Egyptian Farmers' awareness of Nano Technology and their readiness to utilize its applications for promoting their Agricultural production and marketing activities, A case study in Giza and Menoufia Governorates

*Pro. Emad M. EL-Shafie, * Dr. Radwa M. Ata, ** Pro. Sally F. M. Allam
*Rural sociology and agricultural extension, Dept., Faculty of Agric., Cairo Univ. Egypt.
**Zoology and Agricultural Nematology Department, Faculty of Agriculture, Cairo Univ., Egypt
E-Mail : Radwa.Mohamed@agr.cu.edu.eg

Abstract

Nano Technology (NT) is one of the latest scientific innovations that have many useful applications in resolving agricultural production and marketing problems. NT facilitates and improves many processes, services, and activities needed to effectively manage the production and marketing of many crops and agricultural commodities. Egyptian Farmers' (EFs) awareness and knowledge about NT innovations, such as NT-designed devices, materials, practices, and interventions contribute to their readiness for the proper application and wise utilization of these innovations.

This study aimed to identify EFs' awareness and information about NT, to measure their readiness, and their opinions concerning the readiness of their rural community, to utilize NT-based applications to facilitate and improve their Agricultural production and marketing activities.

Data were collected from a purposive sample of 87 farmers through personal interviews. A questionnaire was designed and pretested to achieve the study objectives. Frequencies and percentages were utilized for data analysis and presentation .

The study revealed the following results:

The respondents' characteristics were as follows:

(78%) were from middle and old age categories, the majority are relatively less educated (respondents with preparatory and secondary education represent only 12.6 %, the majority have relatively high levels of experience in agriculture (around 69% have more than 30 years of experience), the majority of the respondents (around 71 %) are involved in farming animal husbandry activities, land holding varies from renting (60.9%), land ownership (31%), and share cropping (10.1% as), the cultivated summer crops include green beans (56%), fruits (21.8%), vegetables (25%), and corn (19%). Winter crops include wheat (33.3%), potato (27.9%), clover (20.7%), and cabbage (19.5 %).

This highly diversified cropping pattern, combined with e long levels of experience in agriculture, could positively impact the respondents' knowledge and farming practices, in addition to influencing the individual and community decision-making processes related to the adoption of new technologies.

Medium and high levels of readiness were found among farmers for utilizing various NT-based applications in agriculture. These high levels indicate farmers' expectations to get the advantages of increasing access to production requirements, improving marketing activities, improving veterinary vaccination and treatment of farming animals in addition to using chemical fertilizers and increasing farming net return.

Keywords: Nanotechnology, Egyptian Farmers, Agricultural production and marketing, Sustainable Development Strategy.

introduction

Egypt's food security is facing several serious challenges including the over-population problem, the ever-decreasing per capita quota of natural resources, specifically cultivable land and freshwater, in addition to the current and expected negative impacts of climate change on agricultural productivity. Consequently, coping with the latest agricultural technological innovations, such as NT and its applications, is becoming an important and urgent priority. When applied properly and timely, NT-based devices, materials, practices, and interventions have high applicability potential to upgrade and facilitate many agricultural production and marketing activities, processes, and practices.

EFs' awareness of the existence, and the meaning of NT, could significantly contribute to their readiness to utilize its applications for improving their agricultural production and marketing activities. High levels of awareness and readiness could lead to high levels of adoption of NT-based devices, materials, and products which, in turn, increase food security and improve the quality of rural life through augmenting agricultural productivity increasing

NT has considerably high applicability potential to upgrade and facilitate all agricultural inputs, processes, activities, and products. Farmers' awareness and information about NT is considered an essential step for accepting and applying its applications.

As reported by Mwangi and Kariuki (2015), agricultural technologies are seen as an important route out of poverty in most developing countries. However, the rate of adoption of these technologies has remained low in most of these countries. They reviewed several past studies on the factors influencing the adoption of agricultural technology. They concluded that the

perception of farmers towards new technology is a key precondition for adoption to occur.

