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Smart Agricultural Approach and Good Agricultural Practices in Sustainable Development Goal

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Abstract

Environmentally sustainable development and agricultute strive to integrate ecological practices into life, fostering a culture of environmental responsibility among people. In these sustainable cities efforts are made to reduce the ecological footprint by implementing energy-efficient technologies, waste reduction strategies, eco friendy production of agricultural products and green agriculture applications. Renewable energy sources, such as solar panels and wind turbines, are often incorporated to meet energy needs while minimizing the impact on the environment. Biodiversity conservation is another focus area, with green spaces, native plantings, and wildlife-friendly landscaping contributing to the overall ecological balance. Sustainable development and construction practices are aiming to achieve energy efficiency and minimize resource consumption. Green agricultural building certifications and eco-friendly materials contribute to the creation of environmentally responsible infrastructure. In the modern era, the concept of sustainable agricultural buildings has emerged as a transformative force, leveraging technology to enhance urban living. This paradigm shift is characterized by the integration of information and communication technologies to optimize various aspects of city life, including mobility, health, safety, and productivity. The doubling of technology investments in these cities from 2018 to the present demonstrates a concerted effort to reduce costs, minimize environmental impact, and enhance internal city efficiency. As interested cities continue to join the movement, the smart cities that integrated with sustainable agriculte activities market share is anticipated to be seven times larger by 2030 compared to the present day. The ongoing technological revolution in these cities force shaping the future of urban living. This study provides examples of sustainable city applications implemented in recent years globally.

Keywords: Biodiversity, Eco friendly, Native plantings, Sustainable development

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INTRODUCTION

The rapidly increasing trend of urbanization today necessitates making cities more efficient, sustainable, and livable. In response to this need, the concept of "environmentally friendly smart cities" has emerged, aiming to significantly ease urban life by integrating various technological solutions and smart infrastructures. Environmental sustainability is a major priority in sustainable agricultural practices (Coulibaly and Diakite 2021).

The management of smart energy sources and their usage in sustainable agriculture increases energy efficiency, thereby reducing the negative impact of agricultural activities on the environment. Similarly, smart agricultural waste management optimizes waste collection and recycling processes, contributing to sustainability goals (Dudley and Alexander, 2017).

The management of agricultural structures within smart farming simplifies the daily lives of individuals (Basso and Antle, 2020). Energy-saving smart building systems support a more sustainable lifestyle in agricultural activities. Increased community engagement and communication enhance the interaction of smart buildings with their inhabitants. This transformation aims to enable agricultural regions to respond more effectively to future challenges and to provide a better quality of life for their residents (McNeill, 2019).

Smart farming practices focus on the principles of sustainability and livability, aiming to minimize environmental impact and provide a higher quality living experience for city residents. In this context, digital solutions and services are also developed to enhance citizen participation, strengthen transparency, and improve the overall well-being of the community (Ayres et al., 2001).

The key elements include sensor networks, big data analytics, the Internet of Things energy management, and digital governance. These elements enable city administrations to manage resources more effectively based on real-time data, optimize production and marketing methods, reduce energy consumption, and improve public health services.

Every day, more than 180,000 people move to live in a city. The Organisation for Economic Co-operation and Development. predicts that by 2050, the world population will reach 9 billion, with 70% living in urban centers rather than rural areas.

They use Information and Communication Technologies (ICT) and big data to manage everything effectively and sustainably, from transportation to the use of energy and water resources, public spaces, and communication with city residents. The goal is to reduce energy consumption, decrease CO_2 emissions, and enhance the well-being of the residents.

One of the sustainable development goals endorsed by the United Nations is the commitment to environmental sustainability. The most striking aspect of this commitment is the measures taken to reduce the consumption of natural resources.

There are several steps that an agricultural production region can take to adopt sustainable agriculture policies and develop its production stages with this understanding. These steps include:

Energy Efficiency and Green Energy Use: The first step in conducting sustainable agricultural activities is to ensure energy efficiency and transition to renewable energy sources. Building insulation can be improved, energy-efficient lighting systems can be installed, and agricultural machinery for irrigation, fertilization, spraying, or plowing can be utilized. For this purpose, renewable energy sources such as solar, wind, or hydroelectric power can be employed. Alongside all these practices, energy monitoring and management systems can be implemented to track energy usage and crop yield efficiently.

