Applicability of Sustainable Agriculture in Egypt

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Contents

Abstract Sustainable agriculture is the practices that use the resources or inputs in a way that may not affect the opportunities of coming generations to get beneficial use of these resources in the agricultural process. The gap between people needs of agricultural products and available resources in Egypt is getting wider. Sustainable agriculture can be reached in Egypt despite all obstacles and threats. Sustainable agriculture has conditions that should be met to achieve successful transition to a sustainable system. Enabling external institutions, embracing resource-conserving

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technologies should be integrated and work with local communities. Current strategies are not expected to lead us to sustainability in agriculture as it focuses on specific sectors and issues more than another's. The new strategy of sustainability toward 2030 may put wide lines of the expected beneficiaries of sustainable agriculture practices under Egyptian conditions. There is a need to create and embrace new strategies and plans to access sustainable agriculture. Farmers should share in providing information, analyzing, suggesting solutions, and implementing. Science and research should not be far from agricultural system actors. The most important is the policies that support all of these actions. This chapter gives a description for the current challenges of the agricultural sector in Egypt and how we can go toward sustainable agriculture successfully.

Keywords Agriculture in Egypt, Applicability, Sustainable agriculture

Abbreviations

ABE	Agricultural Bank of Egypt
B/C ratio	Benefit-cost ratio
ECES	The Egyptian Center for Economic Studies
FAO	Food and Agriculture Organization of the United Nations
Feddan	Local unit of land area = 4,200 m^2
GDP	Gross domestic products
GIS	Geographical information system
IEA	International Energy Agency
L.E	Egyptian pound
MALR	Egyptian Ministry of Agriculture and Land Reclamation
NEDCO	National Enterprise Development Company (Sri Lanka)
NGO	Nongovernmental organization
NRC	American National Research Council
Toe	Ton of oil equivalent (amount of energy released by burning one ton of crude oil)
US$	United States dollar = 17.85 L.E
USA	United States of America

1 A Vision for Agriculture

When going into agriculture process, there is always a question about the practices you will follow to obtain the best production with minimum inputs. Best evidence on the ability of regenerative and resource-conserving technologies and practices to bring both environmental and economic benefits for farmers, communities, and nations comes from developed countries like in Africa, Asia, and Latin America.

This comes from the emerging concern to increase food production with absence of the externally supplied technologies. In these lands, adopting regenerative technologies have substantially improved agricultural yields, often only using few or no external inputs.

This site is not the only one for successful sustainable agriculture, in very high input lands of industrialized countries; some farmers have maintained profitability while yields have fallen. These improvements have occurred in initiatives focusing on a wide range of technologies, including soil and water conservation, pest and predator management, nutrient conservation, land rehabilitation, green manuring, water management, and many others.

The answer of the question may be found in your road to manage the agricultural process in a sustainable way. Sustainable agriculture practices will result in indirect social and economic benefits. There is reduced environmental contamination and pollution, reducing the costs incurred by farming households, consumers of food, and national economies as a whole, expected less likelihood of the breakdown of rural culture. There is local regeneration, often with the reversal of migration patterns as the demand for labor grows within communities. And, psychologically, there is a greater sense of hopefulness toward the future.

2 What Is Sustainable Agriculture?

2.1 Sustainable Agriculture Definition

When we take a look on the terms that describes agricultural system, it is normal to mean different things to different people. Some may consider production possibilities or technological concentration (green revolution or complex and diverse) to the ability to adopt newly created or derived technologies. Another term may be used to describe the agricultural system is the use of inputs whether natural resources and/or external inputs. The site of keeping natural resources takes us close to the definition and goals of sustainable agriculture. Sustainable agriculture term may be used as an alternative to modern agriculture. It can be understood as an ecosystem approach to agriculture [1]. Sustainable agriculture system makes integration between the production practices having a site-specific application that will last over the long term. Sustainable agriculture is mainly related to practices that use the resources or inputs in a way that may not affect the opportunities of coming generations to get beneficial use of these resources. The agricultural system that is sustainable may be described as resource conserving, low input, and regenerative. It challenges educators and farmers to think about the long-term implications of practices and the broad interactions and dynamics of agricultural systems [2]. The technological and to lesser extent economic dimensions of sustainable agriculture have tended to be privileged, while the social dimension has been neglected. As a result sustainable agricultural has suffered from limited adoption [3].

In any discussions of sustainability, it is important to clarify what is being sustained, for how long, for whose benefit, and at whose cost, over what area and measured by what criteria. Answering these questions is difficult, as it means assessing and trading off values and beliefs. Attempts to define sustainability miss the point that, like beauty, sustainability is in the eye of the beholder. It is inevitable that assessments of relative sustainability are socially constructed, which is why there are so many definitions [4].

2.2 Some Misconceptions About Sustainable Agriculture

In addition to the problems over definitions, there are other misconceptions about sustainable and regenerative agriculture [5–7]. Perhaps the most common characterization is that sustainable agriculture represents a return to some form of low technology, "backward" or "traditional" agricultural practices. This is manifestly untrue. Sustainable agriculture does not imply a rejection of conventional practices, but an incorporation of recent innovations that may originate with scientists, farmers, or both. It is common for sustainable agriculture farmers to use recently developed equipment and technology, complex rotation patterns, the latest innovations in reduced input strategies, new technologies for animal feeding and housing, and detailed ecological knowledge for pest and predator management.

Another misconception is that sustainable agriculture is incompatible with existing farming methods. For the development of a sustainable agriculture, there is a need to move beyond the simplified thinking that pits industrialized agriculture against the organic movement or the organic movement against all farmers who use external inputs. Sustainable agriculture represents economically and environmentally viable options for all types of farmers, regardless of their farm location and their skills, knowledge, and personal motivation.

It is also commonly believed that low or no external input farming produces low levels of output and so can only be supported by higher levels of subsidies. Such subsidies could be justified in terms of the positive benefits to the environment brought by sustainable farming, which could therefore be valued and paid for. But this may not be necessary. Worldwide, many sustainable agriculture farmers show that their crop yields can be better than or equal to those of their more conventional neighbors. Even if their yields are lower, these may still translate into better net returns as their costs are also lower. Sometimes yields are substantially higher and now offer the opportunities for growth for communities that do not have access to, or cannot afford, external resources. Either way, this means that sustainable farming can be compatible with small or large farms and with many different types of technology.

None the less, when specific parameters or criteria are selected, it is possible to say whether certain trends are steady, going up or going down. For example, practices causing soil to erode can be considered to be unsustainable relative to those that conserve soil. Practices that remove the habitats of insect predators or kill them directly are unsustainable compared with those that do not. Planting trees is clearly more sustainable for a community than just cutting them down. Forming a local group as a forum for more effective collective action is likely to be more sustainable than individuals trying to act alone.