According to Agussabti et al (2022), the possible future challenge for food agriculture development led to the transition from conventional to modern agricultural management using smart farming technology (SFT). Some factors detaining the use of SFT for food commodities, specifically in small farmers' communities, are global climate change, low-quality human resources of farmers, and extension workers. Small farmers generally have relatively small land, limited access to capital and farming input, and grow different kinds of commodities according to seasons.

In their study, they examined the adoption readiness in using SFT for three food commodities in Aceh Province, Indonesia, namely rice, maize, and potatoes. They concluded that the perception of farmers and extension workers, concerning the potential implementation of SFT is positive. Farmers believe that this modern procedure can: (1) reduce input costs, (2) provide better information for decision-making, (3) limit agricultural pollution, (4) improve productivity, and (5) increase farm income.

In the realm of sustainable development, the agricultural sector holds pivotal significance, exerting influence on both social and economic dimensions within any given country. Highlighting this critical role, Zein El-Din et al (2021) emphasize the need to explore the ramifications of advanced technologies, particularly nanotechnology, in agriculture. Their focus lies specifically on how nanotechnology is influencing power and farm machinery.

Recent research has investigated the transformative potential of nanomaterials as an alternative solution for enhancing the performance of agricultural equipment. This review scrutinizes the present applications and challenges researchers encounter in the nanotechnology sphere, particularly

concerning the improvement of construction materials and coatings for agricultural equipment. These applications span a wide spectrum, encompassing coatings resistant to sunlight and wear, as well as advancements in machinery components like sensors, tires, microprocessors, lubricants, coolants, and soil conditioners.

In essence, the objective is to comprehend the overarching impact of nanotechnology on the efficiency and effectiveness of agricultural equipment. As we navigate through the current landscape, it becomes clear that nanotechnology is not just a technological innovation but a vital axis for the development of the power and farm machinery sector.

Given these insights, it becomes crucial to advocate for additional research addressing challenges associated with implementing nanotechnology in agriculture. Furthermore, endeavors should be directed toward translating research outcomes into tangible projects and establishing a connection between research initiatives and potential investors.

The subsequent sections of this review delve into existing studies, concluding that while many investigations propose substantial, long-term effects of nanotechnology on the agricultural sector, its complete potential is yet to be fully realized. As the field gradually transitions from theoretical knowledge to practical application, the introduction of nanoparticles emerges as a pivotal factor in refining grains and suppressing cracks, indicating a promising trajectory toward a more advanced and sustainable agriculture industry.

As Periakaruppan et al (2023) have highlighted, nanotechnology is poised to play a crucial role in the trajectory of sustainable agriculture, offering a wide array of applications within agronomy. The evolution of the agricultural sector requires the adoption of advanced materials like Nano fertilizers, Nano fungicides, and Nano pesticides. This imperative arises

from the growing global population's dietary demands and the challenges faced by conventional farming practices, which afflict nearly one-third of crops with issues such as pest infestation, microbiological threats, natural disasters, suboptimal soil conditions, and nutrient deficiencies.

The incorporation of nanotechnology into agriculture serves as a strategic response, providing intelligent strategies for delivering nutrients, herbicides, and genetic materials. The goal is to enhance soil fertility, stress tolerance, and overall crop protection. In the agricultural context, Nanomaterials prove instrumental in promoting plant growth, elevating crop quality and quantity, and effectively managing agricultural diseases

However, Periakaruppan et al point out significant concerns regarding nanotechnology-enabled products, particularly the potential adverse effects associated with the substantial use of nanoparticles (NPs) at varying concentrations. The ongoing utilization of such Nano-enabled items, particularly in agriculture, raises the likelihood of heightened concentrations in both soil and crops, presenting potential risks.

