B - Egypt's Agriculture Land Losses

According to CAPMS (2006), Egypt has a total area of about one million kilometers square. Egypt is situated in the arid and semi arid zones belt characterized by limited arable land resources, whether irrigated, pluvial agricultural land, natural grazing meadows or wetlands. Currently irrigated and cultivated land in Egypt is about 7.95 million feddans, from which 5.3 million feddans are fertile sedilands in the Delta and the Valley, while the remaining land is desert, reclaimed during the last five decades. Old irrigated lands constitute one of the pillars and main resources for fulfilling daily life requirements of people, particularly under the current annual population increase reaching around 1.9% in addition to the continuous increase in individual consumption rates of different nutritive and agriculture products. Demographic growth in Egypt has had a clear impact on lowering per capita share of agricultural land, coming

(5) It has to be mentioned here that about 8% of the total area of Egypt has been declared Protected Areas, and is envisioned to extend to 17% by 2017. The coastal areas along the Mediterranean and the Red Seas have suffered seriously.

down. According to Ministry of Agriculture Censuses in 1982 and 1992 and 2002 estimates by the Ministry of Agriculture, agricultural land per capita decreased from 0.12 feddan in 1960 to 0.04 feddan in 2002. In addition, agricultural land per worker decreased from 0.60 feddan in 1960 to 0.46 feddan in 2002. Moreover, the crop area per capita declined from 0.38 to 0.20 feddan in the same period (see figure 1 below).

Figure (1)
Arable and crop area per worker and capita, 1960-2002



The Greek philosopher, Herodotus said that «Egypt is the Gift of the Nile» because the fertile sedimentary land area in the Delta and the Old Valley, is mainly irrigated by Nile water, that was estimated at the beginning of the fifties to be around 6.25 million feddans. Due to different encroachments, e.g. urban expansion, leaving land uncultivated, stripping land surface or constructing industrial facilities and infrastructure, the total area of this land during the last few decades has diminished to be 5.35 million feddans at the beginning of the present century[6]. Old agriculture lands, reclaimed desert and Nile irrigated areas, reach around 8 million feddans, which represents less than 3.4% of the total area of the Arab Republic of Egypt. This percentage almost corresponds to the percentage of cultivated land in the Arab region. Undoubtedly, reclaiming desert land has become an urgent and complementary necessity. These lands will be added to the fertile Delta and Old Valley areas enabling the State comforts, as well as to preserve the level of agriculture sector participation in Egypt's annual gross domestic product [7].

(6) See: Arab Organization for Agriculture Development, *Lands Uses in the Arab Region* (Khartoum: Annual Statistics Book, 1998).

(7) The agriculture sector participation reaches at present around 20% of the National income and provides employment opportunities to almost 40% of Egypt's labor force, See: M. Hassanayn, *The Interrelated Troika: Population, Environment and Sustainable Development* (Cairo: Institute of National Planning, 1993), and 13th Meeting of the London Group on Environmental Accounting, 29 September- 3 October 2008, Brussels, Belgium, <http://unstats.un.org/unsd/envaccounting/londongroup/meeting13.asp>, Asit K. Biswas, «Environ- =

C - Urbanization and Agricultural Land Loss

Urban encroachment occurred due to the expansion of cities and villages and the establishment of industrial facilities and infrastructure, in addition to soil surface stripping for manufacturing red bricks. Soil stripping has been nearly overcome as a result of the legislation issued in 1983 and amended in 1996. Other encroachments started during the fifties causing the loss of 15000 feddans annually. Rates of losing such fertile soil during the past decades till the last twentieth century decade have increased estimated at about 45,000 feddans annually (see Land, Water and Environment Institute, 2000). A military order has then been issued in 1996 to stop and eliminate such encroachments, significantly limiting such phenomena. Due to the active encroachment of sand and sand dune encroachment, namely in the Western desert towards fertile sedimentary land, an area estimated of 16% of the Old Valley land has been influenced. Satellite images reveal the volume of this impact[8].

