AGRICULTURAL SUSTAINABILITY IN EGYPT

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Abstract: Agriculture sustainability has been the core of research studies in recent years. This study incorporates two stages: first, to develop a framework to measure agricultural sustainability in Egypt, and second, to identify agricultural sustainability practices based on the developed framework and research results. The framework includes a number of social, economic and environmental indicators to measuring agricultural sustainability in Egypt and is developed depending upon indicators used for the same purpose in England, Italy, Venezuela, and Australia, in addition to indicators included in the environmental sustainability index. The application of the framework depends on secondary sources.
Agricultural sustainability practices in Egypt are identified and empirically investigated to examine farmers' perception and adoption of these practices. Interviews were carried out in 2010 with 200 farmers, randomly selected, belonging to four districts in Assiut governorate, Egypt.

Results show positive trends towards agricultural sustainability in Egypt according to most economic indicators and negative trends according to most social and environmental indicators. Results also show low levels of farmers' knowledge and adoption of many agricultural sustainability practices. It is recommended that immense efforts to be devoted to encourage farmers to adopt agricultural sustainability practices concerning these social and environmental dimensions to maintain agricultural sustainability in Egypt.

***Keywords*:** Adoption, Agricultural sustainability, Egypt, Sustainability indictors, Sustainability practices.

INTRODUCTION

The need to increase agricultural production and achieve agricultural development in Egypt is critical due to the high rate of population growth and increasing demands for food on one hand and the limited agricultural land resources on the other. Strategies have been set up and implemented to achieve agricultural development in Egypt. In the last thirty years, three agricultural strategies have been prepared in the 1980’s, in the 1990’s and towards 2017. The 1980’s agricultural development strategy dealt mainly with liberalization of the agricultural sector, pricing and increasing the annual growth rate of agricultural production. The 1990’s strategy concentrated on the completion of the economic reform in the agricultural sector, increasing agricultural exports, and increasing the annual growth rate of agricultural production. The agricultural development strategy towards 2017 concentrated on achieving self sufficiency in cereals, increasing the annual growth rate of agricultural production, and continuing land reclamation. A new strategy has been prepared lately for sustainable agricultural development in Egypt towards 2030. This strategy aims at achieving sustainable use of agricultural natural resources, improving agricultural productivity, increasing competitiveness of agricultural products, achieving higher rates of food security in strategic goods, improving opportunities of agricultural investment, and improving livelihood of rural inhabitants. Implementation mechanisms have been proposed for achieving these strategic objectives [1].

To achieve agricultural development in the past, there has been reliance on intensive use of external inputs such as chemical fertilization, pesticides, chemical control of weeds and insects. This intensive use of external inputs along with the adoption of many wrong practices by farmers caused harm effects on agricultural land resources and environmental pollution. This situation created the need to devote great efforts to conserve our limited agricultural land resources in order to maintain agricultural sustainability in Egypt. To achieve this, knowledge and information on many agricultural sustainability technologies and practices should be diffused among farmers by the extension organization. Farmers have to be encouraged to adopt these practices in the Egyptian agriculture. The main focus of this paper is on measuring agricultural sustainability in Egypt, and examining farmers' perception and adoption of its technologies and practices.

OBJECTIVES

The main objectives of this study are to: (1) develop a framework for measuring agricultural sustainability in Egypt depending upon previously adopted indices and indicators in other countries, (2) apply the developed framework to measure agricultural sustainability in Egypt, (3) determine agricultural sustainability practices, (4) examine farmers' perception and adoption of agricultural sustainability practices in Assiut governorate, Egypt, and (5) identify reasons for adoption and non-adoption of these practices by farmers in Assiut governorate, Egypt.

METHODOLOGY

This research depends on data collected from two types of sources, secondary and primary sources. In order to measure agricultural sustainability in Egypt, a framework was developed depending upon the Environmental Sustainability Index and indicators used to measuring agricultural sustainability in England, Italy, Venezuela, and Australia (Table 1). Data concerning time series of variables included in the proposed framework were collected from secondary sources [2, 3, 4, 5, 6, 7, 8, and 9]. Trend analysis was applied and the annual rate of change and the rate of increase were computed for each variable [10].

In order to examine farmers' perception and adoption of agricultural sustainability practices, 26 practices were determined using research results and other secondary sources [11, 12]. Three focus groups of agricultural extension officials in Assiut governorate were organized and held to know farmers' awareness of these practices from their point of view. Members of focus groups agreed that ten of these practices were not known and adopted by most farmers. Accordingly, our empirical research was limited to the remaining sixteen practices. An empirical investigation was carried out through a survey on a random of 200 farmers selected from farmers in four villages belonging to four districts in Assiut governorate. Data were collected by means of personal interview using a pre-constructed questionnaire during the period from April to September 2010. SPSS was used for data processing and analysis.