At the farm or community level, it is possible for actors to weigh up, trade off, and agree on these criteria for measuring trends in sustainability. But as we move to higher levels of the hierarchy, to districts, regions, and countries, it becomes increasingly difficult to do this in any meaningful way. It is, therefore, critical that sustainable agriculture does not prescribe a concretely defined set of technologies, practices, or policies at these levels. This would only serve to restrict the future options of farmers. As conditions change and as knowledge changes, so must farmers and communities be encouraged and allowed to change and adapt too. Again, this implies that definitions of sustainability are time specific and place specific. As situations and conditions change, so must our constructions of sustainability also change. Sustainable agriculture is, therefore, not a simple model or package to be imposed. It is more a process for learning.

What is important is to ensure that the opportunities exist for wide-ranging debate on the appropriate levels of external and internal resources and processes necessary for a productive, environmentally sensitive, and socially acceptable agriculture.

3 Goals for Sustainable Agriculture

On the global level, agricultural development policies have been remarkably successful at emphasizing external inputs as the means to increase food production during the past 60 years. This will be followed by remarkable growth in global consumption of external resources of energy, water, pesticides, fertilizer, animal feedstuffs, and farm machinery.

However, external inputs substituted the natural control processes and resources, rendering them more vulnerable. Pesticides have replaced biological, cultural, and mechanical methods for controlling pests, weeds, and diseases. Fossil fuels have substituted for locally generated energy sources. Inorganic fertilizers have substituted for livestock manures, composts, and nitrogen-fixing crops. Researchers, extensionists, and input suppliers are the main source of information which is the base of management decision.

The basic challenge for sustainable agriculture is to make better use of internal resources [8] like sun, rain, air, nitrogen, etc. This can be done by minimizing the external inputs used, by regenerating internal resources more effectively or by combining both. A sustainable agriculture, therefore, is any system of agricultural production that systematically strives to achieve the following goals [9]:

- More thorough combination of natural processes such as nitrogen fixation, nutrient cycling, and pest-predator relationships into agricultural production processes
- A reduction in the use of external and non-renewable inputs which has a great potential to damage the environment or harm the human health and a more efficient use of the remaining inputs used to minimizing variable costs
- A more equitable access to productive resources and opportunities and progress toward more socially just forms of agriculture
- A greater productive use of the biological and genetic potential of plant and animal species
- Productive use of local knowledge and practices, including innovative approaches not yet widely adopted by farmers or fully understood by scientists
- An increase in self-reliance among farmers and rural people
- An improvement in the match between cropping patterns and the productive potential and environmental constraints of climate and landscape to ensure long-term sustainability of current production levels
- Profitable and efficient production with an emphasis on integrated farm management and the conservation of soil, water, energy, and biological resources

When allowing these goals come together, farming becomes integrated, with resources used more efficiently and effectively. Sustainable agriculture, therefore, pursues the integrated use of a wide range of pest, nutrient, soil, and water management technologies. These are integrated at farm level to give a strategy specific to the biophysical and socioeconomic conditions of individual farms. Sustainable agriculture aims for an increased diversity of enterprises within farms, combined with increased linkages and flows between them. By-products or wastes from one component or enterprise become inputs to another. As natural processes increasingly substitute for external inputs, so the impact on the environment is reduced.

4 The Scale of the Challenge in Egypt

4.1 Current Strategies of Agricultural Development

Egypt is in the northeastern corner of Africa between latitudes 21° and 31° north and longitudes 25° and 35° east with a total area of 1,001,450 km^2; the country stretches 1,105 km from north to south and up to 1,129 km from east to west. It is bordered in the north by the Mediterranean Sea; in the east by the Gaza Strip, Israel, and the Red Sea; in the south by Sudan; and in the west by Libya. Agriculture remains an important sector of the Egyptian economy. It contributes nearly one-seventh of the GDP, employs roughly one-fourth of the labor force, and provides the country through agricultural exports with an important part of its foreign exchange.

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. Egypt population reached over 93 million people by the middle of the year 2017. Strategies have been set up and implemented to achieve agricultural development in Egypt. In the last 30 years, three agricultural strategies have been prepared in the 1980s, in the 1990s, and toward 2017. The 1980s agricultural development strategy dealt mainly with liberalization of the agricultural sector, pricing and increasing the annual growth rate of agricultural production.

The 1990s 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 toward 2017 concentrated on achieving self-sufficiency in cereals, increasing the annual growth rate of agricultural production, and continuing land reclamation. The previous strategies have been prepared to make a temporary development on the agricultural sector. The look of resources consumption and managing inputs for a long term was absent. The studied tendency of some environmental, social, and economic indicators toward sustainability concluded that the agricultural policy in Egypt might focus on the economic aspects and needs more attention for both social and environmental aspects [10].

Several recommendations and lessons were listed from the application of these strategies [3]:

1. Reforming pricing policies should be the base to maximizing the returns of the economic reform.
2. Further improvements are needed on the institutional reform side by side to the economic reform.
3. Applied policies in water use do not give the efficient use of water, despite the water resources scarcity. Agricultural sector consumes 81.1% of total resources. This makes the agricultural sector the first consumer of water in Egypt.
4. Enacting a clear policy to protect agricultural land from over-encroachment did not prevent violations to continue to take place.
5. Absence of policies for protecting agricultural land against fragmentation. In spite of the fact that all stakeholders agree that the fragmentation of agricultural holdings constitutes a serious impediment to development, no policy has been so far instituted for protecting agricultural land against fragmentation.
6. In spite of the successes achieved in the field of land reclamation, adding 1 ha to the cultivated area, the distribution system failed to establish viable communities capable of settling in the newly reclaimed areas.
7. Skilled labor is scarce due to the lack of balance between human resource development policies, investments, and agricultural development policies, at a time during which rural communities exhibit high rates of unemployment and underemployment.

8. Many research institutions are involved in agricultural research development, but no significant effect for their research.
9. Fisheries development policies have contradictions which created several limitations that hinder further investments in this field.
10. Policies failed to use the Egyptian geographical and historical agricultural base. There was no use to the relationships between Egypt and both African and Arab countries to obtain better marketing opportunities.
11. Cooperation and coordination between governmental and NGOs is almost lost.
12. Weak implementation and follow-up mechanisms proved the impossible to attain the objectives of the strategies even with possible attention from MALR.