Sustainable Transportation: Sustainable transportation options should be encouraged for personnel engaged in agricultural activities. Opportunities such as electric tractors and vehicle charging stations, public transportation options, and support programs can be provided to minimize carbon footprint.

Agricultural Waste Management: Policies and infrastructures related to agricultural waste management processes should be established. Practices such as waste separation and recycling programs, waste reduction campaigns and trainings, and composting of organic waste should be implemented.

Green Areas and Biodiversity: Creating green areas within agricultural activities allows farmers to have closer contact with nature. Additionally, various afforestation and landscaping projects can be carried out to protect local plant species and increase biodiversity.

Sustainable Agricultural Structures: Targeting energy-efficient design and green building certifications through construction compliant with Leadership in Energy and Environmental Design and similar certifications contributes to the sustainability of agricultural structures. This includes utilizing natural light, energy-efficient building insulation, and the use of renewable, recyclable, and environmentally friendly materials.

Environmental-Friendly Farming Awareness and Education: To support efforts towards environmentally friendly sustainable agriculture, training should be provided to producer farmers, personnel in provincial agriculture directorates, and consumers on environmentally friendly integrated farming practices and sustainable agriculture topics. Awareness campaigns and events can be organized within the community to promote the adoption of these values. Sustainable agricultural practices provide a range of advantages and outcomes by focusing on environmental sustainability, energy efficiency, and public health. These outcomes include:

Energy Efficiency and Conservation in Agriculture: Energy efficiency measures in agriculture contribute to budgetary savings by reducing energy costs associated with agricultural activities. Through practices such as the use of renewable resources for more efficient production, the adoption of energy-efficient production methods, and the cultivation of more productive crops, energy savings and efficiency are achieved, thus promoting sustainable agricultural production.

Environmental Sustainability: Practices such as preserving agricultural biodiversity, managing water resources for irrigation, and reducing agricultural waste create a model for environmentally friendly sustainable development, thus preserving natural ecosystems. Additionally, the sustainable preservation of clean air and water sources, green spaces and biodiversity enhances awareness of environmentally friendly farming practices (Farley and Smith, 2020).

Community Health and Well-being: Sustainable agricultural activities support overall community health by creating a healthier living environment for agricultural producers and consumers. This, in turn, leads to cleaner air, greater biodiversity, healthy products, green spaces, and healthy agricultural structures, all of which reduce stress, improve mental health, and enhance overall well-being.

Low Carbon Footprint: Sustainable agricultural practices create positive impacts in combating climate change by reducing carbon footprint. As a result, sustainable agriculture minimizes agricultural carbon footprint through the use of renewable resources and energy efficiency in the agricultural production chain.

Education and Awareness: Developing leadership skills in sustainability by providing agricultural producers and consumers with awareness of sustainable agriculture and environmental consciousness. The development of these skills contributes to the creation of a culture of sustainability within the community, supported by various training programs and awareness efforts.

Sustainable agricultural practices include projects highlighted by various universities focusing on sustainable and environmentally friendly approaches in agriculture. Many universities in Turkey and around the world have aimed to create an environmentally friendly agricultural activity area by adopting sustainable agricultural practices. Some of the examples for these universities are; Bogazici University, Middle East Technical University, Sabanci University.

MATERIAL AND METHOD

In this study, data for 2022 regarding good agricultural practices in Turkey are presented in Table 1 and evaluated within the scope of the concept of sustainable agriculture.