Nanoparticle-treated crops not only show improved growth and better yield, but also better resistance to affliction by insects, pests, fungi, and weeds. NPs increase the potency of the plant, yield, and solubility, and decrease pests, insects, and weeds that grow laterally with crops, decreasing the use of chemical products. The significant interest in the utilization of nanotechnology in the agricultural field has unique and specific applications such as Nano fertilizers, Nano herbicides, Nano fungicides, Nano pesticides, and Nano insecticides to trail the products, which would increase the yield.

As reported by Harini et al (2023), agriculture serves as the primary source of food and crops, and the substantial growth in the global population has resulted in a heightened demand for agricultural products.

Concurrently, the conversion of farmland into residential areas has become more prevalent. This has led to an increased reliance on specific chemicals, particularly pesticides, to enhance crop productivity and storage. However, the excessive use of pesticides presents environmental and health risks, given their release into the environment and incorporation into the food chain

To address these challenges, routine analyses of food and agricultural products are crucial to monitor the presence of pesticide residues. Traditional pesticide detection methods are labor-intensive and necessitate highly skilled professionals. Recognizing this limitation, an alternative approach is imperative, and analytical nanotechnology emerges as a viable solution. Among the nanomaterials commonly applied for pesticide-related tasks, metals, clays, polymers, and lipids are frequently utilized

As reported by Vijayakumar et al (2022), Nanotechnology is an emerging technology in the field of food and agriculture; every individual molecule and atom can be modified or controlled by this technology. Everything that exists on the earth is made up of atoms and molecules. Problems in all fields can easily be overcome by modifying or altering their Nano size. Similarly, nanotechnology could address many issues in the agriculture and food industries. Nanomaterials play a keen role in the place of pesticides, fertilizers, and biosensors. Nutrition enhancement, safe delivery of bioactive components and micronutrients, and food preservations were facilitated by the applications of nanotechnologies. Efforts have to be taken to create awareness among the public in this nanotechnology field. Future research directions were identified in this review to improve the Nano embedded agriculture system.

They concluded that Nanotechnologies have found many applications in agriculture and food industries, such as Nano pesticides, Nano biosensors, Nano fertilizers, and Nano-embedded food packing. The production of the crops will be increased during the optimum usage of Nano fertilizers. At the same time, the productivity of the crops will be decreased in terms of improper Nano fertilizer usage.

This rapid pace of technological revolution can especially be seen in the developed world, where Nano-scale markets have taken over rapidly in the past decade. Nanotechnology is not a new concept since it has now become a general-purpose technology. Four generations of Nanomaterials have emerged on the surface and are used in interdisciplinary scientific fields; these are active and passive Nano assemblies, general Nanosystems, and small-scale molecular Nanosystems.

According to (Shiza,2023), it is pertinent to say that both the developed and developing world's scientific communities agree that nanotechnology will be the next step in technological generation. This will make further industrial upgrading and investment in the field of nanotechnology indispensable in the coming years.

Moreover, the aspect of sustainability is being introduced to convert the environment, food chains, processing industries, and production methods to save some resources for future generations. The usage of precision farming technologies based upon Nanoengineering, modern Nano-scale fertilizers, and pesticides are of great importance in this regard.

Nanotechnology employs two main construction strategies known as "top-down" and "bottom-up." In the realm of commercial production, the prevalent approach is the "top-down" method, which involves diminishing the size of materials through processes like grinding, nanolithography, or

precision engineering to craft nanostructures, as elucidated by Lopes Cruz (2021).

While the utilization of nanotechnology dates back to the twentieth century, recent progress in Nano processes has gained global recognition, as highlighted by Lopes Cruz (2021).

Crops encounter various biotic and abiotic stresses that hinder growth and reduce yields. Conventional methods of managing crop stress prove inadequate in meeting the growing food demand of the projected 10 billion population by 2050, as observed by Nawaz (2023).

