Soil Health and Its Biology

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Abstract

It is well known that, the health of humans is mainly depends on the physical, social and nutrient factors. The health of humans requires safe, proper and sufficient supply of nutrients through the foods. This quality of foods mainly depends on the biology, fertility and quality of soils, in which crops were cultivated. Thus, the biology of soils has direct and/or indirect effects on the health of humans through the exposure to soils and their microorganisms, extract different medicines from soils and deficiency of nutrients through food chain. The biology of soils also has a close relationship with the nutrition of both plants and humans. Therefore, soil quality and its biology is a crucial issue towards sustainable agriculture. Thus, the main purpose of this book chapter is to emphasize the link between soil quality through its biology and human health. The great roles of soils in our life also will be highlighted.

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10.1 Introduction

It is well known that, soils are a dynamic, complex and open system. This system supports all different soil microbial communities including bacteria, actinomycetes, algae, fungi, viruses, protozoa, nematodes, etc. These microbial or biological activities have a great role in cycling of nutrient elements in the biosphere, maintaining the fertility of soils, formation of humus, biological conversions, geochemical cycling of elements, ecosystem sustenance, etc., as well as supporting plant life and its productivity (Bharti et al. 2017; Finkel et al. 2017; Vimal et al. 2017). Some soil microbes have the ability to increase the tolerance of plants to root/soilborne plant pathogens like arbuscular mycorrhizal fungi, thereby acting as a biocontrol agent. Several reports have been stated that, mycorrhizal fungi have the ability to reduce damage caused by soilborne plant pathogens through enhancing plant vigor due to increased nutrients uptake and then increasing the plant resistance to pathogen infection (Finkel et al. 2017).

Soil and its relationships with human health were and still one of the most important issues in soil sciences. These relationships have been built on basis that soil is a crucial source for our life, supporting us with safe and enough foods, different medicines, etc. The biological properties of soils were and still the limit factor in nutrition of both plants and humans (Singh et al. 2017). These biological characteristics represent the most important indicators for soil quality. This soil quality and its biology become an essential approach for the sustainable agriculture. It is well documented that, soil biology and its ecology was and still one of the most important sustainable management of soils (Eisenhauer et al. 2017). Therefore, soil ecology and its

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biology is the main key for the protection and conservation of soils, for sustainable environmental management and for the nutrition and health of humans. As a consequence, soil ecology and its biology will remain an extremely important field of research into the future and requires a coordinated global effort to address the most important issues facing the sustainability of soils and gaps in soil ecological knowledge (Eisenhauer et al. 2017).

The biology, ecology and quality of Egyptian soils are in a crucial need to a great concern at all levels. That means there is no any sustainable agriculture in Egypt without a real guarantee for protection the Egyptian soils from all forms of degradation and careless. Therefore, this review will focus on the soil biology and its impact on health of humans and plants as well as the soils as a main source of our life needs.

10.2 Soil Biology: As a Treasure

Soil biology is a branch of soil sciences dealing with all forms and types of life in soil including soil micro- and macro-organisms. So, there is crucial need for more understanding of the effect of soil biological components on chemical and physical fertility. The maintaining of the fertility and productivity of soils is mainly depends on the desirable levels of numbers, activity and diversity of soil organisms. The biology of soil has serious roles in different issues such as soil fertility and cycling of nutrients, decomposition of organic matter by soil organisms, soil structure, plant growth and soil carbon storage. Regarding soil biota, soil life and soil fauna could be considered a term for all organisms including nematodes, earthworms, protozoa, bacteria, fungi and different arthropods. Therefore, the biology of soils is a real and valuable treasure for plant nutrition and its growth. There is no productive soil without the biology or biological activities in soils and the soil health starts from the biology of this soil (Bharti et al. 2017; Hüberli 2017; Xiao et al. 2017).