Urban encroachment on agricultural land is also a serious problem. Egypt has lost up to 1.2 million feddans of fertile land due to urban encroachment till the year 2002 [9]. Causes of this loss of arable land include: (1) distortions in urban land markets; (2) proliferation of spontaneous settlements, and (3) a lack of information about potential productive capacity of farm lands using treated wastewater. It is essential that Egypt should give urgent attention to reduce the loss of arable land due to urbanization for many reasons. *First*, with growing population, there is need for more agricultural land to meet the population's needs for food. *Second*, land reclamation is an expensive process. *Finally*, land lost due to urbanization is often, if not always, more fertile and productive than reclaimed land.

D - Average Cost Approach

The most recent estimates of the causes of agricultural land loss resulting from urbanization, attributed about 54% of the total land loss from 1980-2002 to urban expansion[10]. Comprehensive studies estimated the total agricultural land loss to be

= mental Sustainability of Egyptian Agriculture: Problems and Perspective,» *Ambio*, vol. 24, no. 1 (1995), pp. 16-20, and World Bank, *Country Environmental Analysis (1992-2002)*.

(8) The area influenced by this phenomenon is estimated to be 1.8 million feddans. Land productivity has diminished by about 25% compared to its original productivity, See: Arab Organization for Agriculture Development, *Lands Uses in the Arab Region*, and World Bank, *Country Environmental Analysis (1992-2002)*, and World Bank, «Egypt Public Land Management Strategy,» in: *Background Notes on Access to Public Land by Investment Sector: Industry, Tourism, Agriculture, and Real Estate Development, Finance, Private Sector and Infrastructure Group* (Washington, D.C.: Middle East and North Africa, World Bank, 2006), Report No. 36520, volume II.

(9) See: Arab Organization for Agriculture Development, *Lands Uses in the Arab Region* (Khartoum: Annual Statistics Book, 2003).

(10) For more details see: Central Agency for Public Mobilization and Statistics (CAPMAS), *Water Resources and the Ability of Expanding Agricultural land in Egypt* (Cairo: CAPMAS, 1987); R. M. Rizk, *Impact of Urbanisation on Agriculture Area in the A. R. E.* (Cairo: Faculty of Agriculture (Zagazig University), 1980); World =

about 1.2 million feddans for the period 1962-2002; and attributed about 28% of the total agriculture land loss from 1962-1979 to rural expansion[11]. Using the above estimates, for the period from 1962-2002, losses resulting from urban and rural expansion are calculated in Table (2). Two proxies have been used to measure these impacts: (1) annual population growth; (2) annual construction data. Table (1) was calculated by multiplying the total land loss by the percentage of loss due to urban and rural expansion. For example, the total land loss from 1962 to 1996 was about 1.2 million feddans, 54 percent because of urban expansion comes to be about 648 thousand feddans and 28 percent because of rural expansion to be about 336 thousand feddans of agricultural land loss, respectively.

The data in Table (2) yields the total and average land loss per capita and per building over the 1962-2002 periods. For example, the increase of one capita of population over 1962-2002 period destroyed 0.034 and 0.013 feddan of agricultural land in urban and rural, respectively. One construction destroyed 0.235 feddan over the same period. Accordingly, two averages of land loss estimates may be derived; one based on population increase in urban and rural areas; the other on annual construction. From these data an average land loss estimate for year (t) based on population increase is given in equation (1) below.

Table (2)
Estimated Agricultural lands loss due to urbanization and construction from 1962 to 2002

	Urban	Rural	Buildings
Total increase (population growth or construction)	19,298,630	25,734,396	2,935,294
Total land loss (in feddans)	648,133	336,422	689,465
Average loss per capita or building	0.033584	0.013072	0.234885

(1) $ALS_t = 0.033584 UR_t + 0.013072\ RU_t$

Where:

ALS_t = agricultural land loss in year t due to urban and rural expansion.

UR_t = population increase in urban areas in year t.

RU_t = population increase in rural areas in year t.

= Bank, *Arab Republic of Egypt: An Agriculture Strategy for the 1990s* (Washington: A World Bank Country Study, D.C., 1993); M. El Zanaty and Asmaa El-Badawy, *Agricultural Land: The Problems and the Future* (Cairo: Academy Library, 1995), and Central Agency for Public Mobilization and Statistics (CAPMAS), *Statistical Yearbook 1952-2002* (Cairo: CAPMAS, 1992).