To tackle these challenges, Nanobiotechnology, an application of nanotechnology in biological contexts, has emerged as a sustainable solution for enhancing agricultural productivity by alleviating diverse plant stresses, according to Nawaz (2023).

Therefore, it is very important to assess EFs' awareness of NT and their readiness to utilize its applications to improve their performance of different processes and activities during the several steps of agricultural production and marketing.

The study problem and objectives

The agricultural sector is one of the most important sectors in the Egyptian economy which is considered as a driving force for activating other economic sectors in addition to its significant contribution to the GDP.

NT has considerably high applicability potential to upgrade and facilitate all agricultural inputs, processes, activities, and products. Examples of the useful applications of NT include Nano fertilizers and Nano pesticides for improving agricultural productivity and the quality of agricultural products.

However, the potential negative effects of using NT-based applications need to be assessed and highly considered by all stakeholders sharing the agricultural business.

Therefore, the problem of this study was to investigate the EFs' awareness of the existence, and the meaning of NT could significantly contribute to their readiness to utilize its applications for improving their agricultural production and marketing activities. High levels of awareness and readiness could lead to high levels of adoption of NT-based devices, materials, and products which, in turn, increase food security and improve the quality of rural life through augmenting agricultural productivity and increasing farming economic net return. NT has considerably high applicability potential to upgrade and facilitate all agricultural inputs, processes, activities, and products. Therefore, it is very important to assess EFs' awareness of NT and their readiness to utilize its applications to improve their performance of different processes and activities during the several steps of agricultural production and marketing.

Objectives

The main objective of this study was to identify EFs' awareness and information about NT, and their readiness to utilize its applications to facilitate and improve their agricultural production and marketing activities.

The study-specific objectives were to:

1. Explore the EFs' awareness of the existence of NT,
2. Identify the EFs' information about NT,
3. Measure the EFs' readiness to utilize NT applications to facilitate and improve their Agricultural production and marketing activities,
4. Measure the EFs' opinion concerning the readiness of the rural community (relatives, neighbors, friends, and colleagues in the membership of the agricultural cooperative) to utilize NT applications

to facilitate and improve their Agricultural production and marketing activities.

Methodology

The study was conducted in Giza and Menoufia Governorates during May and June 2023. As previously mentioned, the study aimed to explore the EFs' awareness, information, and readiness to utilize NT-based applications for improving their performance of production and marketing processes. And considering that NT is one of the most important and latest innovations in agriculture, and there are very few field studies that handled this new technology, therefore the study purposive sample were selected from traditional rural communities in the Nile Delta of Egypt, who have experienced traditional agriculture for considerably long time. Consequently, data collection involved personal interviews with a purposive sample of 87 traditional farmers, comprising 61 and 26 farmers from Giza and Menoufia Governorates successively.

To achieve the study objectives, a questionnaire was developed and pretested. It consisted of two main sections: the first covering personal characteristics like, namely: age, educational background, agricultural experience, land holding and involvement in summer and winter crop cultivation and animal production activities. The second part included queries about the EFs' awareness of nanotechnology (NT), and the rural community's readiness to employ NT applications for enhancing diverse agriculture production and marketing activities.

The questionnaire underwent validation by presenting it to a group of 5 agricultural experts, and adjustments were made to ensure its effectiveness in meeting the study objectives. Following modifications based on the group's feedback, a pre-test was conducted with 5 farmers. Upon

confirmation of the form's validity in its final version through respondents' alignment with research objectives, data collection proceeded.

The collected data was transcribed and tabulated for analysis. For statistical analysis, frequencies and percentages were utilized to present and interpret the data.

Results and Discussion

Respondents' characteristics: As shown in table (1), the respondents' characteristics could be summarized as follows:

The majority (78%) were from middle and old age categories (up to 55 years),The majority were relatively less educated, (26.5% illiterate, 33.3% able to read and write and only 17.2% completed primary educational level). Respondents with preparatory and secondary education represent only 12.6 %, and 10.4% successively, the majority of the respondents have relatively high levels of experience in agriculture (around 69% have more than 30 years of experience, compared with only 11.5 % who have low levels (10 to 20 years) and 19.5 % with medium levels (21 to 30 years) of experience.

