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# Applications Of AI in Monitoring and Certifying Organic Food Standards

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**Abstract:** Globally, the demand for organic food products has drastically increased after the effects of the COVID–19 pandemic. Overnight change has turned the market upside down. Many people are trying to build a strong immune system to maintain their health. After the pandemic situation, people are very much aware of consuming organic food products to lead a healthier lifestyle. The demand for organic food has highlighted the need for clear and effective monitoring of organic food standards. Issues like fraud detection, mislabeling, and lack of accountability are common aspects in traditional methods. The study area focuses on the use of artificial intelligence (AI) in monitoring and certifying organic food standards. The main aim of the study is to assess the effectiveness and transparency of organic food certification procedures that are processed with the use of AI technologies in certification and monitoring, and how well AI can detect fraud and non-compliance. A mixed-method approach is used to evaluate AI-driven solutions for improving the trust and reliability of organic food supply chains. By guaranteeing authenticity and accountability in organic food systems, the findings seek to show how AI can enhance certification procedures that boost operational effectiveness and promote sustainable agriculture.

**Keywords:** pandemic, AI technologies, fraud detection, certification and monitoring, sustainable agriculture.

## Introduction

In recent years, the demand for organic food products has significantly increased worldwide, with rapidly growing consumer awareness of ethical production methods, environmental sustainability, and health. However, false labeling, noncompliance with certification standards, and ineffective monitoring procedures make it difficult to guarantee the quality and authenticity of organic foods. In traditional methods, certification and monitoring are made with a documented procedure, with flexible adjustments like false labelling, noncompliance with certification standards, and ineffective ways of certifying organic foods, which have taken place in a manual way of inspection.

For tackling these kinds of issues, the use of AI plays an immersive role in facilitating automated compliance verification, real-time monitoring, and predictive analytics. Technologies that enhance transparency, detect fraud, and boost efficiency in the certification of organic food products include computer vision, IoT-integrated sensors, predictive modeling, and blockchain-based systems. In addition to encouraging supply chain integrity, utilizing AI promotes sustainable farming methods and boosts consumer confidence.

This study focuses on transparency, technology adoption, and fraud detection. It investigates the use of AI in monitoring and certifying organic food standards. By examining AI in these areas, the study intends to offer practical insights for companies, stakeholders, and policymakers who are engaged in organic food production and certification domains.

## Literature Review

(Kamilaris, 2019) Stated that Artificial Intelligence (AI) has emerged as a transformative tool in agriculture and food supply chains. Studies highlight that AI enables real-time monitoring, automated compliance verification, and anomaly detection, thereby enhancing the efficiency and transparency of certification systems. (Sharma, 2021) By reducing manual inspection errors and improving traceability, AI strengthens accountability in organic food production.

(Tian, 2017) Examined that, Block chain has received significant attention as a tool to enhance transparency in organic food supply chains. Block chain-enabled certification provides tamper-proof and verifiable records, which reduce the risks of fraud and misrepresentation. (Tripoli, 2020) Observed that, argue that block chain integration supports trust-building between producers, certifiers, and consumers, making it a vital component of AI-driven certification systems.

(Verdouw, 2017, October.) Explored that, The Internet of Things (IoT) plays a critical role in sustainable agriculture by collecting real-time data on soil quality, pesticide usage, and environmental conditions. IoT sensors, when integrated with AI algorithms, enable continuous monitoring of compliance with organic standards. This not only strengthens certification but also promotes sustainable farming practices. Shukla, A., & Khare, A. (2024)

(Dubey, 2021) Studied that, Predictive analytics, powered by AI, and is increasingly used to identify irregularities and fraud in certification processes. Predictive models can analyze large datasets to detect non-compliance trends and forecast potential risks. This assists certification authorities in focusing their monitoring efforts on high-risk areas, thereby improving efficiency and reducing fraud incidents.

Plenty of studies have highlighted the role of AI in agriculture and processes related to it. But only a few address the application of certification and detection of fraud in organic food standards. Existing research papers mostly focused of the usage of AI tools in agriculture, or block chain, computer vision and the like. But there is limited analysis on how integrated analysis will collectively enhance the transparency, efficiency and reliability in organic food certification systems.