(11) These statistics were extracted from: Arab Organization for Agriculture Development, *Lands Uses in the Arab Region* (Khartoum: Annual Statistics Book, 2003); World Bank, *Country Environmental Analysis (1992-2002)*, and World Bank: *Where Is the Wealth of Nations: Measuring Capital for the XXI Century*, and «Egypt Public Land Management Strategy».

An average land loss function for 2002 using annual construction of land loss per building of 0.365 feddan over the 1962-2002 periods is given by equation (2) below.

(2) $ALS_t = 0.234885\ BU_t$

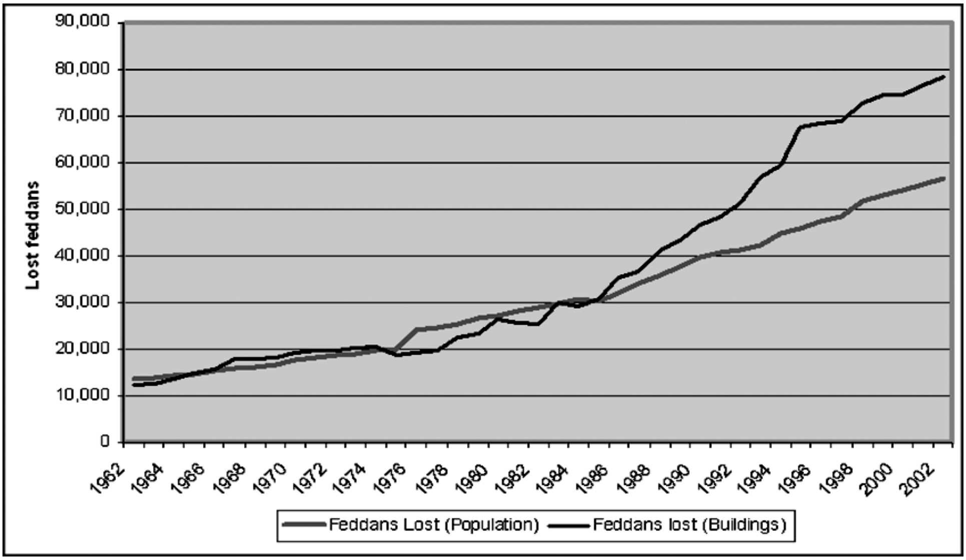
Where:

ALS_t = agriculturl land loss.

BU_t = annual construction in year t.

Agricultural land loss in each year is presented in Figure (2) according to their estimations from the two equations above. The average population increase induced agricultural land loss using 2002 population increase data is about 56,783 feddans, while the average loss using buildings data is 78,187 feddans. These estimates are our first proxies for 2002 agricultural land loss due to population increase and construction.

Figure (2)
Estimated agricultural land losses due to urbanization and construction, 1962-2002



Also, as shown in figure (2) above, the average historical agricultural land loss over these four decades (1962-2002) reflects the total loss from population increase and construction. However, an average loss in any given year is inaccurate to the extent that the marginal loss (annual) may differ from the average loss over the time period. Using equation (2), as soon as current construction falls, land loss rates fall. However, this relation may not hold. Current land losses could increase even when current construction is declining if past construction has lagged effects on future land loss. Hence, it is useful to attempt to determine a land loss function, which takes into account marginal losses in a given year. This is the task of the section below.

E- Marginal Cost Approach

There are two problems with the method of determining an average land loss estimate in the previous section. *First*, it is based on arguable consensus estimates. *Second*, it only allows calculation of the average loss. This does not yield any direct information on the annual changes in population growth and construction induced land loss over the period. However, these marginal changes will be different from the average except in the unlikely case where the marginal land loss is the same in every year. Hence a loss function based on marginal loss will present a more accurate picture than one based on average loss. An annual (marginal) loss function that allows for lagged effects of construction or population growth requires time series on annual agricultural land loss, construction or population growth, and other significant causes of agricultural land loss. Such a statistical model would be of the form.