The treasure of soil biology means that, all processes and factors controlling the fate and bioavailability of nutrients in soil rhizosphere as well as the biological activities (i.e., soil enzyme activities and soil microbial counts) give the soil its vitality and reflect the role of this treasure in plant nutrition, soil biochemistry, soil quality, soil microbiology, soil biogeochemistry, soil geomicrobiology, soil ecology, etc. Therefore, more investigations should be carried out regarding the biology of soils including studies on different levels in particular molecular and genetic level. The most important applications of soil biology related to human health including both the direct contact of human with soils (several human health problems) and discovery of many antibiotics produced by soil organisms. So, the relationship between soils (their biology) and human health was and still a great natural resource for the sustainable development. Furthermore, several investigations regarding the scientific approach of soils and human health are needed.

In Egypt, the biology of soil as a great treasure was well known for ancient Pharaohs several thousand years ago. They expressed about this treasure through different paintings in their Temples (e.g., Karnak) including many agricultural practices like ploughing with a yoke of horned cattle, and other agricultural practices on a large scale. This civilization of Ancient Egypt was indebted to the Nile River and its dependable seasonal flooding. Due to the fertile soil and the Nile River, the Egyptians have been built an empire on the basis of great agricultural wealth. The farming practices of Egyptian s allowed them to grow staple food crops (i.e., grains such as wheat and barley) and industrial crops such as papyrus and flax. From their paintings in different temples and tombs, the Egyptians have been proved about the significance of soils in their entire life including production of food, storing these foods, manufacturing these foods, production some medicines from the soils, manufacturing some cosmetic from soils, etc.

Therefore, soils as complex, dynamic and open systems are very important for the entire of human life. The humans are created from this soil, their natural necessaries from this soil (food, feed, fiber and fuel) are supported, a lot of his medicines from soil are manufactured, a lot of vaccinations against human diseases are produced from soil, the essential nutrients in human diets are depleted from the soil, nearly all nutrient deficiencies on human are definitely recovered from soil, etc.

10.3 Soil Biology and Human Health

The biology of soils refers to soils encompasses a very wide range of different organisms including different species of both plants and animals. These organisms even in macro- or micro-forms give the real biological face for soils. These organisms generally have several activities in soils including the soil enzyme activities and the soil microbial activities, which called as soil biological indicators. Therefore, these soil biological indicators for evaluating the quality of soils are more recently interest and very important indicators, which could serve as early and more sensitive indicators of agro-ecosystems as a response to soil management (Bhaduri et al. 2017; Plekhanova et al. 2017). The soil organisms have a great role in both soil fertility and its quality from one side and human health from the other side (Shao et al. 2017).

In 1952, Selman Waksman was Nobel Prize Winner, and his students cultured *Streptomycin* from a soil borne microbe. He produced the first chemical that was a cure for tuberculosis, as bactericidal antibiotic and on the World

Health Organization's List of Essential Medicines as well as also as a pesticide for crops and a bactericide for animals (SSSA 2017). The impact of soils on human health generally includes (1) its role in soilborne human pathogens or diseases from soils, (2) its role in vaccinations and medicines produced from soils and (3) its role in recovering of deficiency of nutrients through the food chain. These three issues could be presented in the following sections in more details.

10.3.1 Soils and Medicine in Ancient Egypt

Nowadays, the using of soils in producing and manufacturing of different medicines, cosmetics and some personal care products is a profitable industry. This industry has several advantages and disadvantages and related to medical geology. The medical geology (or geomedicine) is a science of studying the health problems related to the place (or environment) and these studies should go well beyond simplistic comparisons of geochemical and epidemiological data (Selinus 2013). Therefore, it could use soil organisms or soil materials in isolating some antibiotics and then manufacturing some medicines. These soil medicines include antibiotics, anti-diarrheal medications, cancer drugs, emollient and drying agents, which could be used to treat poison ivy, poison oak and poison sumac cases and others (Brevik et al. 2017).