SUSTAINABILITY: DEFINITION AND INDICATORS

Sustainability is defined as: "the use of natural resources, development and protection at the rate and manner which allow us meet the needs of current generations as well as future generations" [13]. In other words, it is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs [14, 15].

Sustainable agriculture is "a management philosophy and system providing for agricultural needs of current and future generations. It utilizes management practices that are profitable, environmentally sound, and beneficial to society" [16]. It refers to an agricultural production and distribution system that: (a) achieves the integration of natural biological cycles and controls, (b) protects and renews soil fertility and the natural resource base, (c) optimizes the management and use of on-farm resources, (d) reduces the use of nonrenewable resources and purchased production inputs, (e) provides adequate and dependable farm income, (f) promotes opportunity in family farming and farm communities, and (g) minimizes adverse impacts on health, safety, wildlife, water quality, and the environment [17]. It challenges educators and farmers to think about the long-term implications of practices and the broad interactions and dynamics of agricultural systems [17]. The farming system is unsustainable "if natural resources such as soil, nutrients and water are used up at a rate faster than they are replenished" [18].

Indicators can be defined as: "the variables that help to measure changes in any situation" [19]. They are "measurable attributes of the environment that can be monitored via field observation, field sampling, remote sensing or compilation of existing data" [20]. The indicator gives an indication to its reader of a key future or state of a human or environmental system. A good indicator provides valuable information in making important decisions. It must be relevant to policy, simple and provide information easy to understand, and in a manner appealing to the targeted, valid and reflect the facts, reliable, based on data through time series that are available and can be obtained, and are meaningful to the people [21].

Sustainability indicators can be classified according to the number of indicators included into: One combined indicator (the form of a single number), A set of many indicators each directed towards a specific, well-defined issue, and an intermediate approach using indicators that attempt to reconcile the advantages and disadvantages of single and multiple indicator methodologies [22]. They may be classified according to sustainability dimension into three types: social dimension indicators, economic dimension indicators, and environmental indicators [23]. Sustainability indicators can be divided also according to the level of measurement into three groups: farm level indicators, ecosystem level indicators, and national or region level indicators [24].

MEASURING ENVIRONMENTAL AND AGRICULTURAL SUSTAINABILITY

Several indexes and indicators have been used to measure environmental and agricultural sustainability. Of these indices and indicators, the Environmental Sustainability Index and indicators used for measuring agricultural sustainability in England, Italy, Venezuela, and Australia.

The Environmental Sustainability Index includes 76 variables which can be grouped under five key areas including 21 indicators. These indicators are: air quality, biodiversity, land, water quality, Water quantity, reducing air pollution, reducing ecosystem stress, reducing population pressure, reducing waste and consumption, reducing water stress, natural resource management, environmental health, basic human sustenance, reducing environment-related natural disaster vulnerability, environmental governance, eco- efficiency, private sector responsiveness, science and technology, participation in collaborative efforts, greenhouse gas emissions, and reducing trans-boundary environmental pressures. The variables included in this index (76 variables) are measured separately and then assembled in one index to measure the environmental sustainability in a given country [25].

The agricultural sustainability indicator used in England includes 35 variables, related to many domains in agriculture such as structure of the agricultural industry, farm financial resources, agricultural productivity, and agricultural employment, etc. [26]. The Indicator used in Italy is based on 38 variables under three main dimensions, namely: social, economic, and environmental dimension [27].

The Agricultural Sustainability Indicator used in Venezuela includes 16 variables under four domains: agricultural biodiversity, efficiency of the agricultural system, the use of natural resources, and food security [28]. The Indicator used to measuring agricultural sustainability in Australia includes 19 variables related to four key areas concerning the real net farm income in the long run, the status of natural resources, external environmental impacts, management skills, and socio - economic impacts [18].

Table 1 show variables included in the above agricultural sustainability indicators, and 28 variables of the environmental sustainability index as they are related directly to agriculture.