(3) $ALS_t = f(\text{Intercept}, X_t, X_{t-1}, X_{t-2},...BU_t, BU_{t-1}, BU_{t-2}...) + e_t$

or

(4) $ALS_t = f(\text{Intercept}, X_t, X_{t-1}, X_{t-2}...POP_t, POP_{t-1}, POP_{t-2}...) + e_t$

Where:

* ALS_t = agricultural land loss in year t.

* X_t = important causes of land losses in year t other than current population growth or construction.

* BU_t or POP_t = annual population growth or construction in year t.

* e_t = error term representing unsystematic causes of agricultural land loss.

Given this model, the marginal agricultural land loss in year t due to population growth or construction could be estimated from the coefficients of the independent variables.

However, it is difficult to use the above model in equation (3) or (4) due to several data limitations. The *first* statistical problem involves uncertainty as to the best available proxy for the environmental effects of major causes on agricultural land. Two proxies have been chosen for this environmental effect, annual construction, and annual population growth in all the country. The *second* statistical problem is the lack of annual data on other causes of agricultural land loss than buildings or population growth. Thus, the simplifications of equation (3) or (4) will be of the form shown below in equations (5) and (6).

(5) $ALS_t = f(\text{Intercept}, BU_t, BU_{t-1}, BU_{t-2}...) + e_t$

Or

(6) $ALS_t = f(\text{Intercept}, POP_t, POP_{t-1}, POP_{t-2}...) + e_t$

Where:

* ALS_t = agricultural land loss in year t.

* BU_t or POP_t = annual population growth or buildings constructed in year t.

* e_t = error term representing unsystematic causes of agricultural land loss.

Egypt's Ministry of Agriculture in 1996 estimated the annual agricultural land loss converted to urban for the period 1971-1996.Thus, it is possible to use equations (5) and (6) to estimate the agricultural land loss from 1996 to 2002. Two equations resulted from the regression procedures:

(7) $ALS_1 = C + \alpha_1 BU_t + e_t$

(8) $ALS_2 = C + \alpha_2 POP_t + e_t$

Where:

* C = intercept.

* BUt = annual construction in year t.

* POP_t = annual population growth in year t.

* e_t = error term.

The results of the regression of the previous two equations are shown in Table (3).

Table (3)
Results of regressions of construction and population growth

Variable	Buildings(BU)	Population (POP)
Intercept (C)	10.5171 (2.275) **	-4.2402 (0.785)
α_1 and α_2	0.34516 (3.754)*	0.03949 (1.456)***
F stat. (1,25)	65.2354 (10.9378)*	4.7653 (3.2465)***
R^2	0.9276	0.6745

* Significant at 1%.-
** Significant at 5%-
*** Significant at 10%.
(t statistics in parentheses).

As regressions (7) and (8) show, as expected there is a positive relationship between population growth, construction and agricultural land losses. But, the relationship is much stronger between construction and land losses explained by the significance of α_1 at 1 percent and 0.9276 for adjusted R^2. This makes the results of equation (8) more credible than those of equation (7). Based on historical data for the period 1962 - 1996 (MOA data), we have obtained the agricultural land loss function (for buildings and population) that is shown in equations (7) and (8). Now, these equations may be used in estimating agricultural land losses for the period 1996 - 2002. The results are shown in Table(4) below.

From Table (4) above, physical land losses using the marginal cost approach for 2002, as a result of construction or population growth, are 76,670 and 55,453 thousand feddans, respectively. Based on the above calculations, physical agricultural land losses, resulted from population growth or construction, for the average and marginal cost approaches will be used in estimating a capital consumption allowance for land loss for the period 1962 -2002. This is the task of the next section.

Table (4)
Estimated agricultural land losses using Marginal Cost Approach, from 1996 to 2002 (in 000s feddan)

Year	Population growth	Constructions
1996	46,148	67,819
1997	47,252	68,227
1998	48,382	68,863
1999	51,647	72,543
2000	52,884	74,533
2001	54,153	74,798
2002	55,453	76,670

F- Agricultural Land Depreciation (ALD)

In this section, the physical agricultural land depreciation or loss, derived in the last two sections along with estimates of agricultural land values, will be used to form agricultural land capital consumption allowances for the period 1962 - 2002, the years the Egyptian environmental economic-accounts will be partially established. The capital consumption allowance for agricultural land loss is equal to the stream of undiscounted agricultural land losses in each year multiplied by the present value of feddan lost in each year as shown in equation (9) below.