**Objectives**

1. To know about the transparency and efficiency of monitoring organic food production and certification standards.
2. To identify specific AI technologies used for monitoring and certifying organic foods.
3. To examine the effectiveness of AI in fraud detection in organic food standards.

**Methodology**

**Research Design**

In order to examine the uses of artificial intelligence (AI) in monitoring and certifying organic food standards, this study uses a descriptive and exploratory research design. While an exploratory approach is utilized to identify specific AI technologies that can be applied in the study area, a descriptive design is utilized to record perceptions of transparency, efficiency, and fraud detection in the current certification processes. R, K., T, K., & Sreenidhi, T. S. (2024)

**Sample Size**

A sample of 60 respondents was selected using a simple random technique, targeting individuals who have prior experience, such as organic farmers, certification authorities, technology experts, and consumers. The sample size is small due to the short period of study.

**Data Collection**

The data is collected with a combination of both primary and secondary data. The primary method is used to capture the perspectives of stakeholders, farmers, certification authorities, consumers, and technology experts. The secondary data is gathered from information that already exists in books, newspapers, e-journals, and the like.

**Kmo And Bartlett's Test of Sphericity Table 1**

| **KMO and Bartlett's Test** | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .721 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 531.64 |
| | df | 45 |
| | Sig. | .001 |

In KMO, a value of 0.5 or greater is deemed appropriate for factor analysis to proceed. The value of the test statistic is given in Table 1 as 0.721, which means the factor analysis for the selected variables is found to be appropriate for the data.

Bartlett's test is another indication of the strength of the relationship among the variables. From the table, the Bartlett's Test of Sphericity test value is 531.64 at degrees of freedom 45. That significance level is less than 0.05. In fact, it is actually 0.001; i.e, the significance level is small enough to reject the null hypothesis ($p<0.05$). This means that the correlation matrix is not an identity matrix (there exists correlation between the variables).

**TABLE - 2**

| **Component Matrix** | | | |
|---|---|---|---|
| | Component | | |
| | 1 | 2 | 3 |
| AI increases the traceability of the food supply. | .812 | | |
| AI improves transparency in the certification process. | .794 | | |
| AI is a much more accepted method to build trust among consumers. | .765 | | |
| Paperwork is being reduced with the help of AI. | | .779 | |
| AI reduces time delays in certification progress. | | .761 | |
| Automated compliance checks are processed with the help of AI. | . | .684 | |
| Real-time monitoring is enabled by AI. | | .657 | |
| AI improves the reliability of certification. | | | .856 |
| AI helps to reduce human error in monitoring. | | | .781 |
| The use of AI increases audit efficiency. | | | .754 |

The component matrix Table 2 shows that these variables together constitute factor 1, which can be termed as **"Transparency"**, the variables representing factor 2, which can be termed as **"Efficiency"**, and the variables representing factor 3, which can be termed as **"Reliability".** Here, the AI plays a significant role in enhancing the transparency, efficiency, and reliability of organic food certification processes.

**Cross – Tabulation:**

**Table – 3 Cross – Tabulation (Ai-Tech X Respondents)**

| AI Technology | Farmers (n=20) | Certifiers (n=10) | Consumers (n=20) | Tech Experts (n=10) | Total (N=60) |
|---|---|---|---|---|---|
| Computer Vision | 5 (25%) | 3 (30%) | 4 (20%) | 6 (60%) | 18 (30%) |
| Predictive Analytics | 4 (20%) | 2 (20%) | 7 (35%) | 5 (50%) | 18 (30%) |
| IoT-integrated AI | 12 (60%) | 3 (30%) | 6 (30%) | 4 (40%) | 25 (41.7%) |
| Block chain-based AI | 3 (15%) | 6 (60%) | 7 (35%) | 6 (60%) | 22 (36.7%) |

Table 3 shows the cross-tabulation of AI technology adoption by respondent group (N=60). Farmers (60%) predominantly used IoT-integrated AI applications, such as smart sensors and monitoring tools. Certifiers (60%) relied more on blockchain-based AI systems for traceability and certification records. Consumers reported relatively balanced usage, with 35% indicating adoption of blockchain-based AI and predictive analytics. In contrast, technology experts showed strong adoption of computer vision (60%) and blockchain (60%), highlighting their focus on advanced monitoring and fraud detection tools. Divakaran, P., & Chaturvedi, V. M. (2024)

**CHI- Square**

Ho: There is no significant association between the respondent group and the type of AI technology used in monitoring and certifying organic foods.