PROPOSED FRAMEWORK FOR MEASURING AGRICULTURAL SUSTAINABILITY IN EGYPT

The development of a framework for measuring agricultural sustainability in Egypt depends mainly on the above index and indicators. To develop our proposed framework for measuring agricultural sustainability in Egypt, several variables were excluded as they are not applicable to the Egyptian agriculture, or because of non-availability of necessary data required. Some other variables were excluded because of the difficulty of their measurement. Other indicators are modified to be more understandable; and some others are added. These processes have resulted in a framework composed of 31 variables as shown in Table 1. These variables can be classified under three main dimensions as follows:

(1) Economic dimension which includes nine indicators. These are: (1)Total income from farming. (2) Average real net farm income. (3) Average earnings of agricultural workers. (4) Profitability of labor. (5) Productivity of labor. (6) Profitability of land. (7) Agricultural productivity. (7) Share of agricultural value added in total value added (8) Per capita of agricultural land.

(2) Social dimension including six indicators. These are (1) Agricultural employment. (2) Percentage of men's employees in agricultural sector (3) Percentage of women's employees in agricultural sector (4) Resident population in rural municipalities (5) Rate of increase in population (6) Percentage of population with access to improved drinking water source.

(3) Environmental dimension which includes sixteen indicators. These are (1) Fertilizer consumption (2) Pesticide consumption (3) Area of agricultural land (4) Intensification (5) Herd density (6) Livestock (7) Degraded land (8) Emissions of methane from agriculture (9) Emissions of nitrous from agriculture (10) Area of reclaimed land (11) Dissolved oxygen concentration in water (12) Industrial organic water pollutant (BOD) emissions per available freshwater (13) Absorbed chemical oxygen in water. (14) Salinity in streams. (15) Use of water for irrigation (16) Area converted to organic farming.

Table 1: Variables Included in Indices and Indicators Used for Measuring Environmental and Agricultural Sustainability

Variables	Environmental Sustainability Index	agricultural sustainability Indicators used in				Proposed Framework
		England	Italy	Venezuela	Australia	
1 – Indoor air pollution from solid fuel use	●					
2 - Percentage of country's territory in threatened eco- regions	●					
3 - Threatened bird species as percentage of known breeding bird species in each country	●					
4 - Threatened mammal species as percentage of known mammal species in each country	●					
5 - National Biodiversity Index	●					
6 - Dissolved oxygen concentration in water	●					●
7 - Phosphorus concentration in water	●					
8 - Suspended solids in water	●					
9 - Internal groundwater availability per capita	●					
10 - Coal consumption per populated land area	●					
11 - Anthropogenic NOx emissions per populated land area	●	●				●
12 - Anthropogenic SO2 emissions per populated land area	●					
13 - Anthropogenic VOC emissions per populated land area	●					
14 - Total Fertility Rate	●					●
15 - Industrial organic water pollutant (BOD) emissions per available freshwater	●					●
16 - Fertilizer consumption per hectare of arable land	●		●			●
17 - Pesticide consumption per hectare of arable land	●	●	●			●
18 - Percentage of undernourished in total population.	●			●		
19- Productivity overfishing	●					
20 - Percentage of total land area under protected status	●	●	●			
21 - Energy efficiency	●	●	●			
22 - Acidification exceedance from anthropogenic sulfur Deposition	●					
23 - Percentage of total forest area that is certified for sustainable management	●	●				
24 – Agricultural subsidies	●					
25 - Percentage of population with access to improved drinking water source	●					●

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Table (1) Continued: Variables included in Indices and Indicators used for measuring environmental and agricultural sustainability

Variables	Environmental Sustainability Index	agricultural sustainability Indicators used in				Proposed Framework
		England	Italy	Venezuela	Australia	
26 - Carbon emissions per capita	●		●			
27 - Annual average forest cover change rate	●		●			
28 - Agricultural assets & liabilities		●			●	
29 - Age of Farmers		●	●		●	
30 – Percentage of holdings that are tenanted		●				
31 - EU Producer Support estimate (PSE)		●				
32 - Agri.-environment payments to farmers		●				
33 - Total income from farming		●		●	●	●
34 - Average earnings of agricultural workers		●				●
35 - Agricultural productivity		●	●	●	●	●
36 - Agricultural employment		●	●			●
37 - Adoption of farm management systems		●				
38 - Area converted to organic farming		●	●			●
39 – Knowledge of codes of agricultural practice		●				
40 - Pesticides in rivers		●				
41 - Pesticides in groundwater's		●				
42 - Quantity of pesticide active ingredients used		●				
43 - Pesticide residues in food		●			●	
44 - Phosphor levels in agricultural soils		●				
45 - Manure management		●				
46 - Ammonia emissions from agriculture		●	●			
47 - Emissions of methane & nitrous oxide from Agriculture		●	●			●
48 - Trends in indirect energy inputs to agriculture		●				
49 - Use of water for irrigation		●	●		●	●
50 - Organic matter content of agricultural top soils		●				
51 - Accumulation of heavy metals in agricultural top soils		●				
52 - Area of agricultural land		●	●	●		●
53 - Change in land use from agriculture to hard Development		●		●		
54 - Planting of non-food crops		●				
55 - Characteristic features of farmland		●				