It is clear that the three strategies are far from sustainability. There is a need to increase the agricultural production by 70% within 2050 in order to keep pace with population growth and changing diets. Data listed in Table 1 show some indicators about the agricultural sector in Egypt to be compared in the years 1965, 2000, and 2014. In spite of the need to increase the production, the increase in agriculture lands does not give a reassured indicator to cover the needs of population which increased to doubles of agricultural land increase. This could appear in the arable land per capita which reached 0.03 ha/person which means a decrease in the opportunities of agricultural production to meet the needs. In addition, the value added of GDP decreased by 61%. This is considered as a strong indicator to the failure of the running strategies in making a significant development in the Egyptian agricultural sector or even keeping the situation as it is. The absence of social policies to keep qualified labors serving in the agricultural sector clearly appears in the percentage of male employed in agricultural sector. This decrease in male employment was replaced by the increase in female employment in agriculture. Egyptian social structure indicates this replacement is just for keeping labors' families income. Women in Egypt are not supposed to have the same skills or experience of men. This means that the agricultural sector lost the ability to attract labors that preferred to find another activity as a source for their income. There is an urgent need for social policies in farm areas to encourage people to go into agricultural activities.

Table 1 Changes of the agricultural sector indicators in Egypt since 1965 till 2014 according to the calculations of World Bank

	1965	2000	2014
Total population, millions	30,872,982	68,334,905	91,508,084
Agriculture land (% land area)	2.68	3.31	3.76
Permanent cropland (% of land area)	9.65	0.492	1.08
Arable land (% of land area)	2.59	2.81	2.68
Arable land (hectares per person)	0.08	0.04	0.03
Value added (% of GDP)	28.6	16.74	11.18
Employment in agriculture (% of male employment)	NA	27.4	24.1
Employment in agriculture (% of female employment)	NA	39.4	42.9

It is clear that Egyptian agricultural sector is in a real need for different planning strategies toward sustainable agriculture. Current planning strategies till 2017 did not consider the required integration between social, economic, technical, and environmental faces of the agricultural sector but tried to make fast solutions for specific issues. As mentioned before planning for a regenerative system needs a long-term vision, or degradation on all the agricultural sector components is expected.

4.2 Challenges of Agricultural Sector in Egypt

4.2.1 Resources Mismanagement

Egypt is facing unprecedented resource crisis: in energy, water, and arable land. Total energy production in Egypt increased from 53,090 to 80,357 ktoe during the period between the years 2000 and 2014. The agricultural sector consumption of energy increased 751.3% during the same time period according to the statistics of IEA. In spite of this increase, 17% of Egyptians still suffer from food insecurity [11] which means the energy use in the agricultural sector is inefficient as it did not make remarkable increase in agricultural production. The agricultural sector comes first at water resources consumers as it uses 81.1% of total water resources. Most of Egyptian lands are irrigated with surface irrigation system especially in Delta region. 85% of irrigation systems in this region is based on surface irrigation [12] which has no control on the amount of applied water and managed by the farmer's experience and far from scientific management bases.

Small holders' farmers are about 81% of total farmers. The average of agricultural land holding in Egypt is 1.26 ha; this means that most of arable lands in Egypt are uneconomic units. As a result farmers will try to go through another activity may be followed by soil dredging.

4.2.2 Marketing and Rationing Policy

Pricing policies of agricultural products may hinder farmers to cultivate important crops like cereals. Rationing policies are based mainly on export for cereals, red meat, forage, sugar, and oil. As a result of these policies, the Egyptian net agricultural trade according to World Bank statistics reached −9,284,28 million US$ in 2010. Generally, activities of value chain [13] under local Egyptian conditions are losing control. There are no regulations for human resources management like training or hiring. Absence of supportive activities like infrastructure, accounting, finance, quality assurance, and technological development is another reason to lose control on marketing. Lack of organized central markets and low level of marketing services makes it difficult to exchange and trade food products among Egyptian governorates.

4.2.3 Poor Planning for Implementing Modern Technologies and Agriculture Practices

Implementation of modern technologies not only related to the direct implementation or the percentage of farmers who tried to use modern technology. For example, a number of used tractors increased from 307,944 in the year 2000 to 390,568 by the year 2008 according to World Bank statistics. This increase should be an advantage to increase production and better field management. With the small tenure which does not exceed 1.26 ha (refer to the Sect. 4.1), it may turn into uneconomic practice. Another example related to modern irrigation systems which are recommended by many studies to replace surface irrigation system [14–17]. This replacement is considered a must with the current water scarcity situation. The cost of these systems is the first obstacle for the farmers to apply this technology.

Another example may be found with agricultural chemicals; most of farmers use chemicals like fertilizers and pesticide to increase their production. Wrong use of these chemicals made a lot of healthy problems because of the highly polluted products beside the expected contamination of the soil itself. This problem is also related to the low qualification levels of the farmers and labor beside the absence of extension role. Despite the need to increase the production, this increase will have to be achieved in a way that preserves the environment. The use of pesticides and plant nutrients like nitrogen and phosphorous should be used in such a way to minimize the emissions of greenhouse gases [18]. One of the threats which face the application of modern technologies in the Egyptian water sector is lack of information or non-dependency on databases to make decisions, policies, and managing agricultural practices. The wide frame of this scene shows that agriculture modernization is self-practice not following certain plan or strategy and this can't give any expected positive impact toward sustainable agriculture.

4.2.4 Weak Support to the Food Industries Sector

Agriculture-based industries are not just related to the quality and quantity of the products, but also related to the logistic services introduced to this sector. Food industries sector contributes 11% of the GDP with total investments 500 billion L.E [19]. This number reflects the importance of this sector to the national economy. At the same time most of the factories are still far from the cultivation areas and concentrated near to the capital or large cities that have industrial zones. This creates the need for better transportation utilities and infrastructure. Policies should consider also facilitating flow of capitals, organize competition between producers, and open export markets. Whenever strong was the food industries, this will encourage farmers to improve their products in addition to encourage investors to go through the agricultural sector itself.

4.2.5 Lack of Necessary Infrastructure

Most of arable lands are near to villages which still suffer from lack of drinking water supplies, sewage stations, transportation, and roads. Even the large area farms in the west of Egypt still suffer from absence of energy supplies, central markets, and some necessary services like huge refrigerators. Wheat is considered a clear example on how the weak infrastructure affects the possibilities to reach self-sufficient of agricultural production. Annual wheat production heat production is about 9.46 million ton faces needs of 18 million ton. Silos can accept till 6 million tons. They are not enough to accommodate the local production or the imported quantity. According to World Bank statistics, cereal lands increased from 2,614,460 to 3,291,950 ha from year 2000 till 2014 in Egypt. There is a direct threat that the current storage capacity of silos may prevent proposing to increase the strategic reservation or annual production of wheat and cereals in general.