The majority of the respondents (around 71 %) are involved in farming animal husbandry activities (24 % in cows , 11.5% in buffalo, 28.7%, in Livestock fattening, and only 6% in goats), the majority of the respondent farmers (60.9%) are renting land for cultivation, compared with 31% land owners and only 10.1% as share croppers), the cultivated summer crops include green beans (cultivated by around 56% of the respondents, followed by fruits (21.8%), vegetables only (25%), and corn only (19%). The cultivated winter crops include wheat (33.3%), followed by potato (27.9%), clover (20.7%), and cabbage (19.5 %).

These results indicate a relatively highly diversified cropping pattern, with considerable long levels of experience in agriculture, which could positively impact the overall agricultural knowledge and practices, in one hand, and the other factors that influence the individual and community decision-making processes related to the adoption of new technologies.

Respondents' levels of readiness to utilize NT-based applications

In general, medium and high readiness was notable in applications related to increasing access to production requirements, improving marketing activities, using bio-pesticides, improving veterinary treatment for animals, and using chemical fertilizers.

-Access to Production Requirements

A substantial portion (32.2%) was highly ready to utilize NT for increasing access to production requirements. High Readiness, a notable 31.0% of farmers express high readiness to utilize nanotechnology (NT) to increase their access to production requirements. This suggests a positive inclination towards adopting NT-based applications for enhanced production resources.

-Increasing farming net return

Balanced Distribution in Production Net Return: Readiness for improving farming production net return was distributed across various levels, with 37.9% expressing high readiness. This indicates a diverse range of attitudes toward adopting NT for overall production profitability.

- Increasing farming production net return

High readiness (49.4%) is observed for increasing farming net return, while a significant portion (37.9%) was highly ready for improvements in farming production net return, nearly half of the respondents (35.6%) exhibit high readiness to use NT for increasing

farming net return. This signals a significant interest in adopting NT to enhance financial outcomes in agriculture.

-Marketing net return

More than half (56.3%) were highly ready to utilize NT for increasing net return in marketing activities, The majority of respondents (56.3%) showed high readiness to utilize NT for increasing net return in marketing activities. This indicates a strong inclination towards adopting NT for improved marketing outcomes.

-Veterinary and Animal-related Applications

Varied Readiness Levels were shown by the readiness levels for improving veterinary vaccinations and treatment for animals exhibit variation, indicating diverse attitudes among farmers. This diversity suggests that the adoption of NT in veterinary practices may face differing levels of acceptance.

-Rural Services

High Readiness for Rural Services: A significant portion (44.8%) expressed high readiness for improving rural services using NT, while readiness was more evenly distributed for using chemical fertilizers. This signals a positive reception to NT-based applications for enhancing services in rural communities.

-Using NT-based Chemical Fertilizers:

Even Distribution for Chemical Fertilizers: Readiness to use NT-based chemical fertilizers was distributed across different levels, suggesting varying degrees of interest among respondents.

Overall Implications

-The findings indicate a generally positive attitude towards adopting NT-based applications in agriculture.

-Medium and high readiness in key areas such as marketing and access to production resources indicates a potential openness to innovative technologies.

-Varied attitudes towards veterinary applications and chemical fertilizers suggest the importance of tailored strategies for promoting NT in specific agricultural domains.

These insights can guide policymakers, extension services, and researchers in developing targeted interventions and educational programs to enhance the adoption of NT-based applications among farmers, addressing their specific needs and priorities

EFs' opinion concerning the readiness of the rural community to utilize NT-applications to facilitate and improve their Agricultural production and marketing activities

In general, as indicated by the respondents, medium and high levels readiness of the rural community (relatives, neighbors, friends, and colleagues in the membership of the agricultural cooperative), to utilize NT-based applications to facilitate and improve their Agricultural production and marketing activities.