H1: There is a significant association between the respondent group and the type of AI technology used in monitoring and certifying organic foods.

**TABLE – 4 Respondent group and type of AI – Technology**

| Test Statistic | value | df | Sign. |
|---|---|---|---|
| Pearson Chi-square | 11.23 | 9 | **0.024** |
| Likelihood Ratio | 12.01 | 9 | 0.018 |
| No of Valid Cases | 60 | | |

**Interpretation:** The above table shows that there is a significant association between the respondents' group and the AI technology used in monitoring and certifying organic foods. Hence, the significance value is less than 0.05 (0.024), and the null hypothesis is rejected, and the alternative hypothesis is accepted.

**Mean – Score Ranking:**

The mean score ranking method is used to find respondents' average scores by identifying the AI applications that are thought to be the most successful. Technologies can be ranked based on how well they detect fraud and monitor compliance by looking at the average ratings from respondents.

**TABLE – 5**

| AI Applications | Mean | Rank |
|---|---|---|
| Computer Vision (detecting mislabeling) | 4.20 | 1 |
| Blockchain-based AI (traceability, certification) | 4.03 | 2 |
| Predictive Analytics (fraud detection) | 3.97 | 3 |
| IoT-integrated AI (sensor-based monitoring) | 3.89 | 4 |

**Interpretation:** The table above shows that computer vision has rank 1 with a mean score of 4.20, an AI tool in detecting mislabeling of organic foods, block chain-based AI has rank 2 with a mean score of 4.03, AI in traceability and certification, predictive analytics has rank 3 with a mean score of 3.97, AI in identifying and detecting fraud, IoT- integrated AI has rank 4 with a mean score of 3.89, AI is useful in sensory based monitoring. Computer Vision and block chain have scored the highest rank with the most effective AI application for fraud detection of organic food certification.

**Suggestions**

1. Stakeholders in the organic food domain should adopt advanced AI tools with computer vision and blockchain-based AI for effective detection of fraud in organic certification.
2. Government & self-development groups can provide effective training to create awareness among farmers, certifying authorities, and supply chain agents on how to use tools like IoT in monitoring for predictive analysis.
3. Certified bodies and the government should promote investment in blockchain-enabled platforms to boost the transparency of records and reduce fraud and mislabeling of organic food products.
4. With the help of AI and IoT sensors, it integrates real-time monitoring of soil quality, use of pesticides, and traceability.
5. Regulatory bodies should provide guidelines to ensure compliance with the organic certification system and the ethical practices in respective areas.

**Conclusion**

This study focused on how artificial intelligence (AI) is used to promote monitoring and certifying organic food standards. AI tools like computer vision, block chain–based systems, predictive analytics, and IoT-integrated monitoring tools have immensely increased the effectiveness and transparency of organic food certification processes. Computer vision and block chain-based systems are the best tools for detecting fraud, preventing mislabeling, and guaranteeing standards. The study shows that different stakeholders have different preferences for AI technologies: farmers rely more on IoT-based tools, certifiers prefer block chain systems and technology exports comfy to have go for computer vision. These findings imply that the adoption of AI is driven by capabilities as well as context.

AI improves operational efficiency, increases consumer trust, and supports sustainable agriculture practices by automating compliance checks, cutting down on paperwork, and minimizing human error. The certification process can become more dependable, fraud-resistant, and future-ready with the right training, regulatory support, and investment in cutting-edge AI tools. All things considered, artificial intelligence (AI) offers a potent remedy for persistent issues with organic food certification, encouraging sustainability, authenticity, and accountability in organic food supply chains.

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