5 Reaching Sustainable Agriculture and the Record of Modernized Agriculture

5.1 Types of Agriculture Systems

The modernization of agriculture has resulted in the development of three different types of agriculture. The three types are industrialized agriculture, Green Revolution, and diverse, complex, resource-poor systems. Industrial agriculture is a form of modern farming that pointing to the use of agricultural productions in industry, including livestock, poultry, fish, and crops. The methods of industrial agriculture are techno-scientific, economic, and political. The Green Revolution was a period when the productivity of global agriculture increased drastically as a result of new advances. This was due to new farming practices implementation comprising the use of new chemical fertilizers and synthetic herbicides and pesticides. The chemical fertilizers made it possible to supply crops with extra nutrients to increase the yield. The newly created synthetic herbicides and pesticides controlled weeds, deterred or killed insects, and prevented diseases.

Green Revolution included genetic technology, innovation in agricultural machinery and farming management methods, techniques for achieving economies of scale in production, the creation of new markets for consumption, the application of patent protection to genetic information, and global trade. Yield levels by applying these systems showed that industrialized systems have the greatest indicative yields followed by Green Revolution and finally diverse systems. Involving sustainable agriculture practices will cause higher yields if compared to the existing systems all over the world [9]. The first two types may not be compatible with the current agriculture system in Egypt, but they are still able to respond to the technological packages, producing high output systems of agriculture in the industrialized countries and in the Green Revolution lands. The third type comprises all the remaining agricultural and livelihood systems which are the low input systems, complex and diverse, with considerably lower yields. This system may be near to the Egyptian agriculture system. In general, not all the countries of the third world untouched by modern technology. Some 2.3–2.6 billion people are supported by agricultural systems characterized by modern technologies brought by the Green Revolution. These systems have good soils and reliable water and are close to roads, markets, and input supplies. The area of these lands is some 215 million ha, and they currently produce 60% of the grain in Third World countries. Alternative sustainable systems in these regions have been able to match their yields and profitability. On the other hand, 1.9–2.2 billion people are largely untouched by modern technology (based on estimates from FAO and World Bank data). They tend to be in the poorer countries with little foreign exchange to buy external inputs. Their agricultural systems are complex and diverse and are in the humid and semi-humid lowlands, the hills and mountains, and the drylands of uncertain rainfall. They are remote from services and roads, and they commonly produce one-fifth to one-tenth as much food per hectare as farms in the industrialized and Green Revolution lands. It is in these regions that sustainable agriculture has had the greatest impact on local food production so far, with yields doubling to trebling with little or no use of external inputs. Referring to the character of such countries, we can say Egypt is one of those countries. At the same time, we can't say that lack of technology is the only reason to be in this situation. Mismanagement and poor planning play the greatest role to reach this situation.

Agricultural modernization process has had many impacts. These include the loss of jobs, the further disadvantaging of women economically if they do not have access to the use and benefits of the new technology, the increasing specialization of livelihoods, the growing gap between the well-off and the poor, and the co-option of village institutions by the state.

Despite the expected improvement through these modern technologies, all too often there are adverse environmental and social impacts. Many environmental problems have increased dramatically in recent years. These include:

- Contamination of water by pesticides, nitrates, and soil and livestock wastes, causing harm to wildlife, disruption of ecosystems, and possible health problems in drinking water
- Contamination of food and fodder by residues of pesticides, nitrates, and antibiotics
- Damage to farm and natural resources by pesticides, causing harm to farm-workers and public, disruption of ecosystems, and harm to wildlife
- Contamination of the atmosphere by ammonia, nitrous oxide, methane, and the products of burning, which play a role in ozone depletion, global warming, and atmospheric pollution
- Overuse of natural resources, causing depletion of groundwater, and loss of wild foods and habitats, and of their capacity to absorb wastes, causing waterlogging and increased salinity

- The tendency in agriculture to standardize and specialize by focusing on modern varieties, causing the displacement of traditional varieties and breeds
- New health hazards for workers in the agrochemical and food-processing industries

Despite these problems, many scientists and policy makers still argue vigorously that modern agriculture, characterized by externally developed packages of technologies that rely on externally produced inputs, is the best, and so only, path for agricultural development. Influential international institutions, such as the World Bank, the FAO, and some institutions of the Consultative Group on International Agricultural Research, have long suggested that the most certain way to feed the world is by continuing the modernization of agriculture through the increased use of modern varieties of crops and breeds of livestock, fertilizers, pesticides, and machinery. Remarkably, these international institutions often appear unaware at policy level of what can be achieved by a more sustainable agriculture. However, there are some signs of change, mostly limited to small groups of individuals, plus some small modifications in policy.

The FAO has estimated that over 50% of future gains in food crop yields will have to come from fertilizers. This calls for massive increases in fertilizer consumption by poor countries.

Traditional agriculture is presented as environmentally destructive, so needing to be modernized, or as efficiently managed systems which have hit a yield ceiling, so again needing modern technologies. Even where there have been recent shifts in emphasis, both in rhetoric and substantive policy, the Green Revolution model tends to be widely believed to be the "only way to create productive employment and alleviate poverty" [20].

5.2 Stagnating Capacity in Modern Systems

Modern agriculture has remarkable impact in the Third World countries. The modernization exampled in planted modern varieties of wheat and maize and growing consumption of fertilizers, nitrogen, and pesticides. As a result, food production per capita has, since the mid-1960s, risen by 7% for the world as a whole, with the greatest increases in Asia, where per capita food production has grown by about 40% [21]. In Egypt, there are a lot of tries to obtain the positive impact of modern agriculture. These tries included:

1. Creating high-productive varieties for rice, maize, cotton, wheat, and some other crops
2. Creating highly resistive varieties against diseases and climate change
3. Building up a gene bank to protect the genetic specifications of Egyptian crops
4. Genetic improvement of local breeds of ruminants and poultry
5. Conservation and dissemination of improved local genetic resources from animals and poultry

6. Making scientific studies on the effects of climate change [22]
7. Improvement of irrigation infrastructure and going toward modern irrigation systems
8. Utilization of climate data, GIS, remote sensing in agriculture, and water sectors

Even though all of these did not get the significant impact on the agricultural sector in Egypt, many challenges are still facing the efficient application of such modern practices (refer to Sects. 4.1 and 4.2).

The application of modern agriculture is expected to decrease the gap between the need of food and increased population. In addition, these practices will give the increase in yield which is more important than the increase on cultivated lands [20]. The description of this situation is that science-based agriculture is the key to permit higher and more stable production, ensuring food stability and security for a constantly growing world population [23].