-**Increasing Access to Production Requirements**

The majority of respondents (56.3%) reported that others in their community are highly ready to adopt NT to increase access to production requirements. This indicates a positive inclination of the community's preparedness for utilizing NT in enhancing access production inputs and resources.

-**Increasing Farming Production Net Return**

Medium and high levels of readiness among others in the rural community to adopt NT to increase their farming production net returns were

reported by (35.6% and 41.4%) of the respondents. This indicates positive attitude toward the potential advantages of using NT-based applications to improve overall production profitability

-Increasing Marketing Activities Net Return

High and middle readiness to utilize NT for increasing net return in marketing activities, were reported by (20.7% and 50.6%) of the respondents. This indicates a widespread belief in the effectiveness of NT in enhancing marketing outcomes.

-Improving Veterinary Vaccination Activities

Medium and high readiness to utilize NT-based applications for improving veterinary vaccination activities, were reported by (37.9% and 25.3%) of the respondents. This indicates positive attitudes among the respondents toward the valuable benefits of the NT-based applications for improving veterinary vaccination activities.

-Improving Veterinary Treatment Activities

Low and medium readiness to utilize NT-based applications for improving veterinary vaccination activities were reported by (36.8% and 16.1%) of the respondents. This indicates a negative attitude among the respondents toward the valuable benefits of the NT-based applications for improving veterinary treatment activities. This result indicates uncertainty among the respondents regarding the potential benefits of using NT-based applications for improving veterinary treatment of their animals.

-Improving Rural Services

Medium and high levels of readiness to utilize NT-based applications for improving rural services in the rural communities were reported by (39.1% and 36.8%) of the respondents. This indicates a positive attitudes among the respondents toward the valuable advantages

and benefits of the NT-based applications for improving rural community services.

-Using NT-based Bio-pesticides

Medium and high levels of readiness to utilize NT-based applications for using bio-pesticides for more safe plant protection were reported by (48.3% and 36.8%) of the respondents. This indicates high inclinations among the respondents toward the valuable advantages and benefits of using bio-pesticides for more safe plant protection and producing clean and healthy food.

- Using NT-based Chemical Fertilizer

Medium and high levels of readiness to utilize bio-fertilizers for promoting plant production were reported by (42.5% and 35.6%) of the respondents. This indicates high positive inclinations among the respondents toward the valuable advantages and benefits of using bio-fertilizers for augmenting crop production and productivity to achieve food security objectives and satisfying the food demands of the ever-increasing population.

Overall Implications

High and medium levels of readiness were reported by the respondents in all the studied areas except using NT-based applications for veterinary treatment of farming animals. This indicate a general positive attitudes towards the potential value, advantages and use of NT for promoting and enhancing production and marketing activities.

Understanding and addressing varying perceptions within the community could help tailor interventions to specific needs, thereby fostering a more widespread acceptance of NT-based applications in agriculture

These findings could guide outreach efforts and interventions aimed at fostering community-wide acceptance and adoption of NT-based applications in agriculture

Conclusions and recommendations

Overall Positive Attitude toward Nanotechnology (NT)

The study revealed an overall positive attitude among surveyed farmers towards the adoption of NT-based applications in agriculture. This was evident from the high levels of perceived readiness in areas such as increasing access to production requirements, marketing activities, and rural services. The study highlights that the readiness to adopt NT-based applications is community-dependent, with varying attitudes and beliefs among farmers. Understanding these community dynamics was crucial for designing targeted interventions and awareness campaigns

Recommendations

- **Targeted extension Campaigns**: Design and implement targeted extension campaigns to address awareness gaps and provide clear information about the benefits of NT-based applications. Focus on areas with divergent opinions, such as farming net return and veterinary activities.
- **Rural Community and Awareness Programs**: to foster a better understanding of NT within the agriculture community. Encourage discussions and knowledge-sharing to build a collective understanding of the potential benefits of NT.
- **Interventions for Veterinary Applications**: Develop interventions for promoting the adoption of NT in veterinary vaccinations and treatment for farming animals.
- **Collaboration with Agricultural Extension Services**: to disseminate information about NT-based applications. Leverage existing

networks, utilizing appropriate extension methods to reach a wider audience and facilitate knowledge transfer.