(9) $ALD_t = ALS_0 * PV + ALS_1 * PV/(1+r) + ALS_2 * PV/(1+r)^2 + \ldots$

Where:

* ALS_t = undiscounted agricultural land loss in year t.

* PV = monetary present value of one feddan lost in 2002.

* r = discount rate (5% or 10%).

Factoring the present value term from the right hand side of equation (9) yields equation (10), which expresses the ALD as the physical feddan present value of agricultural land multiplied by the monetary present value of one feddan lost in 2002.

(10) $ALD = PV \sum_{t=0}^{n} \frac{ALS}{(1+r)^t}$

Where:

* ALS_t = undiscounted agricultural land loss in year t.

* n = number of years of agricultural land loss until there is less than one feddan of agricultural land loss.

The average and marginal cost approaches yield the land loss per capita or buildings. In the average cost approach, the ALD in year t is simply equal to the estimated agricultural land loss in year t due to population increase or construction multiplied by the present value of feddan of agricultural land loss in year t. Thus, equation (10) above simplifies to equation (11) below for the average cost approach.

(11) $ALD_t = PV * ALS_t$

Where:

* PV = present value of feddan lost in year t.

* ALS_t = estimate of agricultural land loss according to the average cost approach.

In the marginal cost approach, the ALD in year t is equal to marginal agricultural land loss α_1 or α_2, multiplied by an additional building or person, respectively. Thus, equation (11) could be simplified to equation (12) and (13) for the marginal cost approach.

(12) $ALD_t = PV * \alpha_1 BU_t$

or

(13) $ALD_t = PV * \alpha_2 POP_t$

Where:

* α_1 = marginal increase of agricultural land loss from additional building

* α_2 = marginal increase of agricultural land loss from additional person

* PV = present value of feddan in monetary terms

* BU_t = buildings constructed in year t

* POP_t = population increase in year t

One of the main characteristics of most developing countries, if not all, is that land markets exhibit imperfections and distortions. This leads to the use of a second best methodology, which is estimating the present value of land rent (LR) or shadow price (SP), as proxies of land value. Biswas (1995) has estimated the shadow price per feddan of agricultural land to be about £E1011 for 2002. On the other hand, the only available data on land rent are the records of the official land rents. The official land rent was constrained to seven times the amount of the land tax of around £E20 per feddan. In the mid of 1990s land rent changed to 22 times of the land tax. However, the marginal value of land is much higher than the official rent. Both the World Band (1993) and Hakim and Aboumandour (1993) reported that the actual rent either in cash or implicit in share cropping arrangements, is equal to or above seven times the official land rent depending on soil fertility, land location and planted crops. This means that the annual rent per feddan is estimated to be £E 980, which is almost equal to the same amount estimated by Biswas in 1995.

Now we have two ranges of monetary values per feddan, the SP and LR estimates, to use in constructing monetary capital consumption allowances. These values will be used in equations (11), (12) and (13) for deriving capital consumption allowances using the average and the marginal cost approaches. Accordingly, the calculation of ALD using the average cost approach is shown in Table (5) below. The average loss estimates assume loss due 2002 activity will ultimately equal that implied by the long-run historical average. Multiplying the estimated 2002 agricultural land loss, due to population growth or construction, by the present value of feddan lost in 2002 derives the ALD estimates presented in Table (5).

Table (5)
Estimated 2002 ALD using the Average Cost Approach of land loss

Estimated agricultural land loss (in feddans)	Population growth		Construction	
	56,783		78,187	
Discount rate	5%	10%	5%	10%
SP - PV (£.E.)	20,220	10,110	20,220	10,110
ALD - SP (million £.E.)	1,148.15	574.08	1,580.94	790.47
LR - PV (£.E.)	19,600	9,800	19,800	9,800
ALD - LR (million £.E.)	1,112.95	556.47	1,548.10	766.23

Using the 39,610 feddans lost due to population growth, the ALD-PV at 10% is then £E 10, 110 per feddan multiplied by 56,783 feddans, or £E 574.081 million as shown in Table (5). The capital consumption allowances using buildings and land rent (LR) present values are calculated in the same manner. Now, we turn to the calculation of ALD using the marginal cost approach, as explained by equations (12) and (13). This is shown in Table (6) and figure (3) below.