Table (1) Continued: Variables included in Indices and Indicators used for measuring environmental and agricultural sustainability

Variables	Environmental Sustainability Index	agricultural sustainability Indicators used in				Proposed Framework
		England	Italy	Venezuela	Australia	
56 - Area of semi-natural grassland		•	•		•	
57 - Surface variability (monoculture)				•		•
58 - Educational level of farmers			•		•	
59 - Breakdown of workers in agriculture			•			•
60 - Profitability of labor			•			•
61 - Profitability of land			•			•
62 - Productivity of labor			•	•		•
63 – Diversification in farm holders' activities			•			
64 - Marginalization			•			
65 - Share of agricultural value added in total value added			•			•
66 - Fixed investments in agriculture			•			
67 - Herd density			•			•
68 - Livestock			•			•
69 - Phosphorus balance			•		•	
70 - Nitrogen balance			•			
71 - Potential leaching of nitrates			•			
72 - Application of a fertilizing plan			•			
73 - Irrigation systems			•			
74 - Irrigated land	•		•			
75 - Condition of plant species			•	•	•	
76 – Agri- environmental measures			•			
77 – Intensification			•			•
78 - Concentration			•			
79 - Resident population in rural municipalities			•	•		•
80 - man-made and natural elements			•			
81- Agro-diversity Index of surface percentage of crops (ISPC)				•		
82 - Genetic variability				•		
83 – Parity index				•		
84 - Land demand/Land used			•			
85 - Degraded land			•			•

Table (1) Continued: Variables included in Indices and Indicators used for measuring environmental and agricultural sustainability

Variables	Environmental Sustainability Index	agricultural sustainability Indicators used in				Proposed Framework
		England	Italy	Venezuela	Australia	
86 - Export/Import			●		●	
87 - Average real net farm income					●	●
88 - Salinity in streams					●	●
89 - Dust storm index					●	
90 - Impact of agriculture on native vegetation					●	
91- Implementation of sustainable practices					●	
92 - Extent of participation in training and Land are					●	
93 - Farmers' terms of trade					●	
94 - Access to key services					●	
95 - Area of reclaimed land						●
96 - Absorbed Chemical oxygen in water						●
97 - Per capita of agricultural land						●

DETERMINATION OF AGRICULTURAL SUSTAINABILITY PRACTICES

As stated before, in order to examine farmers' perception and adoption of agricultural sustainability practices, 26 practices were determined but ten practices were excluded since they were not known by most farmers. Accordingly, our empirical research was limited to the remaining sixteen practices. The 26 practices of which the first sixteen practices were included in our empirical research investigation are: (1) Converting agricultural residuals to organic fertilizer (compost). (2) Application of crop rotation. (3) Cultivation of leguminous crops. (4) Application of manure fertilization. (5) Using compost as organic fertilizer. (6) Avoiding erosion of agriculture land (7) Avoiding use of agricultural land in hard development. (8) Using fallow. (9) Cleaning canals from weeds. (10) Good preparation of agricultural land for cultivation. (11) Selecting good varieties which are resistant to diseases. (12) Application of mechanical pest control. (13) Application of biological pest control. (14) Application of bio-fertilizers. (15) Application of green fertilizer. (16) Application of modern of irrigation methods. (17) Application of soil test. (18) Keeping farm records. (19) Planting a fence of trees surrounding the farm. (20) Use of chemicals by trained persons. (21) Forecasting of pest diseases. (22) Continuous monitoring of live stock. (23) Protection of animal residuals from chemicals and veterinary medicine. (24) Reducing non-therapeutic use of antibiotics. (25) Avoiding distortions of non-therapeutic, surgical procedures and violations. (26) Avoiding transportation of life animals (by foot or by vehicles) to livestock markets.