-**Encourage Peer-to-Peer:** Encourage farmers who have successfully adopted NT-based practices to share their experiences and insights with their peers, fostering a sense of community-driven adoption.

Table

Table no.1:Distribution of the respondents according to their characteristics* (N= 87)

Characteristics	Freq.	%	Characteristics	Freq.	%
Age (years):			Landholding:		
Young (up to 40)	19	21.9	Owned	27	31.0
Middle (41- 55)	37	42.5	Rented	53	60.9.7
Old (56 and above)	31	35.6	Sharecropping	7	10.1
Educational level			Cultivated summer crops		
Illiterate	23	26.5	corn only	13	19.1
Can Read & write	29	33.3	vegetables	17	25.0
Primary	15	17.2	only	38	55.9
Preparatory	11	12.6	green beans	19	21.8
Secondary	9	10.4	fruits		
Experience in agriculture			Cultivated		
(years):	10	11.5	winter crops		
10-20	17	19.5	Wheat	23	26.5
21-30	21	24.1	Potato	29	33.3
31-40	39	44.8	Clover	18	20.7
Above 40			Cabbage	17	19.5
Animal production activities:					
Cows care only	21	24.1			
Buffalo care only	10	11.5			
Livestock fattening	25	28.7			
Goats	6	7.0			
Non	25	28.7			

Table No.2: Respondents' Readiness to utilize NT-based applications (N=87)

NT-based applications	Readiness to utilize NT-based applications							
	Not Ready		Low		Medium		High	
	N.	%	N.	%	N.	%	N.	%
Increasing access to production inputs	15	17.2	17	19.5	28	32.2	27	31.0
Increasing farming net return	6	6.9	7	8.5	43	49.4	31	35.6
Increasing production net return	8	9.2	9	10.3	37	42.5	33	37.9
Increasing marketing net return	9	10.3	11	12.6	49	56.3	18	20.7
Improving veterinary vaccination	11	12.6	13	14.9	41	47.1	22	25.3
Improving veterinary treatment	23	26.4	32	36.8	15	17.2	17	19.5
Improving community services	6	6.9	10	11.5	39	44.8	32	36.8
Using NT-based bio-pesticides	6	6.9	11	12.6	37	42.5	33	37.9
Using NT-based chemical fertilizer	12	13.8	6	6.9	35	45.9	34	39.1

Table No.3 Respondents' opinions concerning the readiness of neighbors, relatives, friends, and rural community members to utilize NT-based applications (N= 87)

NT-based applications	Readiness to utilize NT-based applications							
	Not Ready		Low		Medium		High	
	N.	%	N.	%	N.	%	N.	%
Increasing access to production requirements	9	10.3	11	12.6	18	20.7	49	56.3
Increasing Farming production net return	8	9.2	12	13.8	31	35.6	36	41.4
Increasing marketing activities' net return	14	16.1	11	12.6	44	50.6	18	20.7
Improving veterinary vaccination activities for farming animals	23	26.4	19	21.8	33	37.9	22	25.3
Improving veterinary treatment for farming animals	23	26.4	30	36.8	14	16.1	10	11.5
Improving rural services in local community	11	12.6	10	11.5	34	39.1	32	36.8
Using NT-based bio-pesticides	7	8.5	8	9.2	42	48.3	30	36.8
Using NT-based chemical fertilizer	10	11.5	9	10.3	37	42.5	31	35.6