Table (6)
Estimated 2002 ALD using Marginal Cost Approach

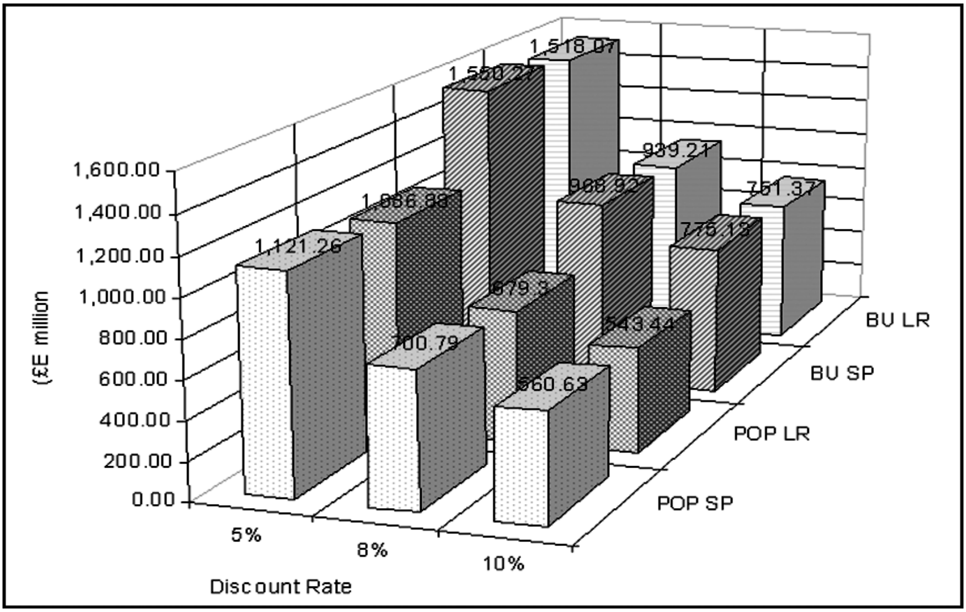
Estimated agricultural land loss (in feddans)	Population growth		Construction	
	56,783		78,187	
Discount rate	5%	10%	5%	10%
SP - PV (£.E.)	20,220	10,110	20,220	10,110
ALD - SP (million £.E.)	1,121.26	560.63	1,550.27	775.13
LR - PV (£.E.)	19,600	9,800	19,800	9,800
ALD - LR (million £.E.)	1,086.88	543.44	1,518.07	751.37

In Table (6), ALD-SP using construction, for example, is about 78, 187 feddans lost multiplied by SP-PV of feddan lost at 5% or 10%. For example, ALD-SP at 10% is about £E 775.132 million. That is calculated using the agricultural land loss resulting from construction multiplied by the SP-PV of feddan at 10%. The rest of the Table is calculated in the same manner.

We have calculated two sets of agriculture land depreciation (ALD): one set using the average cost approach in Table (5), and the second set using the marginal cost approach in Table(6). Each ALD is an estimate of capitalized environmental loss to Egypt of 2002, as a result of construction or population growth. At 10% and 5%, ALD-SP and ALD-LR estimates for the average and marginal cost approaches using buildings data are very similar, regardless the method of estimation, ranging from £E 751.37 to £E 790.47 million and from £E1518.07 to £E1580.94 million, respectively. The 10% or 5% ALD-SP and ALD-LR estimates for the average and marginal cost approaches using population data are not similar, ranging from £E 543.44 to £E 574.08 and from £E 1086.88 to £E 1148.15 million, respectively.

Markets in developing countries are uncompetitive and people's income is low. From consumers' perspective, the lower people's income, the higher rate of return they need to divert resources from consumption to investment. Poor people assumed to discount the future heavily. This explains the high discount rate in developing world. On one hand, Convery (1995) and the World Bank (2005) in their analyses for developing world have adopted 10% discount rate. On the other hand, Nelson (1995) and World Bank (2005) have used 5% discount rate when both calculated the environmentally adjusted product for African countries. The results of ALD using 10% discount rate seem to be more acceptable than 5%. However, 10% for Egyptian economy is high discount rate, because Egypt is categorized as one of the top 20 developing countries. Thus, 8 percent, as an average, is more appropriate for Egyptian economic analysis. Therefore, figure (3) below presents a comparative analysis for ALD estimates at 5%, 8% and 10%.