RESEARCH FINDINGS

The research findings can be presented under the following sections:

First: Application of the Proposed Framework Results

The application of trend analysis on time series data concerning variables included in the proposed framework for measuring agricultural sustainability has revealed to the following results:

Economic Indicators

Results in Table 2 show a positive tendency towards agricultural sustainability according to six out of nine economic indicators included in the proposed framework. The annual rate of change is 10.7 % for total income from farming, 10.2 % for agricultural productivity, 9.6 % for Profitability of land, 8.7 % for average real net farm income, 7.4 % for profitability of labor, and 6.5 % for productivity of labor. This rate has the lowest value with negative tendency towards agricultural sustainability for three indicators, namely average earnings of agricultural workers, share of agricultural value added in the total value added, and per capita of agricultural land. This value is -19.7 %, -2.4 %, and 1.6 % for the three indicators respectively (Table 2).

SOCIAL INDICATORS

Results show that there is a positive tendency towards agricultural sustainability in Egypt according to one variable only out of the six variables included in this dimension, namely percentage of population with access to improved drinking water source. The annual rate of change for this variable is 3.2%. There is a negative tendency towards agricultural sustainability according to the other five variables included in this dimension. The annual change rate of these variables ranges from -1.65% for percentage of men's employees in the agricultural sector to 2.1% for the increase in population (Table 3).

ENVIRONMENTAL INDICATORS

Results concerning environmental variables show a positive tendency towards agricultural sustainability according to six variables, and a negative tendency according to ten variables out of the sixteen variables included in this dimension (Table 4). These variables are: area of agricultural land, dissolved oxygen concentration in water, industrial organic water pollutant (BOD) emissions per available freshwater, absorbed chemical oxygen in water, salinity in streams, and converted to organic agriculture. The annual rate of change for these variables ranges from - 0.27% to 18.6%. Results show a negative tendency towards agricultural sustainability according to the other ten variables included. The annual change rate of these variables ranges from – 14.6% to 41.2% (Table 4).

SECOND: RESULTS OF THE EMPIRICAL INVESTIGATION

As stated earlier, an empirical investigation was carried out on 200 farmers selected randomly from farmers in four villages in Assiut governorate, Egypt in order to know farmers' perception and adoption of the determined agricultural sustainability practices. A summary of respondents' characteristics and their perception and adoption of these practices are presented below.

Table 2: Annual Change Rate and Rate of Increase for Economic Indicators

No.	Indicators	Annual Change Rate %	Rate of Increase %	T value	Level of significance	Tendency towards sustainability
1	Total income from farming	10.7	142.5	9.891	0.000	+
2	Average real net farm income	8.7	102.0	9.104	0.000	+
3	Average earnings of agricultural workers	- 19.7	- 56	2.860	0.019	-
4	Profitability of labor.	7.4	68.3	13.103	0.000	+
5	Productivity of labor.	6.5	59.0	8.636	0.000	+
6	Profitability of land.	9.6	85.0	8.441	0.000	+
7	Agricultural productivity.	10.2	91.0	7.160	0.000	+
8	Share of agricultural value added in total value added	- 2.4	- 35.3	7.427	0.000	-
9	Per capita of agricultural land	- 1.6	- 15.4	5.250	0.01	-

Source: Calculated form time series data of these variables.

Table 3: Annual Change Rate and Rate of Increase for Social Indicators

No.	Indicators	Annual Change Rate %	Rate of Increase %	T value	Level of significance	Tendency towards sustainability
1	Agricultural employment.	-0.5	-8.2	0.998	0.342	-
2	Percentage of men's employees in agricultural sector	-1.65	-12.5	3.724	0.004	-
3	Percentage women's employees in agricultural sector	0.8	0	0.586	0,671	-
4	Resident population in rural municipalities	-0.05	-0.9	1.694	0.279	-
5	The increase in population	2.1	20.1	119.19	0.000	-
6	Percentage of population with access to improved drinking water source	3.2	14	15.0	0.001	+

Source: Calculated form time series data of these variables.

Table 4: Annual Change Rate and Rate of Increase for Environmental Indicators

No.	Indicators	Annual Change Rate %	Rate of Increase %	T value	Level of significance	Tendency towards sustainability
1	Fertilizer consumption	0.2	2.0	30.832	0.000	-
2	Pesticide consumption	9.6	150.8	1.340	0.217	-
3	Area of agricultural land	1.1	10	16.204	0.000	+
4	Intensification	- 0.18	3.0	0.647	0.536	-
5	Herd density	3.2	48.1	6.393	0.000	-
6	Livestock	2.9	27.1	6.503	0.000	-
7	Degraded land	41.2	13.64	2.620	0.120	-
8	Emissions of methane from agriculture	3.9	13.3	2.890	0.102	-
9	Emissions nitrous from agriculture	1.4	2.8	0.755	0.529	-
10	Area of reclaimed land	- 14.6	- 92.00	3.523	0.536	-
11	Dissolved oxygen concentration in water	0.8	5,8	2.585	0.026	+
12	Industrial organic water pollutant (BOD) emissions per available freshwater	-5.7	-37.2	3.295	0.012	+
13	Absorbed Chemical oxygen in water.	- 3.6	-37.7	3.064	0.018	+
14	Salinity in streams.	- 0.27	-0.5	0.817	0.441	+
15	Use of water for irrigation	3.6	14	15.0	0.001	-
16	Area converted to organic farming	18.6	891.6	7.648	0.000	+

Source: Calculated form time series data of these variables.