It is still possible that new technologies, such as biotechnology and genetic engineering, will open up new frontiers. Scientists hope that these will produce crops and animals that are more efficient converters of nutrients, with better drought tolerance and pest and disease resistance. One dream has been the incorporation of nitrogen-fixing nodules into the roots of cereals, so making these crops self-sufficient in nitrogen. If such breakthroughs do occur, it will be important that ways are found to ensure their availability to poorer farmers. If they are still part of a package, or rely on hybrid seeds that must be repurchased after every replanting, then they are likely simply to encourage even greater dependency on external resources and systems and open up gaps between wealthy and poor farmers. Those low-income countries that are currently poorly endowed with natural resources and infrastructure are unlikely to benefit [24].

6 Science and Sustainability

Traditional agriculture is still the dominant paradigm. The word sustainability should be the core element of decision-making, government policies, university research projects, and extension organizations. The results of the strategies of agriculture did not make satisfaction about their implementation. Sustainability is a challenge but it is not the only challenge for agriculture. Climate change, replacing fossil fuels with renewable energy, is relatively new challenges. In general, two broad paradigms of sustainability are identifiable: first one supports systems-level reconstruction of agricultural practice to enhance biological activity and the other adopting a technological fix, in which new technologies inserted into existing systems can improve sustainability outcomes [25].

Reaching sustainability is based mainly on understanding the required links between nature and human action [26]. This gives us a vision on how many sciences should be linked together while searching sustainability. One of the keys to reach sustainability is that no exact science should be forwarded on another. All sciences stand on one line on the road of sustainability.

A Question May Appear in Our Minds: Is There a Sustainability Science? Yes, sustainability science is "a modern field of research transacting with the interactions between natural and social systems." From this definition we can understand that sustainability science is a combination of sciences related to nature and human life. It is also necessary to understand how these sciences can interact to solve the challenge of sustainability and meet the needs of current and future generations while reducing poverty and conserving life support systems [27]. We are in need for balancing human needs with keeping and improving ecosystems ability to provide the goods and services. In a simple way we can reach this by increasing goods and services or by reducing the consumption. In fact doing both is a result for well-planned sustainable system. Understanding the role of each science in sustainability is very important for the necessary integration of biophysical and social sciences that shapes sustainability science.

Successful applications of sustainable agriculture are still not widely spread worldwide. Despite the existence of such practices, only few farmers have adopted new technologies and practices. Sustainable agriculture definition and general concept are deeper and more fundamental challenge than policy makers, researchers, and extensionists may assume. Sustainable agriculture is not just related to specific practices or using modern technologies. It needs technology and knowledge transfer between farmers and professionals, external institution support, local group support and cooperation, efficient resources management, and above and first of all agricultural policies to support all the previously mentioned elements. It needs also a close view to the way we conceptualize and achieve sustainability. Many researchers studied the performance of modern agricultural machines, irrigation systems, farm management practices, etc. They usually recommend using a specific technology or technic that may increase the yield or enhance a feature of any of the agricultural systems components. At the same time they may neglect the economic side of this use or did not mention how the local community can approve this. A study had taken place to compare the hydraulic performance of some emitters of drip irrigation system to find how can emission uniformity affects the sustainable management of such kind of irrigation systems [28]. Results showed that there is a type of emitters gave the greatest water use efficiency, energy use efficiency, and better hydraulic performance. But this type did not give the greatest B/C ratio which is considered the most important indicator that concerns farmers. Science takes its importance from continuous trials to discover the reality, predicting and controlling natural phenomena.

Complex world will be sliced into small parts that will be analyzed and interpreted to make predictions about these parts. This knowledge will be integrated again; then we can know about the world. In this context, investigators can't live away from the world to reach the truth. Knowledge about the world will be summarized to take the universal form. With a high degree of knowledge and control over a studied system, we can say we have a true knowledge which equals good science.

This positivist approach has generated the application of technologies by farmers. As mentioned above, researchers try to simulate the reality to find solutions and give recommendations to deal with a natural phenomenon. Researchers can access all the required inputs, while farmers are controlled by many factors whether natural, economic, and social or any other effect.

Applying modern agriculture in this case may stop in the research station. It is not necessarily that the best performing farmers can obtain the same yield obtained by a researcher. When researcher has access to all necessary inputs at appropriate time, farmers do not have the same ability to reach the package of getting the highest yield. When one element is missing, the whole process will fail.

A Truth About Science

To suggest a solution for a certain problem in scientific way, you should detect the problem and try different solutions to pick the most suitable one. View to the problem will vary greatly from one to another stakeholder in the agricultural system. When trying to recommend solution, the variation in how feasible is it will be greater and more complicated. No scientific method can find a solution that makes complete satisfaction to all the people involved in the system. It is seriously misleading that scientific knowledge and method traditionally embrace uncertainties enthusiastically and exhaustively pursue them [29].

Data collected for a scientific purpose should be objective and value-free. The context of the data affects the outcomes, but you can ignore the context when the data is objective and true.

Selective samples of any study may make what is near to a disaster when depending on their results in decision-making or planning long-term strategy. An example for this was 22 erosion studies in the Upper Mahaweli Catchment in Sri Lanka concerning mid-country tea that have taken place [30]. There was untraditional variation in the estimates of erosion between 0.13 t/ha/year and 1,026 t/ha/year [31–33]. The lowest estimate was by a Tea Research Institute to show how successful and safe they are managing the soil. High estimate was by a developing agency showing how serious is the erosion problem in the Third World. This great variation in estimates and results running in the context of an organization purpose indicate how you can be merely selective and not lying.

Another example was about water use and energy needs described by [34]. The projections of the needs were based on data collected in the northwest of the USA. First projection showed a growth need of energy to the year 2000; second projection showed downward trend. First projection was conducted by an energy providing company, while the second was by environmental groups. In addition projections made by consultancy groups were found in the center.

This should not open the door of doubt about the reality of data. Data should not also be descriptive to the nature of organization, institution, or group who show the data. In both of the two previously mentioned examples, projections were logical and internally elegant. But here you are using specific methodology, sampling, and measuring techniques to introduce our data and recommendations to specific audiences or actors that play a role you need. The great challenge we are facing here is to make agreements between all the actors or stakeholders in the agricultural process. All of these actors have their own agenda and waiting to be served by science to introduce solutions in a way they are interested in it. Science can't serve sustainability if there was no sufficient survey to the needs of sustainability elements (see Sect. 7.1) to solve problems.

The road of science we are following to define and solve problems is straight. The fact is this road is squiggly. Another face of this problem is we have to follow this winding road to access the facts required to deal with problems [35].

When trying to solve problem and doing an act to make change to reach better situation, we need pluralistic ways of thinking [29, 36–43].

