Stories from the Global Call on Agricultural Innovation

Soil pollution management in vegetable fields in the Eastern Nile Delta

Ehab Awad-Allah Ibrahim Ibrahim
Horticulture Research Institute, Agricultural Research Center

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Funded by the European Union

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ABSTRACT

Soil pollution in Egypt, particularly in the eastern Nile Delta, is caused by excessive use of mineral fertilizers, pesticides, and the discharge of domestic wastewater into agricultural irrigation systems. This leads to the accumulation of heavy metals and pollutants in the soil, affecting crop yields and posing risks to human health. Soil pollution not only endangers health and the environment but also reduces food security and causes economic losses.

The project aims to provide farmers, researchers, and agricultural officials with new knowledge and techniques for managing soil pollution in vegetable production. It focuses on sustainable soil remediation technologies and improving soil quality through research, extension programs, and better agrochemical management.

The action plan includes surveying vegetable-producing areas, identifying pollution sources, assessing current practices, and promoting soil remediation techniques. This initiative will enhance vegetable productivity and promote sustainable soil use while ensuring economic, social, and environmental sustainability in Egypt.

TAPipedia Tags

irrigation system, crop yield, sustainable agriculture, agrochemicals, food security

Other keywords

Soil health, Vegetable production, Building capacity, Biochar, Adaptation strategy

Context

There are interactions between soil contamination and climate change. Soil health changes can either speed up or slow down climate change, which has a significant impact on soil. The negative consequences of soil contamination on ecosystem productivity and sustainability, biodiversity, agriculture and food security, and clean ground and surface water may make it more difficult to achieve Sustainable Development Goals. Soils can adapt to climate change and help us deal with its effects if they are properly maintained. Significant carbon is absorbed by soils, which helps to moderate climate change. Soil pollution is one of the largest issues facing the world right now. The physical and chemical properties of the soil are affected by soil pollution. Agricultural soil pollution takes place due to use excessive amounts of mineral fertilizers and pesticides that are unnecessarily applied without any guidelines to increase vegetable yield in Egypt, especially in the eastern part of the Nile Delta. Moreover, discharging of domestic wastewater in rural areas to drains are reused in agricultural irrigation in this region. These promote the accumulation of heavy metals and other pollutants in soils, and consequently in the plants grown in such soils, thereby, posing a risk to human health. Moreover, soil pollution reduces food security by both reducing crop yields due to toxic levels of contaminants and by causing crops produced from polluted soils to be unsafe for consumption by animals and humans. Therefore, in addition to endangering human health and the environment, soil pollution can also cause economic losses.

Soil health changes can ether speed up or slow down climate change

Through this project, an innovative approach in research and extension and outreach programs that help vegetable growers to improve the quality of soil and productivity and control of the agrochemicals applications was conducted. The action plan depended on: 1. Samples of soil, water, and crops were analyzed for the total contents of heavy metals and pesticide residues to determine the characteristics of contaminants and identify their sources in the soil over the Eastern Nile Delta region.

2. A survey was conducted to evaluate the current situation, assess soil pollution management in the project pilot areas, and draw conclusions from the survey results. 3. The pilot farms and formulation of the adaptation strategy were selected and established to develop and provide knowledge and information about soil pollution management at the farm level to increase pesticides, water, and nutrient-use efficiency while maintaining or increasing yields and protecting the environment in the cultivation of vegetable crops.

4. Produce and characterize biochar produced from biomass locally available. Field performance experiments were established and the testing activity was concentrated on evaluating biochar applications for remediation of contaminated soils.

5. Building the adaptive capacity of the farming community by continuous learning, adaptive management, and stakeholder engagement to translate research findings into practical, science-based management tools and policy recommendations.

Challenges addressed

- *Population and development dynamics, food and nutrition security, sustainable diets*
- *Climate change and disaster risks*

Key Problems

- The fast increase in soil pollution in Egypt has become a real threat to crop productivity, people's health, and food security. Howover, there is a shortage of soil pollution monitoring in Egypt.

- Vegetable productivity is hampered by climate change and unsustainable farming methods, which endangers the production of sustainable food. The intensified vegetable production to supply growing markets forces farmers to adopt short-term solutions that exacerbate the problem of degrading the agro-ecosystem by no replenishing soil organic matter adequately and soil over fertilization; leading to low efficiency in the nutrient and irrigation water use, and falling yields and soil degradation.