RESPONDENTS' CHARACTERISTICS

The distribution of farmers surveyed according to their characteristics show that more than one half (56%) of them are less than 50 years old. Most of them (60%) have never been to school, and 42% of them are illiterate. The majority of them (92%) have families composed of four or more individuals. Agriculture is the main occupation for more than two-thirds (69%) of sample members. Most respondents (57.5 %) have less than one feddan of agricultural land holding. While 71.5% of them do not have agricultural projects, the remainder have fattening calves, milk, and poultry projects (Table 5).

FARMERS' PERCEPTION AND ADOPTION OF AGRICULTURAL SUSTAINABILITY PRACTICES

In order to know farmers’ perception of agricultural sustainability practices, they were asked to know if they have heard about each practice and if they have see it adopted by any other farmer. Results given in Table 6 show that most farmers have heard about all practices included except for two of them, namely converting agricultural residuals to organic fertilizer (compost), and use compost as organic fertilizer. Fifty five percent of sample members have never heard about the former and 65% have never heard about the latter. The percentages of farmers who have heard about the other practices range from 53% as a minimum for the application of modern irrigation methods to 98.5% as a maximum for the application of manure fertilization (Table 6). Results also show that the majority of farmers interviewed have never seen these two practices (80.5% and 89.5% for these two practices respectively). Over one half of sample members have never seen two other practices, namely the application of green fertilizers, and the application of modern irrigation methods. The percentages of farmers who have seen the other twelve practices range from 56% as a minimum for using fallows to 98% as a maximum for the application of manure fertilization (Table 6).

Results concerning farmers’ adoption of agricultural sustainability practices show that nine of the sixteen practices included are adopted by high percentages of farmers (between 65% and 93%). The remaining seven practices are adopted by lower percentages of farmers (ranging from 2% to 41%). If we added the excluded ten practices this means that farmers in the study area are not aware of many agricultural sustainability practices, and that most of these practices are not adopted by farmers.

Table 5: Distribution of Respondents According to their Characteristics

Characteristics		Number	%
Total sample		200	100
Age :	- Less than 30 years	7	3.5
	- 30 -	40	20.0
	- 40 -	65	32.5
	- 50 -	46	23.0
	- 60 years and more than	42	21.0
Education:	- Illiterate	84	42.0
	- Read and Write	45	22.5
	- Primary and preparatory	14	7.0
	- Secondary school	35	17.5
	- Above average	12	6.0
	- University	10	5.0
Main occupation:	- Farmer	138	69.0
	- Government employee	47	23.5
	- Merchant	7	3.5
	- Handicraft	4	2
	- Others	4	2
Number of family members:	- Three and less	16	8.0
	- 4 to 7 members	133	66.5
	- More than 7 members	51	25.5
Area of agricultural holding:	- Less than feddan*	115	57.5
	- From one to three feddans*	74	37.0
	- More than three feddans*	11	5.5
Having agricultural projects:	- None	143	71.5
	- Fattening	25	12.5
	- Poultry	6	3.0
	- Dairy	23	11.5
	- Horticulture	2	1.0
	- Others	1	0.5

* One Feddan = 4200.8 m2 = 1.038 Acre

Source: Questioners.

Table 6: Respondents Distribution According to Their Perception and Adoption of Agricultural Sustainability Practices