It is worth to mention that, ancient Egypt has been treated with seaweed (as a good source for iodine) in dealing with goiter disease (severe iodine deficiency) several thousand years ago. Several descriptions also of lead poisoning have been found in texts from Egyptian civilization further corroborate the heavy uses of lead. Clay tablets have been provided for lead-poisoning symptoms from the middle and late Assyrian periods (1550–600 BC) as do ancient Egyptian medical papyri and Sanskrit texts dating from over 3000 years ago. More details about the role of ancient Egyptian civilization in the history of medicine, science and technology, it could be referred to *Encyclopedia of the History of Science, Technology, and Medicine in Non-Western Cultures*, which published by Springer (Selin 2016). This encyclopedia includes several topics regarding ancient Egypt such as the medicine in ancient Egypt, meat preservation, fishing, surveying, gardens, basketry, maps and mapmaking, tombs, temples and archaeoastronomy, ship- and boatbuilding, obelisks, and origins of agriculture in Egypt. A comprehensive history of the origins of agriculture in Egypt could be found in this encyclopedia edited by Janick (2016).

Concerning the medicine in ancient Egypt, they concluded their life in this sentence "*Magic is effective together with medicine. Medicine is effective with magic*". They have been recognized these beliefs and used the prosthetic medicine for living persons as well as some mummies are outfitted with prosthetic devices. The ancient Egyptian have been achieved a great progress in medicine more than the modern progressive world nowadays especially in case of mummification. Ancient Egyptians also had advanced their physiological and anatomical knowledge. It is reported that, the known medical papyri originate beginning with the Middle Kingdom and the last we hear about are mentioned by Clement of Alexandria (second half of the second century AD). He knew about six Egyptian handbooks devoted to specific aspects of medicine such as illnesses, anatomy, surgical instruments, drugs, eye diseases and gynaecology (Győry 2016).

Therefore, it is well stated that, ancient Egypt would be the preferred place if anyone had to be ill in antiquity due to their medications were mainly empirical and aimed at the relief of symptoms. The medical knowledge of the physicians in ancient Egypt was without equal at that time; their formal, structured and logical approach to the patient is unchanged in modern medicine; and their techniques and treatments are often comparable to today's medical profession. About 300 diseases are mentioned in ancient Egyptian texts (Győry 2016). The soils have a lot of roles in medicine in ancient Egypt as painted in many walls of temples. These roles are still in concern in modern Egypt but needs more management and protection.

10.3.2 Soils and Human Diseases

The complete physical, mental and social state of human is defined as the health. This health of humans has been linked directly and/or indirectly with soils (Brevik and Sauer 2015). It is reported that, soils have some important roles on human health including disposal of wastes, food availability with high quality, human diseases from contacting with some chemicals and/or harmful microorganisms in soils, and production of some medicines manufacturing from soils (Brevik et al. 2017). Therefore, several studies have been published about the effects of soils on the health of humans through the exposure of humans to radioactive elements (Wang et al. 2017) or some chemicals like heavy metals in soils (Zhang et al. 2017) or exposure to some microbial pathogens in soils (Brevik et al. 2017), and others. It is worth to mention that, soil are teeming with life as well as being a home for a huge array of living organisms mainly microorganisms. The most common soil-dwelling microbes pathogenic for humans include bacteria, fungi, protozoa and viruses, both of which require a plant or animal host for their survival. These microorganisms could be found in different environments including salt and fresh water, all soils, different climatic zones, in deep-sea hydrothermal vents, throughout the atmosphere and deep below the surface of the Earth in oil wells (Vimal et al. 2017).

It is well known that, some elements have the ability to emit radiations (like alpha, beta and gamma rays) due to the radioactive behavior of a nuclide (e.g., $^{89-90}Sr$, ^{131}I, ^{140}Ba, ^{137}Cs). A lot of modifications will cause in cells and/or death of cells, when human or plant cells interact with these radiations. Under high radiation level, several problems could be created such as nausea, diarrhoea, vomiting, leukaemia, etc. The relative effect of different radionuclides depends on management practices such as fertilization and its types, organic matter application and cultivation method (Bharti et al. 2017). These radionuclides could be resulted from the soil, fertilizer application, nanoparticles or nanomaterial application, pollution with radiation, nuclear medicine, etc. Therefore, the universe faces nowadays the over-use of nanomaterials in almost all fields in our life, which may allow to the radioactive of some elements like gold and its nanotechnology to destroy the human health (Jain 2017).