Positivism [44] may introduce suitable philosophy to use science in sustainable agriculture research. For both natural and social sciences, positivism assumes that real knowledge comes from physical experiments which will be then analyzed and processed. This paradigm of scientific philosophy studies the properties of any phenomena and the links between it and other ones. This theory is near to the philosophy and nature of sustainability because of the integration between sciences and linking phenomena.

Despite this rapprochement between positivism and sustainability, many scientists still see that information should be interpreted by public and policy makers. By the meaning, positivism makes nature the source of information and idea, while some scientists see the science itself is the source of information, and they are free to choose what to study and show the results to the public.

Following any of the ways to find the "truth" of something is related to the way we think about methodologies for finding out about our environment. Sustainable agriculture practices are dynamic and complex, and no certain way whether positivism or reductionism can simplify these practices [41].

There are five principles set out the main differences between positivist science and other paradigms in sustainable agriculture implementations [45].

1. The belief that sustainability can be accurately defined is flawed. Sustainability concept does not indicate fixed set of technologies or practices. Each stake holder has different values. This is a part of the problem that sustainable agriculture is not a specific farming strategy or certain scientific methodology, but it is related to what we are trying to achieve. An example for this principle may be clear in the strategies of Egypt from 1980 to 2017 to reach sustainable agriculture. They may be based on scientific studies, but they have very wide titles and concerned on specific issues so we can say they were far from a scientific paradigm that leads to sustainability.
2. All actors have their own point of view and try to explain their problems in a unique way. This is also identical to their tries and suggestions for finding solutions and makes improvement. We should deal with the fact that there is no single correct understanding because it is related to believes, understanding, framework, and personal knowledge which are socially constructed. It is essential to deal with a problem with different views from involved actors.

3. Solving one problem may create another problem. We have to consider collecting large amount of data before reaching certainty about an issue. This is one of the impacts of positivism. One of the examples in Egypt may be taken from the lack of energy resources. Egypt is rich in solar radiation and many studies succeed to use solar power in farm applications like irrigation machines and greenhouses environment control. There may be a reduction in energy cost, but the capital cost of solar cells does not encourage normal farmers to convert to using this source of power. Here an economic and social studies have to be done in parallel with power studies.
4. Continuous learning for the actors enables them to accept new technologies and deal quickly with any change in conditions. Wider knowledge encourages improvements in technologies and practices as they are supposed to be accepted by the farmers.
5. Systems of learning and interaction like extension systems are required to encourage greater involvement of all the agricultural system actors.

We can conclude from this that it is may be not expected but human is the most important element that controls dealing with problems. Human education, experiences, skills, the way they see the problem, and the way they accept solutions are limitations for scientific approach we are following to detect and solve issues. Data about any problem should be collected from all the actors of the problem, and the description of problems should be in agreement or in between with their views.

Also solutions have to be accepted to be implemented through actors. Research may find best solutions but if not accepted by actors, it loses its beneficiary. We need to make development in research to combine discovering dynamic and complex situations and taking action to improve them by making actors and stakeholders involved as companions in the whole process [46].

Making human involvement in solutions may open the door to clarify unique properties of information required in agricultural sector. Changeability and local validation are two general specifications of information. When looking to these specifications in the agricultural sector, we see that they transform to be more critical. The change of information in agricultural sector is because it is related to many other conditions like marketing, human resources skills, education, climate change, and last but not least political situation. Also the nature of a certain problem may vary from a territory to another, and so there will be differences in description. As a result information should be locally valid and collected.

In Egypt many studies have been done to discuss agriculture sustainability [10, 22, 47, 48], and of course there are hundreds of studies on agricultural practices and how to improve them to increase crop production and conserve resources. The problem is not related to the topic of studies or quantities. The question is how these studies can go into implementation framework to give beneficiaries to the stakeholders.

Educational institutes and organization should consider the need of professionalism in agriculture. They should be able to train and transfer the knowledge to professionals and make them able to deal with farmers or work with them.

Sustainable agriculture policy in Egypt has to give the opportunity to science and scientist to go out toward implementation not jailed in conferences and papers.

7 Conditions for Sustainable Agriculture

7.1 Successful Transition to Sustainable Agriculture

Understanding the challenges for sustainable agriculture is the right start to access it. Of course the challenges are different from a region to another. We may now are in agreement that Egypt is following the diverse and complex lands type of agriculture. The main challenge here is how to increase the yield per ha while keeping natural resources.

Sustainable agriculture can be reached in any of agriculture systems. In the diverse, complex, and resource-poor lands, embracing regenerative technologies may double or triple the yield. This can be side by side to the use of little or no external inputs. A problem may appear here about if the farmers get more output from less output. The answer may lead us to the main problem of planning and making strategies to reach sustainable agriculture in Egypt. The plans try to solve the problems without any try to change the current barriers. Nature and level of the Egyptian farmers' knowledge, labor skills, field and resources management practices are picturing essential elements in the agricultural process that in need to change but we are dealing with them as constants. When resource-conserving technologies are developed, they should be used by local groups and institutions, and both should be supported by external research. Sustainable agriculture can't be reached unless the three elements worked together Fig. 1.

Favorable policy environment and successful strategy can link the three elements together. Missing these elements will lead to failure of reaching a sustainable system. Policies and strategies in Egypt till 2017 are still missing the linking mechanism between sustainable agriculture elements. In best case the policy frame work will encourage going to increase external inputs or modern technologies without planned steps to convey this to the farmer. Farmers also need to improve their knowledge about modern farming. Also labors need to enhance their skills to deal with modern farming practices.

They have made use of resource-conserving technologies, such as integrated pest management, soil and water conservation, nutrient recycling, multiple cropping, water harvesting, waste recycling, and so on. In all there has been action by groups and communities at local level; and there have been supportive and enabling external government and/or nongovernment institutions. Most though are still localized. They are simply islands of success. This is because a fourth element, a favorable policy environment, is missing. Most policy frameworks still actively encourage farming that is dependent on external inputs and technologies. It is these policy frameworks that are the principal barriers to a more sustainable agriculture.

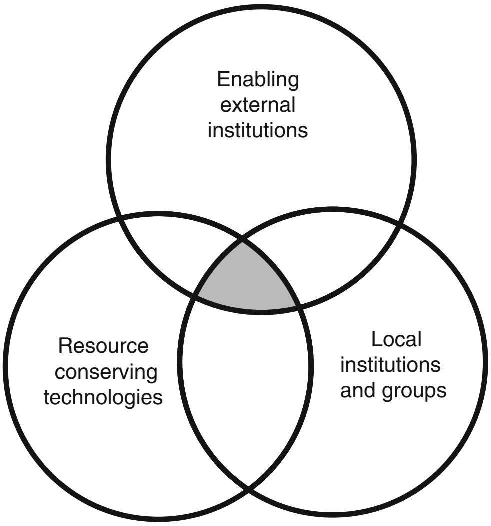

Fig. 1 Conditions and elements of sustainable agriculture [9]

It should be understood that transferring to sustainable agriculture is not a win-win relationship. There are always winners and losers. The idea here is to avoid repeating the same planning mistakes and nominate a category of actors or give an element of sustainable agriculture less care.