Table 1. Good agricultural practices in Turkey by geographical regions (Anonymous, 2024)

GOOD AGRICULTURAL PRACTICES PRODUCTION AREAS				
REGIONS	**Provinces**	**2022**		
		Number of Producers	**Production Area (da)**	**Production Quantity (kg)**
Marmara Region	**Balıkesir**	269	89.305	105.299.104
	Bilecik	15	149	322.500
	Bursa	152	29.896	154.529.734
	Çanakkale	152	27.512	35.443.773
	Edirne	189	108.651	84.946.101
	İstanbul	12	40	757.159
	Kırklareli	18	4.878	7.433.723
	Kocaeli	3	875	5.090.006
	Sakarya	257	8.963	7.063.928
	Tekirdağ	9	2.848	7.828.307

Table 1. Good agricultural practices in Turkey by geographical regions (Anonymous, 2024) (Continued)

Marmara Region	**Yalova**	9	262	745.000
Black Sea Region	**Amasya**	38	10.149	67.653.708
	Artvin	10	91	81.700
	Düzce	169	4.786	1.456.891
	Çorum	16	2.158	6.316.844
	Bolu	1	3	555
	Bartın	1	191	152.602
	Bayburt			
	Giresun	35	735	146.051
	Kastamonu	25	281	281.202
	Gümüşhane			
	Karabük	6	33	1.185.450
	Ordu	136	7.811	1.331.431
	Sinop	4	105,517	454806,3125
	Rize			
	Samsun	96	2532,875	8601975
	Trabzon	4	129,828	10600
	Zonguldak			
	Tokat	10	892,795	4192342
Central Anatolia Region	**Aksaray**	115	13651,639	47485597
	Ankara	179	41196,3612	158849170,9
	Çankırı	11	412,135	824270
	Eskişehir	47	11647,695	60404674,2
	Karaman	40	19781,699	88592178
	Kayseri	163	38670,513	73690656,24
	Kırıkkale	17	829,736	85000
	Kırşehir	5	5023,475	34712956
	Konya	308	130220,088	759856602,9
	Nevşehir	47	11727,118	55980180,01
	Niğde	314	68018,324	295375724,1
	Yozgat	3	4374,341	17161760
	Sivas	4	979,983	6621824
Aegean Region	**Afyonkarahisar**	54	7128,86	92515935
	Aydın	232	44641,281	96816380
	Denizli	160	26486,282	49716849
	İzmir	339	41947,105	107673599
	Kütahya			
	Manisa	286	73002,524	104074762
	Muğla	273	32362,215	67859173,4
	Uşak	18	3179,808	4771502
Eastern Anatolia Region	**Elazığ**	12	862,298	844093
	Malatya	3	2294,147	10827846
	Ağrı	1	37,6	1203200
	Erzurum	13	236,52	160100
	Erzincan	9	1131,668	140259
	Hakkari			
	Ardahan	90	2858,797	571757

Table 1. Good agricultural practices in Turkey by geographical regions (Anonymous, 2024) (Continued)

Eastern Anatolia Region	**Muş**			
	Bingöl	11	95,435	5900
	Kars	23	937,089	187414
	Van	1	6,3	850000
	Tunceli			
	Bitlis	1	49,25	343000
	Iğdır	10	164,75	183697
Southeastern Anatolia Region	**Batman**			
	Şırnak			
	Diyarbakır	3	1371,466	5880542
	Adıyaman	103	16156,7974	30899662,74
	Gaziantep	841	172034,807	31315511
	Kilis	5	2001,836	840000
	Mardin			
	Siirt	19	4945,225	2451244,1
	Şanlıurfa	1.350	255393,581	27288128,68
Mediterranean Region	**Adana**	1.512	451164,3827	1680444490
	Antalya	199	29854,689	219185388,1
	Burdur	27	2117,792	20251025,43
	Hatay	255	41471,975	118818870
	Isparta	79	15088,452	112778841
	Kahramanmaraş	220	36161,216	19939250
	Mersin	495	136270,871	367264700,9
	Osmaniye	37	17665,337	59182399
TOTAL		**9.570**	**2.068.933**	**5.336.251.605**

RESULTS AND DISCUSSION

Looking at Table 1, the region with the most producers is the Mediterranean Region with 2.824 producers; on the other hand, the region with the fewest producers is the Eastern Anatolia Region with 174 producers. When evaluated in terms of production area, the region with the largest area is the Mediterranean Region with 729.795 decares; On the other hand, the region with the least production area is the Eastern Anatolia Region with 8.674 decares. Considering the total amount of products, the region that produces the most is the Mediterranean Region with approximately 2,6 million tons; on the other hand, the region with the least production is the Eastern Anatolia Region with 15.317 tons.