Concerning the soil biology and human diseases in Egypt, it is reported that, several helminthes have the ability to transmit into the soils of Egypt (Farghly et al. 2016). Soils could be considered, as well known, an important source for several infections such as protozoal, bacterial and helminthic ones. Many parasites also could be transmitted through soils as well as several parasitic infective stages and their development. Indeed, soil could transmit different protozoal cysts such as *Entamoeba histolytica*, *Balantidium coli* and *Giardia lamblia* (Farghly et al. 2016). In Egypt, the spread of parasites through soils is a little bit common and different parasites could transmit through soils (e.g., Etewa et al. 2016; Farghly et al. 2016) and waters (e.g., Elbana et al. 2017a, b). The most vulnerable Egyptian groups could host or infect with the large numbers of intestinal worms include school-aged children and preschool children. Further studies with holistic survey are needed to know exactly the current situation in Egypt about the most common soil-borne human pathogens as well as the role of soils in qualitative and quantitative spread of these pathogens.

10.3.3 Soils, Deficiency of Nutrients and Human Health

Human must consume a variety of foods in modest quantities to protect his body from mineral nutrient deficiencies as well as these foods should include low fat dairy, different whole grains and proper quantities of vegetables, fruits and meats. Concerning the macro-mineral nutrients like potassium and phosphorus, human is required them in amounts of up to 10 g d^{-1}. Regarding the daily requirement of secondary and micro-mineral nutrients, they will be requested by humans in ranges from 400 to 1 500 mg d^{-1} and 45 µg d^{-1} to 11 mg d^{-1}, respectively (Gupta and Gupta 2014). Therefore, an increase in published investigations has been recorded day by day regarding the interrelations between essential metal ions and human diseases (Cakmak et al. 2017; Davison 2017; Liu et al. 2017; Marles 2017; Palzer 2017).

It is well documented that, mineral nutrients are the main key and the essential engine for many functions in the human body. That means, mineral nutrients are required for many biological processes in human in very particular amounts and a specific minerals. For example, there are no vitamins could be absorbed by human or can carry out its intended function without their specific mineral nutrients (Gupta and Gupta 2014). Therefore, many ways should be followed to increase the level of these mineral nutrients in human diets like the biofortification approach. This biofortification is considered one of the most important strategies in supporting humans with enough and essential mineral nutrients such as copper, iodine, iron, selenium, zinc, etc. This approach has been already used in enriching some strategic crops with these previous mineral nutrients such as wheat, rice, maize, sweet potato, etc. Several books (e.g., de Pee et al. 2017; Field et al. 2017; Rakshit et al. 2017; Pearce 2017; Pilon-Smits et al. 2017; Zhao 2017) and other publications have been issued this year focusing on the human health and soil mineral nutrients (e.g., dos Reis et al. 2017; Kim et al. 2017; Bharti et al. 2017).

Therefore, it could be listed some common human diseases related to deficiency of mineral nutrients or some trace elements as follows (Davison 2017):

(1) **Calcium**: Ca-functions in human include bone and tooth structure, nerve transmission, muscle contraction, blood clotting, blood pressure regulation, hormone secretion. Ca-deficiency cause bone loss disease or osteoporosis.
(2) **Copper**: Cu-functions include its role in lipid metabolism, iron absorption, collagen synthesis, antioxidant protection, nerve and immune function. Cu-deficiency cause anemia, poor growth and bone abnormalities.
(3) **Iron**: Fe-functions include part of hemoglobin, electron carriers in electron transport chain and immune function. Fe-deficiency causes anemia, pale red blood cells, low hemoglobin, weakness and reduced immunity.
(4) **Magnesium**: Mg-functions include ATP stabilization, bone structure, enzyme activity, nerve and muscle function. Mg-deficiency cause vomiting, nausea, weakness, confusion, muscle pain and depressed pancreatic hormone secretion.