Agricultural Sustainability Practices	Heard		Seen		Adopted	
	No.	%	No.	%	No.	%
1 - Converting agricultural residuals to organic fertilizer (compost).	90	45.0	39	19.5	33	16.5
2 - Application of crop rotation	172	86.0	161	80.0	155	77.5
3 - Cultivation of leguminous crops.	154	77.0	146	73.0	130	65.0
4 - Application of manure fertilization	197	98.5	196	98.0	186	93.0
5 - Use compost as organic fertilizer	70	35.0	21	10.5	6	3.0
6 - Avoiding erosion of agriculture land	168	84.0	125	62.5	188	94.0
7 - Avoiding use of agricultural land in hard development	176	88.0	132	66.0	150	75.0
8 - Using fallow	145	72.5	112	56.0	77	38.5
9 – Cleaning canals from weeds	176	88.0	175	87.5	167	83.5
10 - Good preparation of agriculture land for cultivation	177	88.5	176	88.0	166	83.0
11 - Selecting good varieties	172	86.0	171	85.5	164	82.0
12 – Application of mechanical pest control.	194	97.0	194	97.0	186	93.0
13 – Application of biological pest control.	146	73.0	134	67.0	82	41.0
14 – Application bio-fertilizers	134	67.0	121	60.5	77	38.5
15 – Application of green fertilizer	142	71.0	93	46.5	62	31.0
16 – Application of modern irrigation methods	106	53.0	91	45.5	4	2.0

Source**:** Questionnaires.

Reasons for Adoption and Non- Adoption of Agricultural Sustainability Practices

Several reasons were mentioned by sample members for adoption and non-adoption of these practices. The most frequently mentioned reasons for their adoption are to: increase agricultural productivity, improve soil properties, maintain soil fertility, reduce spread of wees and insets, maintain agricultural land area, and rationalize irrigation water use. The most frequently reasons for non-adoption of these practices are: lack of knowledge of these practices, non-availability, fragmentation of land holdings, and availability of better alternatives.

Conclusion

Based on the above results, it can be concluded that agricultural policy in Egypt might have focused on economic aspects of agricultural sustainability. Social and environmental aspects need ore attention. Great efforts should be devoted to maintain agricultural sustainability in Egypt. Special emphasis should be made to social and environmental dimensions of agricultural sustainability in Egypt. The agricultural extension organization in the country has a great role to play. It should diffuse knowledge and information on agricultural sustainability practices among farmers, and encourage them for their adoption in order to maintain agricultural sustainability in the country.

REFERENCES

[1] Abul-Naga, Adel M. (2009), Egypt Sustainable Agricultural Development Strategy, CIHEAM Analytical Notes, No 53, December 2009, Retrieved on 28/8/2011 from: http://74.6.117.48/search/srpcache?ei=UTF-8&p=strategy+agricultural..

[2] Abdel- Rady, Yasir A. (2006), (In Arabic), An economic Study of the Potential Expansion of the Organic Agriculture System in Egypt, Ph. D. Thesis, Faculty of Agriculture, Assiut University, Egypt.