Figure (3)
Comparative ALD for agriculture Land
in 2002 at 5%, 8% and 10%. (marginal approach)



As calculated in Table (7) below, using construction in estimating agricultural land losses is more acceptable than using population growth. As explained above, construction is a better proxy for agricultural land loss, which gives very similar results regardless of the applied approach. Therefore, ALD for agricultural land loss, using construction and 8 percent discount rate, for the average and marginal cost approaches is compared.

Table (7)
Comparative ALD for Average and Marginal Cost approaches (construction -8%)

Estimated land loss (in feddans)	Average	Marginal
	78,187	76,670
SP - PV (£.E.)	12,637.50	12,637.50
ALD - SP (million £.E.)	988.09	968.92
LR - PV (£.E.)	12,250	12,250
ALD - LR (million £.E.)	957.79	939.21

From Table (7) ALD, for the marginal cost approach and 8 percent discount rate in 2002, is calculated by multiplying 76,670 feddans by SP and LR present value per feddan. This yields £E 968.92 and £E 939.21 million for ALD-SP and ALD-LR, respectively. The ALD for the average cost approach is calculated in the same manner. Finally, the ALD for the marginal cost approach and the average of SP and LR present value is £E972.94 million, that is considering our estimation of ALD for agricultural land loss in 2002.

4. Conclusion and Policy Implications

As stated above, a serious problem is facing the growth of Egyptian agricultural sectors, that is land loss due to urban expansion. The government policy of keeping lower prices for agriculture production causes the reduction in the farming profits that in turn lower the value of agriculture land because the value of land is the capitalization of the stream of profits from the uses of this land. This makes alternative uses for agriculture land, urban and industrial, more attractive. Population growth and industrialization are responsible for the loss of most Egyptian fertile land. However, no serious actions have been taken, except the military action in 1996, by the government to put an end to this problem, especially if the alternative to replace this loss, through land reclamation, is a very expensive process. Therefore, having the value of this loss in economic terms is a very great help in addressing this problem that has a very serious impact on the growth of the agricultural sector and on the Egyptian economy.

In particular this study has developed an accounting methodology for calculating Egypt's capital consumption allowance estimate for agricultural land loss resulting from the economic activity, a loss that is clearly seen to be a significant quantity. Clearly, ignorance of these sorts of costs will produce misleading guidance to policymakers, and compromise the goal of sustainable long-run income growth. While our estimations are inevitably subject to a number of minor inaccuracies that are common in this type of research we believe, nevertheless, that the results are very significant. It follows that the future of natural resources base countries (developing countries) is in danger if they do not account for the depletion of natural resources. Finally, we hope that the methodological approaches developed and used in this paper may be of use to further research of this type in developed and developing countries.

Therefore, this paper has been concerned with the issue of accounting for environmental goods and services in Egypt. Its underlying theme that standard measures of macroeconomic quantities significantly underestimate the costs associated with the use of natural resources. Concentrating on just one of Egypt's natural resources, which is agricultural land, we estimate depletion costs amounting to be approximately 15.3%, 4.3%, 1.8%, 5% and 1% in respect of the total Egypt's produced assets depreciation, savings, consumption, agriculture production and gross domestic product, respectively. Moreover, the study results are indicating that Egypt needs to reinvest, at least an amount equal to 1% of its gross domestic product or 5% of its agriculture sector income, for instance, in reclaiming new agriculture lands that is equal to estimated ALD for agriculture land, in order to sustain and maintain the current contribution of agriculture sector income in the whole economy. Finally, this significant loss of Egypt's sustainable income would prove that if Egypt is going to continue losing its fertile agriculture land, alongside the Nile, at the current rates, it will, of course lose its merits of being the Gift of the Nile, as been stated thousands of years ago, by The Greek philosopher Herodotus.

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