The change may face many threats but this will be solved by changing policies. For example, the target of exporting agricultural production is directly related to the international markets policies. Any decrease in commodity price will reduce the net benefits of farmers. This will not be followed by a decrease in the price of chemicals or farm tools, for example, because local companies are trying to keep the prices of their products. Farmers themselves face transition costs of adopting sustainable agriculture practices and technologies and acquiring new management and learning skills.

7.2 Resource-Conserving Technologies and Processes

Integrated pest management, nutrient management, water and soil conservation, and multiple cropping are examples of resource-conserving technologies. The adoption of these technologies results a favorable changes in the farming system. For example, there is an encouragement of rice farmers to grow fish in rice fields. This practice means low consumption of external input like nitrogen as the wastes of fish will do the same role. In addition the final benefits of unit area will increase. This implies that the resource-conserving technologies are multifunctional.

Integrated pest management does not mean only the reduction of pest population. It is also the way to find suitable strategy to make pest control sustainable and friendly to the environment. Nutrient conservation may also be easy to implement by using manure as local nutrient. This means that farmers should give better care to their cattle health to ensure sufficient and qualitative local nutrient.

Following these practices looks more complicated than following a schedule for spraying and using chemicals. It requires basic training and analytic skill and the capacity to monitor on-farm ecological processes. Without training and increasing farmers knowledge, all these practices will keep its position just in research papers. Farmers should be convincing with the importance of these practices specially it is expected to reduce their benefits on the short term. Agricultural extension role appears here to transfer the knowledge and clarify all the opportunities and threats of implementing such practices. With appropriate incentives, farmers may be capable of applying such practices.

Policy makers and farmers need to realize that these biological processes which include rebuilding of stock of natural predators and wild host plants, increasing the levels of nutrients and improving soil structure, and the establishment and growth of trees need time to be established and work as a sustainable agriculture practice.

7.3 Local Groups and Institutions

Successful sustainable agriculture not only based on the knowledge and skills of the farmers and labors. Participation and cooperation between farmers are required. Collective action of household farming is necessary for mainly two possible reasons. First, conventional farming system which causes resources degradation conveys this harm to the sustainable system. Second, sustainable system is expected to produce goods which can be diminished by the lack of support of tradition systems.

Motivation and coordination between farming households are necessary conditions for sustainable agriculture. These include pest management, soil and water conservation, nutrient management, livestock management, and controlling groundwater pollution.

There is a need to establish platforms for collective decision-making. Absence of such platforms to manage the global decision-making is a problem facing sustainability [43].

Local groups or institutions can be found in six shapes that are relevant to sustainable agriculture [9]:

- Community organizations
- Natural resource management groups
- Farmer research groups
- Farmer to farmer extension groups
- Credit management groups
- Consumer groups

Community organizations: They are mainly concerned with community development. The role of these organizations in Egypt in the agricultural sector is limited to introduce financial support for farmers. Recently some of this organizations turned into profits organizations dealing with all kinds of people. There is a complete absence for organizations that introduce training and extension services for farmers. Even services introduced by Egyptian government like health care is introduced to the small residential communities that are mostly located in villages but not focusing on farmers themselves.

Natural resource management groups: Some of agricultural areas in Egypt suffer from lack of natural resources like water. Farmers in these areas make a local management group to manage the operation of irrigation. They may share the costs of digging well(s) or pumping plants and make rotation between each other's to use water delimited by time and date.

Farmer research groups: As mentioned before, research should start from the people and their share by problem identification, analysis, planning, suggesting solutions, and implementation side by side to researchers and extension staff. Farmer research group makes researchers know fast and accurately about agricultural problems.

Farmer to farmer extension groups: When relying on experience, transferring knowledge from farmers is greatly easier if transferred by researcher or extensionists. It is easy to farmer to understand what are the questions and ideas occupying his colleagues head. Training farmer as extensionists may introduce a good solution to transfer newly obtained skills and information.

Credit management groups: They have the responsibility to manage granting credits. This function should be done under the umbrella of banks. The lack of the effective role of credit managers is evident in the legal problems that faced farmers recently because of loans and financial support introduced by banks. The ABE which is the destination of most farmers does not have its own policy which should be suitable for farmers' conditions not as any normal bank.

Consumer groups: Introduce great opportunity to give feedback about the quality of agricultural products and share information about markets. They may suffer from lack of organized communication mechanism so it will be self-belt.

7.4 Enabling External Institutions

Local people should be engaged in data collection, decision-making, analyzing, and improved practice implementations. There are benefits if people share in decision-making and analysis and provide information. In general the share of people can be passive if just they are told what will happen. We can turn this share into positive one by giving them the opportunity to feel that their opinion are valued and the have incentives. Incentives encourage farmers to obtain more knowledge, improve their skills, provide resources such as labor, and able to contribute financially. When incentives are absent, people lose their stake in sharing in the agricultural process.

People participation expression is normal to be used by development agencies because of its importance. When people are well organized, they should be encouraged to form groups.

When planning to reach sustainability, the interactive participation of people is a must. In such planning people engage in joint planning and formation, which leads to form new institutions or make the existing stronger.

It tends to integrate different branches of knowledge with structured learning and show perspectives. Sustainable agriculture should create new ways of learning about environment. We should not be confused between learning and teaching. Transferring from teaching to a learning style has deep effects on agricultural development institutions.

Central to sustainable agriculture is that it should enshrine new ways of learning about the world. Learning should not be confused with teaching. A move from a teaching to a learning style has profound implications for agricultural development institutions. The focus is less on what we learn and more on how we learn and with whom [41]. Sustainable agriculture implies new role for development professionals, and this is related to make a new professionalism concepts, values, behavior, and methods [49]. The issue of learning should be about what and how we learn with whom [41].

7.5 Supportive Policies

Policy makers and the state play an important role in sustainable agriculture. Any interaction from any of the stake holders in the agricultural system needs support from governmental policies. Governmental policies also have the ability to make all interactions and development tries more easily through the following steps:

1. Government can make a mix of policy instruments and measurements.
2. Make decentralization of administration to facilitate reaching and communication with local people.
3. Create a framework to manage land tenure and resources.
4. Making institutional framework which is sensitive to the people needs.
5. Developing suitable marketing policies to increase the efficiency of using resources.
6. Giving incentives of conserving resources and pollution decrease.