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وعي المزارعين المصريين عن تكنولوجيا النانو واستعدادهم لاستخدام تطبيقاتها للنهوض بأنشطتهم الإنتاجية والتسويقية الزراعية – دراسة حالة في محافظتي الجيزة والمنوفية

أ.د. عماد مختار الشافعي*، د. رضوة ماهر عطا*، أ.د. سالي علام**

*قسم الاجتماع الريفى والارشاد الزراعى، كلية الزراعة، جامعة القاهرة، جمهورية مصر العربية

**قسم الحيوان والنيماتولوجيا الزراعية، كلية الزراعة، جامعة القاهرة، جمهورية مصر العربية

E-Mail : Radwa.Mohamed@agr.cu.edu.eg

المستخلص

تكنولوجيا النانو هي واحدة من أحدث الابتكارات العلمية التي تمتلك العديد من التطبيقات المفيدة في حل مشاكل الإنتاج والتسويق الزراعي. كما تُيسر وتُحسن تكنولوجيا النانو العديد من العمليات والخدمات والأنشطة الضرورية لإدارة فعالة لعمليات الإنتاج والتسويق للعديد من المحاصيل والسلع الزراعية. وأيضا استعدادهم لاستخدام تطبيقاتها فيما يتعلق بمبتكرات تكنولوجيا النانو الزراعية، مثل الأجهزة والأدوات الحديثة والمواد المطلوبة والممارسات الجديدة والمدخلات التي تم تصميمها باستخدام تكنولوجيا النانو، وأيضا تسهم في وعي المزارعين المصريين واستعدادهم لتطبيق هذه الابتكارات الزراعية بشكل صحيح والاستخدام الواعي الحكيم لها.

وقد تناولت الدراسة وعي المزارعين المصريين عن تكنولوجيا النانو واستعدادهم لاستخدام تطبيقاتها للنهوض بأنشطتهم الإنتاجية والتسويقية الزراعية مع التركيز على الإنتاج الزراعي. وقد تم جمع البيانات من خلال المقابلات الشخصية، من عينة عمدية مكونة من 87 مزارعاً مصرياً مختلفاً. وتم تصميم الاستبيان وإجراء اختبار مبدئي لتحقيق أهداف الدراسة. وتضمن الاستبيان مجموعة من الأسئلة حول مدى وعي المزارعين المصريين بتكنولوجيا النانو ومدى استعدادهم للاستفادة من تطبيقاتها في تعزيز الإنتاج والتسويق الزراعي.

وقد أظهرت الدراسة أهم النتائج التالية والمتعلقة بمستويات استعداد المزارعين لتطبيقات التكنولوجيا النانوية المختلفة في مجال الزراعة. وتبين استعدادهم للحصول على متطلبات الإنتاج الزراعي وأيضا تحسين أنشطة التسويق، بالإضافة الي استعدادهم للتطبيقات النانوية المتعلقة بعلاج وتحصينات الحيوانات البيطرية والأسمدة الكيميائية. واتضح استعدادهم بنسبة (49.4%) لزيادة صافي العائد بالمزرعة، وأن (37.9%) أفادوا بأنهم مستعدون تمامًا للتطبيقات النانوية فيما يتعلق بزيادة صافي العائد من الإنتاج الزراعي، مما يشير إلى درجة عالية من الاستعداد لتبني التكنولوجيا

النانوية من أجل تحقيق ربحية أعلى. كما أظهرت النتائج استعداد عالي نحو استخدام التكنولوجيا النانوية في أنشطة التسويق، حيث تبين استعداد أكثر من نصف المزارعين بنسبة (56.3%) لذلك.

الكلمات المفتاحية: النانوتكنولوجي، الزراع المصريون، الزراعة المصرية، استراتيجية التنمية المستدامة.

Keywords: Nanotechnology, Egyptian Farmers, Agricultural production and marketing, Sustainable Development Strategy.