(5) **Phosphorus**: P-functions include acid–base balance, structure of bones, teeth, membranes, ATP, DNA. P-deficiency causes bone loss, weakness.
(6) **Potassium**: K-functions include fluid balance, protein synthesis, nerve transmission and muscle contraction. K-deficiency cause muscle weakness, paralysis, confusion, can cause death and accompanies dehydration.
(7) **Sodium**: Na-functions include fluid and acid–base balance and nerve impulse transmission. Na-deficiency cause mental apathy, muscle cramps and loss of appetite.
(8) **Zinc**: Zn-functions include regulation protein synthesis, growth development, antioxidant protection, wound healing, immunity, vitamin A transport and making sperm. Zn-deficiency includes poor growth and development, skin rashes, decreased immune function, loss of taste and poor wound healing.
(9) **Fluoride**: F-functions include formation of bones and teeth; resistance to tooth decay. F-deficiency causes susceptibility to tooth decay.
(10) **Chromium**: Cr-functions include its association with glucose metabolism and enhancing insulin action. Cr-deficiency causes abnormal glucose metabolism and high blood glucose.
(11) **Iodine**: I-functions include its need for synthesis of thyroid hormones and cellular energy. I-deficiency causes goiter disease, intellectual disability, growth and developmental abnormalities.
(12) **Selenium**: Se-functions include its role in fat metabolism, spares vitamin E, synthesis of thyroid hormones and it is an antioxidant as part of glutathione peroxidase. Se-deficiency causes muscle pain, weakness or Keshan disease.

Regarding the health care system in Egypt, it is quite complex. It is involved with a large number of public entities in financing, the management and provision of care. The public health expenditure is low and has pluralistic and complex financing mechanisms including health insurance, tax-based financing and fee for service through out-of-pocket expenditures. It is estimated that Egypt produces more than 90% of the pharmaceuticals consumed and pharmaceuticals account for more one-third of all health spending, which around 85% is private expenditure (Elshamy 2016). In the Nile Delta, the diseases of both liver and kidney have been recorded the highest number of patients and ranking worldwide. Several studies have been proved these figures and confirmed that about 38% of all newly diagnosed cancer cases recorded in Egypt (e.g., Elshamy 2016; Bogan et al. 2017). Studies also suggested that, cancer is an increasing problem in Egypt recording for liver (23.8%), breast (15.4%) and bladder (6.9%) for both sexes (Elshamy 2016). There is also some evidence suggesting a positive association between particular pesticides and liver cancer or hepatocellular carcinoma (VoPham et al. 2017). Concerning the prevalence of the hepatitis C virus (HCV) worldwide, it is recorded by 2.8%, whereas Egypt has the highest HCV prevalence in the world with 14.7% (Youssef et al. 2017). Serious fungal infections also have been reported in Egypt (Zaki and Denning 2017). Egypt also is considered an endemic country according to several European reports as well as other outbreaks. It is estimated that hepatitis A virus (HAV) has a high prevalence and circulating in Egypt (Hamza et al. 2017a). This virus is transmitted primarily by the ingestion of contaminated food or water, the fecal-oral route, person-to person contact, or on rare occasions transmission via blood has also been also reported (Hamza et al. 2017b).

Therefore, great challenges face Egypt in frame of the safety and protection of health for the Egyptian people. This urgently needs an effective system in health insurance to include all Egyptian citizens with supporting the nursery, doctors and patients. Health care systems should be strengthened focusing on patient centered care to optimize outcomes for patients. Making real improvements in health management will require the proactive efforts of many organizations with stress on education as a cornerstone to improve health care in general and pain relief and palliative care specifically.

10.4 Soil Health and Its Biology Towards Sustainable Agriculture

In the near future, the world will face great and serious challenges regarding issues of climate changes, food security, energy security, freshwater scarcity, and biodiversity losses. Therefore, the UN has been published a fascinating perspective for soil science called the sustainable development goals. These goals included the major soil-related environmental issues, which are presented in a societal context and soil expertise are needed to reach these goals. These goals also covered many soil functions such as food production, water availability, climate change, biodiversity losses and energy, which are covered in goal no. 2, l, 13, 15 and 7, respectively.