Pretty et al. (1996) suggest that sustainable agriculture follows these principles: (i) fully integrating natural processes such as nutrient cycling, nitrogen fixation, and predator-prey relationships; (ii) minimizing the use of external and non-renewable inputs that harm the environment or the health of farmers and consumers; (iii) involving farmers and rural communities in problem analysis, technology development, adaptation and dissemination, monitoring, and evaluation processes; ensuring more equitable access to productive resources and opportunities; (iv) making more efficient use of local knowledge, practices, and resources; integrating various natural resources and enterprises; and (v) increasing self-confidence among farmers and rural communities. Efforts by countries to increase production for better nutrition and competitiveness have led to an increase in the use of intensive inputs in agriculture. The interest in conventional agriculture, which relies on intensive input use, has persisted for many years worldwide.

However, with the emergence of environmental problems caused by conventional agriculture, the impact of chemical input use on sustainable agriculture has been debated. As a result, to mitigate the harmful effects of conventional agriculture, good agricultural practices, one of the sustainable agriculture systems, have gained importance. It should be emphasized that sustainable agriculture does not represent a return to low technology, backward, or traditional farming practices, but rather a combination of the latest innovations, which may originate from scientists, farmers, or both (Velten et al., 2015). The rural economy is not only about food production; it is also concerned with enhancing the capacity of rural people to be self-reliant and resilient in the face of change, as well as building strong rural organizations and economies (Sumberg and Giller, 2022).

Efforts to increase countries food security and competitiveness have led to an increasing use of intensive inputs in agriculture. The long-standing focus on conventional agriculture, which relies heavily on intensive input use, has persisted for many years. However, with the emergence of environmental issues associated with conventional agriculture, discussions have begun regarding the impact of chemical input use on sustainable agriculture. As a result, in order to mitigate the harmful effects of conventional agriculture, there has been a growing importance placed on good agricultural practices, which are one of the sustainable farming systems.

The inability to fully address food security and poverty issues in Turkey has delayed the emergence of environmental concerns and, consequently, the widespread adoption of good agricultural practices. In terms of the number of producers and the area under cultivation, the Southeastern Anatolia Region ranks first in implementing good agricultural practices. Considering the importance of protecting human health and the environment, it is necessary to increase farmer awareness of good agricultural practices in other provinces as well.

As a result, increasing smart agricultural approaches and good agricultural practices is vital to achieve sustainable development goals. These strategies not only increase efficiency and productivity in farming, but also support environmental sustainability, economic sustainability and social equity. This paragraph have to be in discussion section

CONCLUSIONS

Looking at current practices, it appears that agricultural policies do not aim for a fundamental shift towards strong sustainability. While sustainable agriculture creates more opportunities for developing countries, they face many challenges on the path to this goal. Governments of these developing economies need a proper and comprehensive assessment of the level of digital transformation implementations and the sustainability of the agricultural sector.

There may be additional channels, such as the effectiveness of government policies, the level of economic development, and the performance of economic complexity and digitalization, which impact sustainable agriculture to varying degrees of significance.

Smart farming technologies enable farmers to optimize resource use, reduce waste and increase crop yields. These innovations contribute significantly to food security and the resilience of agricultural systems in the face of climate change and other challenges.

Meanwhile, good agricultural practices provide a framework for sustainable agriculture that ensures the health and safety of both producers and consumers. By adhering to standards, farmers can produce quality, safe and environmentally friendly products. These practices cover a range of activities including soil management, water conservation, pest control and animal welfare, all of which are essential for sustainable agriculture.

Expanding smart farming approaches offers a holistic solution to many problems facing modern agriculture. It supports the creation of a more sustainable food system that can meet today's needs without compromising the ability of future generations to meet their own needs.

Ultimately, successful implementation of these practices requires collaboration between governments, private sector stakeholders, and the agricultural community. Policies that support innovation, education and infrastructure development are vital to facilitate the adoption of smart technologies.

By fostering an environment that encourages sustainable agricultural practices, we can take important steps towards achieving the sustainable development goals, ensuring a healthier planet and prosperous future for everyone.

Future research should consider these issues to provide more insightful lessons for economists and policymakers in designing policies that promote digital transformation and sustainable agriculture in these economies.

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