[3] Alabd, W. A. E., and A. M. K. Bashir (2009) (In Arabic), Estimate the Target Consumption of Chemical Fertilizers in Agriculture in Egypt, Journal of Agricultural Science, Mansoura University, Vol. 34, No. 8: 8605-8615.
[4] Central Agency for Public Mobilization and Statistics (2008 and 2009), (In Arabic), Statistical Yearbook, Cairo.
[5] International Centre for Advanced Agronomic Studies of the Mediterranean Sea (2006), (In Arabic), Agriculture, Fisheries and Food, and Rural Development in the Mediterranean region, the annual report.
[6] Ministry of Agriculture, (In Arabic), Sector of Economic Affairs, Bulletin of Agricultural Statistics, Different Issues (1998 – 2008).
[7] Ministry of Economic Development (2009), (In Arabic), A Series of Basic Data, Output, Investment, Operating and Wages, Arab Republic of Egypt.
[8] Ministry of State for Environmental Affairs (2009), (In Arabic), Bulletin of Environmental Information, Environmental Affairs Agency, Issue 2, January, Cairo, http://www.eeaa.gov.eg/english/reports/Newsletters/IndicatorsBulletinjan09.pdf
[9] The World Bank (2009) (In Arabic), The Indicators, Available At: http://data.albankaldawli.org/indicator
[10] Saunders, M.; P. Lewis; & A. Thornhill (2003), Research Methods for Business Students, Prentice Hall, Pearson Education, Great Britain, Third Edition.
[11] FAO (2002), Good Agricultural Practices, Second Version, Retrieved on 12/2/2009 from: http://www.fao.org/ag/magzine/GAP-V2June02.pdf
[12] Arab Organization for Agricultural Development (1999) (In Arabic), Studying Evaluation of Environmental Effects of land Pollution and degradation in the Arab World, League of Arab Countries, Khartoum.
[13] Tryens, Jeff, and Silverman, Bob (2000), Measuring Sustainability: The Role of Oregon Benchmarks, Retrieved on 18/12/2008 from: http://www.oregon.gov/DAS/OPB/docs/sustainwhiteppr.PDF?ga=T
[14] Rao, N. H. and Rogers, P. P. (2006), Assessment of Agricultural Sustainability, Current Science, Vol. 91, No. 4, August, Retrieved on 6/2/2010 from: http://www.ias.ac.in/currsci/aug252006/439.pdf
[15] Cox, Linda J. and John Cusick (2006), What is Sustainable Development?, Cooperative Extension Service, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, Retrieved on 25/5/2008 from: http://www.hawaii.edu/envctr/ecotourism/docs/WhatisSustDevelopment.pdf
[16] Ball, S. T. and Popiel, F. G. (2007), Sustainable Agriculture: Cooperative Extension Service's Strategic Plan for New Mexico, Retrieved on 3/4/2008 from: http://aces.nmsu.edu/pubs/h/h-162.html
[17] Boone, Jr. Harry; Hersman, E. M.; Boone, D. A.; and Gartin, S. A. (2007), Knowledge of Sustainable Agriculture Practices by Extension Agents in Ohio, Pennsylvania, and West Virginia, Journal of Extension, Vol. 45, No. 5, October, Retrieved on 23/3/2008 from: http://www.joe.org/joe/2007october/rb2.shml
[18] NOVA (2009), Feeding the Future – Sustainable Agriculture, Key Text, Australian Academy of Science, Retrieved on 6/2/2010 from: http://www.science.org.au/nova/071/071key.htm
[19] Misra, D. C. (1997), Monitoring Extension Programmes and Resources, In: Improving Agricultural Extension: A Reference Manual, Edited by Swanson, B. E., Bentz, R. P. and Sofranko, A. J., Retrieved on 1/1/2008 from: http://www.fao.orgdocrep/w5830E/w5830e00.htm
[20] Walker, Joe (2002), Environmental Indicators and Sustainable Agriculture, in: Mcvicar, T. R.; Li, Rui, Walker, J.; Fitzpatrick, R.W. and Liu Changming (eds), Regional Water and Soil Assessment for Managing Sustainable Agriculture in China and Australia, ACIAR Monograph No. 84: 323-332, Retrieved on 1/1/2008 from: http://www.eoc.csiro.au/aciar/book/pdf/Monograph84Chapter24.pdf
[21] Miller, Clark A. (2007), Creating Indicators of Sustainability, A Social Approach, Draft for Discussion, iisd, Retrieved on 2/2/2009 from http://www.iisd.org
[22] Van Loon, Gary W.; S. G. Patil and L. B. Hugar (2005), Agricultural Sustainability: Strategies for Assessment, Chapter 2, Sustainability Indicators, Sage Publications, New Delhi, Retrieved on 2/2/2009 from http://www.queensu.ca/envs/ENSC802/ENSC802-van loon.pdf
[23] European Commission, Agriculture Directorate-General (2001), A Framework for Indicators for the Economic and Social Dimensions of Sustainable Agriculture and Rural Development, Retrieved on 1/1/2008 from: http://ec.europa.eu/agriculture/public/report/sustain/index-en.pdf
[24] Russillo, Aimee and Pinter, L. (2009), Linking Farm-Level Measurement Systems to Environmental Sustainability Outcomes: Challenges and Ways Forward, iisd, Retrieve on 6/2/2010 from:

http://www.iisd.org/pdf/2009/linkingfarmlevelmeasurementsystems.pdf

[25] Yale Center for Environmental Law and Policy; Center for International Earth Science Information Network Columbia University; World Economic Forum; and Joint Research Centre European Commission (2005), 2005 Environmental Sustainability Index, Benchmarking National Environmental Stewardship, Retrieved on 13/10/2008 from: http://www.yale.edu/esi/ESI2005_Main_Report.pdf

[26] The University of Reading, ECIFM (2009), Sustainable Agriculture, Retrieved on 2/2/2009 from: http://www.ecifm.rdg.ac.uk/sustainableagriculture.htm

[27] Trisorio, Antonella (2004), Measuring Sustainability, Indicators for Italian Agriculture, National Institute of Agricultural Economics, Italy, Retrieved on 14/12/2008 from: http://www.inea.it/public/pdf_articoli/250.pdf

[28] Berroteran, J. L. and Zinck, J. A. (N d), Indicators of Agricultural Sustainability at The National Level: A Case Study of Venezuela, Retrieved on 1/1/2008 from: http://www.ces.iisc.ernet.in/energy/HC270799/LM/SUSLUP/Thema1/258/258.pdf