The soil health or quality is a measure of the ability of soil to fulfill its requirements for plant growth and/or human health. In other words, soil health is the ability of soils in providing social and ecosystem with proper and enough services through its capacities to perform its functions under different changing conditions. Soil quality also is the capacity of soil to fulfill its functions including management of ecosystem boundaries, sustaining the plant and animal productivity, maintaining or enhancing both water and air quality and supporting both human health and its habitation. Therefore, the quality of soils reflects how soils perform their functions including the maintenance of soil biodiversity and its productivity, filtering and buffering, partitioning water and solute flow, cycling of nutrients and providing support for plants and other structures (Shivlata and Satyanarayana 2017).

The health or quality of soils may be declined under many soil practices such as excessive use of chemicals like fertilizers or pesticides, intensive cropping system, pollution with different sources and its forms, reducing the recycling of organics and other waste generated from the farm, etc (Bharti et al. 2017). It is worth to mention that, soil quality has several indicators including physical, chemical and biological indicators. Regarding soil physical indicators, they are very important in determining the characteristics and micro-habitat utilization. These soil physical indicators for example include permeability, porosity, texture, water-holding capacity and temperature. Therefore, all of these aspects of the soil environment are important for crop production and thereby for human health through the supply of nutritious and adequate crop products (Shivlata and Satyanarayana 2017).

Concerning soil health and its biology towards sustainable agriculture, many studies have been published focusing on this relationship including the following issues:

(1) Role of soils in biodegradation of plastics in frame the sustainable modern agriculture.
(2) Role of soil health, soil biology, soilborne diseases in sustainable agriculture (e.g., Hüberli 2017).
(3) Different adaptive practices in soil management such as digital soil mapping for best management of soil resources, adaptive remote sensing approach in supporting of precision agriculture, site-specific nutrient management approach in maintaining soil health, technological conservation of soil resources using sustainable soil health management, changes in soil–plant–microbes interactions under climatic change conditions, etc. (Rakshit et al. 2017).
(4) The role of biofertilizers microbial inoculants in soil quality and plant health (e.g., Alori et al. 2017).
(5) Sustainable management of salt-affected soils using nanotechnology and more (e.g., Sharma and Singh 2017).
(6) Different approaches for sustainable agriculture through plant-microbe interaction (e.g., Choudhary et al. 2016).
(7) Study of soil pollution as an emerging threat to agriculture and its effects on soil and crop quality as well as soil fertility (Saha et al. 2017).

In Egypt, almost all soil studies have been involved the soil health and different management practices. These studies generally include physical, chemical and biological soil properties and different effects of soil management practices on these soil properties as soil quality indicators. These investigations included sustainable agriculture and climate changes in Egypt (e.g., El-Ramady et al. 2013; Froehlich and Al-Saidi 2017), sustainable irrigation management and conservation of soil and water (e.g., Elbana et al. 2017a, b), sustainable land use management using GIS and remote sensing (e.g., Kamel and Abu El Ella 2016; Elbasiouny et al. 2017a), effects of irrigated agriculture in Egypt on soils in past, present and future (e.g., Satoh and Aboulroos 2017), the sustainable management for the soils of Nile Delta as well as the remediation of agricultural drainage water for sustainable reuse (e.g., Fleifle and Allam 2017), management of salt-affected soils in the Nile Delta (Mohamed 2017b), the expected degradation of some Egyptian soils after the construction of Aswan High Dam (Khalifa and Moussa 2017), etc. It could mention some examples for some investigations carried out under Egyptian conditions:

(1) The effects of recommended soil fertilization as an important factor controlling the biology of soil and its health such as the study of recommended soil NPK fertilization and selenite foliar application (up to 20 mg kg^{-1}) on spinach plants significantly increased the yield, Se accumulation in leaves as well as the activity of nitrate reductase enzyme under soil salinity and acidity or pH to 3.89 dS m^{-1} and 7.67, respectively (Fouda 2016).
(2) Distribution of nutrients in soils is totally controlled by soil properties and its climatic and pedogenic properties like a clear relation in field study in different Egyptian areas (i.e., Matrouh, El-Arish, El-Hesynia Plain, El-Tina Plain, El-Mansoura, El-Gabal EL-Asfar, El-Fayoum and Toshki). The obtained correlation between indigenous soil parameters and these nutrients (e.g., selenium) showed that soil parameters including clay content, cation exchange capacity, soil pH and sulfur content are the domain factors (Abd El-Razik et al. 2013; Table 10.1).
(3) A comparison between organic and conventional farming systems has been evaluated using soil quality indicators (e.g., chemical and fertility). It was found that, available N, P, K, Fe, and Mn, soil organic carbon, total N, and CEC were significantly higher in the organic farming system comparing with the conventional system. The results also showed that, the soil nutritional status in organic farming was significantly better than the conventional system regardless the periods of farming practice (Ahmed et al. 2015).

Table 10.1 Soil characterization of surface layer (0–30 cm) of coastal, middle Delta and new reclaimed areas of Egypt as well as their parent materials for different lacations

Parent material	Soil texture	pH (1:2.5)	EC (dS m^{-1})	$CaCO_3$ (%)	OM (g kg^{-1})	CEC (cmol kg^{-1})	Available Se (mg kg^{-1})
Matrouh (Mediterranean coastal region)							
Alluvial deposits	Silty loam	7.69	10.33	78.94	3.5	15.67	0.13
El-Arish (Mediterranean coastal region)							
Alluvial deposits	Silty loam	7.87	2.71	4.36	3.9	8.80	0.13
El-Mansoura (a middle Delta region)							
Alluvial deposits	Clay loam	7.78	2.17	4.33	3.7	8.08	0.27
Tina Plain (a new reclaimed area)							
Fluvio marine deposits	Silty loam	7.89	10.25	76.95	3.7	17.77	0.36
El-Hesynia Plain (a new reclaimed area)							
Alluvial deposits	Silty loam	7.88	2.37	4.53	3.7	8.08	0.36
Qaroun Lake (El-Fayoum region)							
Fluvio lacustrine deposits	Clay loam	7.99	27.27	20.08	10.9	23.82	0.49
Kom Oshim (El-Fayoum region)							
Fluvio lacustrine deposits	Sandy clay loam	7.86	20.80	5.70	15.4	23.7	0.32
Toshki region (uncultivated soils)							
Alluvial deposits	Sandy loam	7.85	15.32	1.94	2.4	11.76	0.19
Toshki region (cultivated soils)							
Alluvial deposits	Sandy loam	7.78	1.03	3.55	3.2	4.33	0.41
EL-Gabal EL-Asfar area (normal soil without irrigation with sewage effluent)							
Aeolian deposits	Sandy	8.77	3.31	3.89	0.9	2.41	Nil
EL-Gabal EL-Asfar area (Soil irrigated for 15 years with sewage effluent)							
Aeolian deposits	Sandy clay loam	6.58	9.17	3.00	37.9	4.85	Nil
EL-Gabal EL-Asfar area (Soil irrigated for 100 years with sewage effluent)							
Aeolian deposits	Sandy clay loam	6.08	14.16	1.57	61.5	8.76	0.03

Adapted from Abd El-Razik et al. (2013)
Abbreviations Soil EC = soil salinity, CEC = cation exchange capacity, OM = organic matter

(4) Study the effects of silicon foliar application and biofertilization (*Azotobacter chroococcum* and *Bacillus megatherium*) on productivity of some crops like sunflower (*Helianthus annuus* L.) under New Valley conditions. It was found that, the microbial activity in rhizosphere and some enzymatic activities (dehydrogenase, nitrogenase and phosphatase) have a positive response in all treatments comparing with control (Abd El-Gwad and Salem 2013).
(5) Survey of several locations, monitoring of soil fertility, land use change and sprawl urban using Remote Sensing and GIS using and measuring the change in soil parameters (e.g., Elbasiouny et al. 2017b; Ibrahim et al. 2017).
(6) Effects of different organic acids (i.e., tartaric, salicylic, oxalic, humic and fulvic acid) on nutrients availability from natural alternative fertilizers (e.g., rock phosphate and feldspar). The results confirmed that rock phosphate and feldspar as alternative fertilizers under acidulation with different previous acids could enhance release of available nutrients (e.g., N, P and K) improving some soil chemical properties reflecting on the soil productivity (Seddik et al. 2016).
(7) The soil biology and its health in Egypt suffer from different sources of pollution like pollutants resulting from automobile exhausts. These exhausts are source for airborne pollutants, which precipitate on soils