- More information and capacity-building activities at the local community and national levels are needed to spread the knowledge about the benefits of healthy and fertile soil to raise awareness of soil health and to improve the economic situation of all beneficiaries at different scales in the Nile Delta.

- Egyptian soil tends to be low in organic matter which reduces soil fertility status and nutrient availability. There are six types of degradation that characterize the Nile Delta: salinization, alkalization, soil compaction, waterlogging, and erosion of water and wind.

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INNOVATIVE SOLUTIONS

- Conduct soil pollution prevention management and remediation to improve regional soil environment quality.
- Integrated nutrient management is also a practice that has significantly shown impacts by decreasing the chemical application through a combination of inorganic and organic fertilizers either with or without bio-fertilizers that could minimize the nutrient applications and then lessen their nutrient requirements, and reduce food contamination.
- Implementation of IPM techniques to manage diseases and pests in a sustainable manner. This makes agroecosystems more ecologically balanced and rely less on chemical pesticides.
- Developing and providing innovative technological solutions based on biochar to improve soil health, prevent the continued unsustainable use of soils, and reduce chemical inputs and protect natural resources. Also, the application of biochar in soils may provide a new solution to the soil pollution problem, and increase and sequester carbon in the soil.
- Building the adaptive capacity of the farming community to translate these innovative approaches into practice to increase productivity and protect natural resources, through increased awareness about the techniques that make it possible to conserve vegetable soil and its health as well as water and nutrients, in the context of sustainable agriculture.

- Effective soil pollution management was enacted in target areas, which boosts Egyptian farmers' competitiveness, as one of the direct benefits is an increase in net earnings.
- The project has increased awareness among farmers about the importance of soil pollution management, leading to greater understanding of soil fertility and its impact on production and long-term farm sustainability.
- Produce the new biochars from biomass locally available that remediate the contaminated soils.
- The project results became public via publications, courses, and seminars at the national level, serving a larger audience.
- Through the extension activities, the ultimate beneficiaries were the small-scale farmers and the training of extension personnel.
- The results of the project were covered in scientific publications and reports at scientific conferences and international journal articles.
- Farmers were provided the tools to implement sustainable soil management practices that require fewer agrochemical inputs while maintaining or increasing yields and protecting the environment.
- The study provided valuable data for the evaluation of soil pollution in vegetable systems, which could help make decisions for good agriculture practices. 9) The introduction of technology solutions has boosted agricultural productivity and raised crop yields, giving farmers access to economic stability and ensuring food security.
- The implementation of innovative practices has improved resource efficiency and reduced environmental impact. Sustainable soil management practices have optimized water and nutrient usage, minimized chemical inputs, and conserved soil health, leading to environmental protection and sustainable resource management.
- Enhanced soil biodiversity and its ability to capture and store atmospheric carbon.
- The project aimed to improve the skills of extension workers and farmers in vegetable cultivation and soil pollution reduction, conducting 38 seminars for 2,380 trainees, 4 training courses for 115 trainees, and 45 workshops for 950 trainees.
- Many farmer field schools were conducted to encourage vegetable farmers to increase the use of integrated soil fertility management plans and integrated pest management plans.

Factors for Success

- Many innovative technologies and practices have low costs, making them highly accessible to smallholder farmers.
- Localization and customization of technologies based on local needs and conditions by participatory approaches that involved farmers in the design and adaptation of technologies ensured their applicability and adoption. A more successful implementation is made possible by taking into account variables including the climate, soil type, agricultural patterns, and socioeconomic conditions.
- Readily available raw materials for making biochar.
- The innovations were built on knowledge co-creation, fusing science with farmers' traditional, practical, and local expertise, and enhancing the farmer's autonomy and capacity for adaptation making him the primary change agent.
- Collaborations between research institutions universities, and extension services helped address the technical knowledge gaps and limited technical skills of farmers through programs to build farmer capacity, farmer field schools, and extension services.

CRITICAL CAPACITIES

- Identification of activities that have the potential to contaminate soils in vegetable fields.
- Development and providing of knowledge and information about soil pollution management at the farm level to increase pesticides, water and nutrient use efficiency while maintaining or increasing yields and protecting the environment in the cultivation of vegetable crops.
- Collaboration with a range of vegetable farmers interested in soil pollution management adaptation strategies to ensure that research findings are appropriate for adoption.
- Evaluation of the effectiveness of the cultivation practices in enhancing the prevention and reduction of soil pollution and vegetables' productivity through the application on the field and monitoring.
- Provide growers, crop consultants, farm advisors, fertilizer producers, regulators, and other stakeholder groups with clear and objective information regarding the use of biochar to increase soil fertility, add value to crop wastes, and enhance the soil's ability to store atmospheric carbon.
- Applying sustainable technology for soil remediation at polluted sites. Farmers were provided the cost-effective solutions to implement sustainable soil management practices. The results were covered in five scientific publications.