If the policies are not well planned, they will give reverse effect. Policies should be designed to make integration between farm, community, and national levels.

8 Applicability in Egypt

Sustainable farming can be compatible with small or large farms and with many different types of technology. From this point we can say sustainable agriculture is applicable in Egypt. We discussed in the previous sections the challenges of the agricultural sector in Egypt and condition to reach the sustainable system. Current strategies and policies push the agriculture sector far from sustainability. Sustainable agriculture can have wider benefits. But this does not in itself indicate how it may be adopted by farmers worldwide. It suggests there can be many winners, but it is not clear who will be the losers in the short term. All successes have had three elements in common and there is much to be learnt from these. First, all have made use of locally adapted resource-conserving technologies. Second, in all there has been coordinated action by groups or communities at the local level. Third, there have been supportive external (or nonlocal) government and/or nongovernment institutions working in partnership with farmers.

On the road to sustainable agriculture, a new strategy has been prepared in Egypt to convert agricultural policies and plans to sustainability by the year 2030. It may be the first strategy that considers the integration and links between sustainable agriculture system elements. The main aims of this strategy are as follows [3]:

1. Sustainable use of agricultural natural resources
2. Improving agricultural productivity
3. Increasing competitiveness of agricultural products
4. Achieving higher rates of food security in strategic goods
5. Improving opportunities of agricultural investment
6. Improving livelihood of rural inhabitants

These objectives will be through implementation of some mechanisms to make significant modifications in the agricultural sector and all involved stakeholders and agricultural system components [50].

Current agricultural system in Egypt is a diverse, complex, resource-poor system. To reach the success of these changes, they should be technically, ecologically, economically, and socially approved. A low number of learners and poor quality of education in Egypt make it hard to convey the modern technology and research recommendations to farmers. Environmental problems do not occupy the required importance level in farm practices. Unsafe way to dispose farm residues and high concentration of chemicals and heavy metals in water and soil are considered most serious and dangerous environmental problems in the Egyptian agriculture sector, for example, a farm residue like rice straw getting disposed by burning despite various available uses of this waste. Profusion in using chemicals because of lack of training and experience has also affected the quality of soil and water. As a result kidney and liver diseases are concentrated in the agricultural area. We should keep away from the impractical technologies that farmers can't adopt [51].

We will introduce an example on the considerations of making policy changes. It is known that the agricultural sector is the greatest consumer of water resources in Egypt [52]. The main reason of this situation is the current depend on surface irrigation system which is also managed in bad way. Till now modern irrigation system did not succeed to replace this system. If we made a comparison on which system can be applied under Egyptian conditions, we will find that surface irrigation system will achieve superiority over modern systems as shown in Table 2. From the technical side, surface irrigation system does not need high skilled labor contrary to modern systems. On the environmental seen Lack of farmers' awareness of water scarcity makes the ability of modern systems in saving water out of their consideration. In addition there is no price for irrigation water, so any talk about water crises does not make effect because the reply will be "It's free." The high capital cost of modern systems prevents most farmers to use it even they are convinced with its importance. Small holding area makes it hard to cover the cost of modern systems in short time period. No certain problem may face both systems to be socially approved. When we try to solve this, we will find a need to improve labor and farmer skill to deal with modern systems. This requires improvements in the educational and extension systems.

Also we need to give farmers financial support or make investments.

This is an example of one of many issues related to the conservation of natural resources which made us trying to solve many problems before expecting its successful implementation.

Sustainable agriculture strategy toward 2030 is expected to increase the total returns of land and water units as shown in Table 3.

On the other hand, all of these beneficiaries can't be reached if any of the actors in the system played his role individually. This is one of the obstacles of applying

Table 2 Comparison between applicability of surface irrigation system and modern irrigation systems considering Egypt's conditions

Surface irrigation		Modern irrigation
Yes	Technically	No
Yes	Ecologically	In between
Yes	Economically	No
Yes	Socially	Yes

Table 3 Expected benefits of applying the Egyptian strategy toward 2030

Description	Measuring unit	2007	2017	2030
Water qualities anticipated to be used	10^9 m^3	58	61	64
Projected land area	10^6 Feddan	8.4	9.6	11.5
Cropped area	10^6 Feddan	15.4	19.2	22.9
Percentage of intensification	%	183.6	199.1	200
Index of the increase in the returns of water unit	%	100	168	218
Average rate of return of the land area (Feddan)	10^3 L.E	13.2	20.3	22.9
Index of the increase in the returns of the land unit	–	100	154	174

sustainable agriculture practices. Too many people are required to follow the same plan, and alternatives should be ready for any role absence or bad application.

Despite the expected success of modern systems and the recommendations of using external inputs [53, 54], it does not seem that Egypt is able to turn into this model directly. We need to set the three sustainable agriculture conditions together first and expect widely self-spreading. After achieving this, policy makers can plan to turn to the Green Revolution model which can involve small- and medium-sized farms to be driven by productivity-enhancing technological change. This can offer a way to create productive employment and alleviate poverty on the required scale [20].

9 Conclusion and Recommendations

Sustainable agriculture can be applied and reached in the Egyptian environment. To reach sustainability, we should ask from where to start and what you want to access. Sustainable agriculture is accessible with small holding areas and poor resources. Sustainable agriculture is not related to a specific situation, but about how you can achieve its conditions and what strategies and policies you will follow with which mechanism. The sustainable agricultural system which is near to the Egyptian paradigm is diverse, complex, and resource-poor system. It should be clear that sustainable agriculture will be reached in Egypt by achieving the following conditions and recommendations:

1. Understanding that sustainable agriculture is achievable.
2. Policy makers should deal with sustainability as an integrated system, sustainable agriculture can't be reached by finding solutions to the challenges of the Egyptian agriculture sector one by one.
3. Science and research can't support sustainability if they are far from people. Farmers have to be involved in the research system by providing information, making analysis, introducing solutions, and implementation.
4. Enabling external institutions and applying resource-conserving technologies should be integrated with local groups and institutions as a condition for sustainable agriculture. All the actors should work together in the agricultural system.
5. Egypt is poor in natural resources; in addition farmers have not enough financial power to use external outputs. We should build our strategies to reach the resource-poor sustainable agriculture system. Embracing tries to reach industrialized or Green Revolution systems as a road to obtain higher production, and benefits will have negative effects on the Egyptian agriculture system as a whole.
6. Any plans or solutions should be technically, ecologically, economically, and socially accepted according to local conditions.
7. Policies should be supportive to any sustainable agriculture strategy; the fact here is sustainable agriculture is not just related to plans or resources. It is about the supportive policies which will serve all of this [50].

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