surrounding highways (e.g., Cairo-Alexandria agricultural highway) causing serious ecological hazards). The results revealed that the investigated soils were contaminated with some potentially toxic elements such as Pb, Ni and Cd (Hashim et al. 2017).

(8) Abiotic stresses including salinity of soil or water and/or drought have a serious impact on soil biology in Egypt. Several studies confirmed that these stresses represent a real threat for the health of Egyptian soils (e.g., Abdel-Aziz and Sadik 2017; Nossier et al. 2017; Mousa 2017).

(9) Soil erosion could consider a serious problem in Egypt including different kinds of erosion (e.g., chemical, water and wind erosion) as presented in many studies (e.g., El-Nady and Shoman 2017).

(10) The competition between energy and food crops under conventional and stress conditions will influence and effect on the health of Egyptian soils (e.g., Hokam and Abo El-Soud 2017).

(11) The using of municipal wastewater in agriculture may change some soil properties or effects on soil health playing an important role in the availability of nutrients present in the applied wastewater (e.g., Elgharably and Mohamed 2016; Farrag et al. 2017; Elbana et al. 2017a, b).

(12) The intensive use of agro-chemicals including pesticides (e.g., El-Kady et al. 2017), mineral fertilizers (e.g., Negm and Eltarabily 2017) and nanomaterials (e.g., Belal and El-Ramady 2016; Shalaby et al. 2016) may influence on soil biology and aquatic ecosystem in Egypt.

(13) Impact of soil or land degradation on soil biology has been involved in many investigations in Egypt. Land degradation could be resulted from many processes such as seawater rise, soil sodicity, salinization, deterioration of soil structure, urban sprawl, land compaction and nutrient depletion as well as water logging (e.g., Rashed 2016; Kotb et al. 2017; Mohamed 2017a).

(14) Modern agricultural management should be handled to overcome the conservation the biology of soil such as precision farming (e.g., Saleh et al. 2017b), nanotechnology (e.g., El-Ramady et al. 2017a, b) and magnetization of irrigated water (e.g., Amer 2016; Alsaeedi et al. 2017; Fanous et al. 2017; Abd-Elrahman and Shalaby 2017).

(15) The main cause for depleting natural resources in arid lands is desertification. This desertification process also is considered the major environmental threat affecting the soil biology of about 40% of the world dry lands. Several applications of satellite or GIS and remote sensing have been documented in monitoring desertification in arid lands (e.g., Mohamed 2013; Saleh et al. 2017a).

It could be concluded that, there is no sustainable agriculture without conservation of soil health and its biology. The health of soil and its biology mainly depends on soil characterization as well as climatic and environmental conditions. The biology and health of Egyptian soils need more concern and further studies and these studies should be linked to the human health.

10.5 Conclusion

No doubt that, formidable challenges face the universe regarding the security and safety of foods including the scarcity of freshwater, the degradation of lands and climate changes. These challenges or problems will be aggravated in the future according to the available evidences. The current food production and its distribution systems could not be able to ensure the global food and its nutritional requirements. Therefore, the agricultural production must be increased and should be produced from existing agricultural lands as well as the marginal or abandoned lands using non-conventional and stable crops. Indeed, the properties of soil (i.e., physical, chemical and biological ones) are main factor controlling the productivity of these soils. Thus, soil biology and its fertility have a close relationship with nutrition of plants and humans. Therefore, new challenges should be considered regarding the feeding of soils in order to feed the humans and soil quality and its biology will be included within these challenges towards sustainable agriculture.

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