CHALLENGES ENCOUNTERED

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- Farmers' reluctance to cooperate with project activities. The adoption of sustainable technologies is hampered by sociocultural factors such as resistance to change and traditional practices. The project included the following strategies to address this issue: (I) cooperative leader farmers assisted in spreading awareness about the advantages of managing soil pollution, and (II) raised awareness of the project among target groups as well as its objectives through cooperation with agricultural extension officers.

- There was a host of specific COVID-19-related challenges in the project's progress: supplier delivery issues, worker absenteeism due to illness, delayed issuance of permits, travel restrictions, and lost time or inefficiencies due to the need to practice social distancing on the job site caused delay of schedule. The action that was taken is proactively developing a mitigation plan for potential slowdowns and shutdowns.

LESSONS LEARNED

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- Governments and organizations must take proactive steps to develop food production and soil management strategies that can better mitigate the effects of climate change on food security. These initiatives ought to involve training local farmers in sustainable agricultural methods. Technology can be improved and refined over time thanks to shared information and ongoing learning.

- Establishing thorough monitoring and evaluation methodologies for crop production technologies and soil health is essential for monitoring progress, assessing the effects of technologies, and identifying areas for improvement. Regular monitoring helps to identify issues, fill in gaps, and make the necessary modifications in order to guarantee the efficacy and efficiency of actions.

- Farmers' adoption of crop system technology may be hampered by a lack of knowledge and comprehension. To meet this issue, farmers must be informed about the possible advantages and risks associated with new technologies through effective communication and awareness initiatives.

- The lessons learned from case studies in Egypt can be used by other countries with similar issues to develop and apply environmentally friendly innovations and technology that promote food security, climate resilience, and sustainable development.

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Contact information

Prof. Ehab Awad-Allah Ibrahim
Horticulture Research Institute, 9 Cairo University St., Orman, Giza, Egypt
E-mail: e_ebraheem@yahoo.com
Mobile: +201225103883

Links to additional materials

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Acknowledgements

Farming community: Farmers as principal beneficiaries are interested in effective integrated and sustainable solutions for optimal water, nutrient, and pesticide supply and reducing soil pollution while maintaining profitable crop production activities.

Research community: Researchers and scientists from institutes and academia (vegetable experts, soil scientists, and other environmental scientists, engineers, social scientists, and outreach experts).

Private sector and agribusinesses: Triggering the industrial sector's active involvement is one of the project's key goals. It is interested in gaining access to the materials, protocols, and methods issued from the research and innovation activities for further development, utilization, and commercialization.

Government agencies: The project collaborated with agricultural extension services such as Central Administration for Agricultural Extension Services and agriculture directorates.

THE TROPICAL AGRICULTURE PLATFORM

The Tropical Agriculture Platform (TAP) is a G-20 initiative launched in 2012 to promote agricultural innovation in the tropics. TAP has formed a coalition of more than 50 partners, led by the Food and Agriculture Organization of the United Nations (FAO) and generously supported by the European Union (EU). The main goal of TAP is to strengthen agricultural innovation systems (AIS) in developing countries through coordinated multi-stakeholder interventions.

CONTACTS

Tropical Agriculture Platform (TAP) Secretariat,
Office of Innovation
Food and Agriculture Organization of the United Nations
Rome, Italy
tropagplatform@fao.org

MORE INFORMATION

www.fao.org/in-action/tropical-agriculture-platform
www.fao.org/in-action/tap-ais
TropicalAgriculturePlatform
@TAP_G20

Global Call for Agrifood System Innovations and Stories of Capacity Development for Innovation

This publication was developed in the framework of the TAPipedia Call for innovation stories in agricultural innovation under the context of the TAP-AIS project (2019-2024), funded by the European Union, and implemented by the Food and Agriculture Organization of the United Nations. The information contained within this publication was collected through a global call for submissions of innovation stories in agricultural innovation. However, all information, responsibility, and final rights are solely those of the Author(s).