International Journal of Engineering Research and Science & Technology

www.ijerst.org

IF: 9.625

ISSN : 2319-5991



International Conference on Ensuring Global Food Safety-ICEGFS-2026

Vol. 22 No. 4(S) (2026)

ijerst.editor@gmail.com

editor@ijerst.com

International Conference on Ensuring Global Food Safety-ICEGFS-2026
ISSN 2319-5991 www.ijerst.com
© 2026 IJERST. All Rights Reserved

ORGANIC FARMING AS A PATHWAY TO FOOD SAFETY: REDUCING CHEMICAL CONTAMINANTS AND ENSURING CONSUMER TRUST

Aparna Gogoi[1], Dr. Runumi Das[2]
1.Research Scholar, Department of Business Administration, Tezpur University, Assam,India
2. Associate Professor, Department of Business Administration, Tezpur University,Assam,India
Corresponding Author: email-id: gogoiaparna20@gmail.com/ bap24019@tezu.ac.in

Abstract
Food safety has become an important concern in contemporary agricultural and food supply systems because of potential exposure to pesticide residues, toxic metals, microbial pathogens, and contaminants introduced during production, processing, transportation, and storage. Organic farming is increasingly recognised as an alternative agricultural approach that restricts the use of synthetic pesticides and fertilisers and promotes ecological processes, biodiversity, and soil health. However, the relationship between organic farming and food safety is complex and should not be understood as a guarantee that organic food is entirely free from contaminants. The contribution of organic farming to food safety, with particular attention to chemical contaminant reduction, production-system integrity, certification, traceability, and consumer trust. The role of certification systems, transparent labelling, food testing, supply-chain governance, and consumer awareness in strengthening confidence in organic products. In the Indian context, the Food Safety and Standards Authority of India (FSSAI) recognises the National Programme for Organic Production (NPOP) and Participatory Guarantee System (PGS-India) within its organic-food regulatory framework. With focus on integrated food-safety and consumer-trust framework combining preventive production practices, risk-based testing, traceability, credible certification, and transparent communication. It concludes that organic farming can contribute to safer food systems when ecological production practices are supported by effective food-safety management and accountable supply chains.

Keywords: *Organic farming, food safety, pesticide residues, chemical contaminants, organic certification, consumer trust, traceability, India*

Received: 17-09-2026 Accepted: 22-10-2026 Published: 29-10-2026

1. Introduction

Food safety is fundamental to public health, consumer confidence, agricultural sustainability, and the functioning of food markets. Food may become unsafe at different stages of the supply chain, including cultivation, harvesting, processing, transportation, retailing, and household preparation. Potential hazards include pesticide residues, heavy metals, naturally occurring toxins, microbial pathogens, and contaminants arising from inappropriate storage or handling. Consequently, food safety requires a comprehensive approach that extends beyond the choice of agricultural production system.

Contaminated soil and irrigation water may contribute to the build-up of some toxic elements in agricultural produce. These concerns have encouraged interest in production systems that reduce dependence on selected synthetic agricultural inputs.

However, organic farming and food safety are related but distinct concepts. Organic standards regulate how food is produced and handled; they do not establish that every organic product is free from every possible chemical or biological hazard. Smith-Spangler et al. (2012) reported a lower risk of detectable pesticide residues in organic produce, while also finding that the available evidence did not establish a

universal nutritional or food-safety advantage across all outcomes. Likewise, Barański et al. (2014) found lower incidence of pesticide residues in organic crops but no significant differences in the concentrations of toxic metals (e.g., lead and arsenic).

Trust from consumers is another key factor. Consumers may purchase organic products because they believe they are exposed to fewer chemicals, are environmentally sustainable and responsible farming methods. But confidence can be undermined by false claims, poor traceability, inconsistent product quality and limited access to reliable information. Therefore, certification and straightforward communication are essential for linking production practices with consumer expectations.

2. Organic Farming and the Food-Safety Framework

2.1 Understanding organic farming

Organic farming is a production approach that seeks to maintain soil fertility, promote biodiversity, manage pests through ecological methods, and minimise dependence on prohibited synthetic agricultural inputs. Practices may include crop rotation, composting, green manuring, biological pest control, intercropping, and the use of approved organic inputs.

The objective is not merely to replace synthetic fertilisers with organic fertilisers. Organic production requires a management system that is coordinated in terms of soil health, crop protection, suitability of inputs, environmental conditions and post-harvest handling. The appropriateness of a given input is determined by the applicable certification standard and the context of its use.

Organic farming may help in food safety by prevention. Reducing the use of certain synthetic pesticides reduces opportunities for residues to get into harvested produce. However, the advantages of organic practices depend on the implementation, environmental conditions and the adherence to production standards.

2.2 Food safety and food quality are not the same

Food safety is the science of whether food presents an unacceptable risk to human health when used as intended. Other components of food quality are: taste, appearance, freshness, nutritional composition, and consumer preferences.

A product can be produced in accordance with organic standards and still need appropriate controls for microbial contamination, toxic metals, naturally occurring toxins, and unsafe handling. Similarly, a conventionally produced food can comply with applicable food-safety requirements.

3. Organic Farming and the Reduction of Chemical Contaminants

3.1 Pesticide residues

Pesticide residues are among the most frequently examined differences between organic and conventional agricultural products. Organic standards restrict the use of many synthetic pesticides, although specific permitted substances and exceptions vary by standard. Consequently, certified organic crops generally have fewer opportunities for contamination from prohibited synthetic pesticide applications.

Nevertheless, lower residue occurrence should not be interpreted as complete absence of residues. They may be due to pesticide drift, contaminated soil or water, persistent environmental pollutants or accidental contact during harvesting, transportation and storage. Some organic systems may also use permitted crop-protection substances, as allowed by applicable standards.

The concern with pesticide residues varies with the substance, its concentration, dietary exposure, its toxicity and its regulatory limits as appropriate. Detection alone does not necessarily mean a health risk. The presence of a residue does not mean that the agricultural practice was wrong.

3.2 Synthetic fertilisers and nitrate accumulation

Contaminated soil, irrigation water, atmospheric deposition, industrial emissions and certain agricultural inputs may introduce heavy metals and other toxic elements, such as lead, cadmium and arsenic, to agricultural systems. Their occurrence is not determined solely by whether a farm is organic or conventional.

For organic farms close to industrial areas, polluted water bodies, contaminated land or roads with high deposition, specific attention to site selection and environmental monitoring may be required. Soil testing, irrigation-water assessment, and crop testing can help identify hazards before they reach consumers.

4. Food-Safety Risks Beyond Chemical Residues

4.1 Microbial contamination

Effective controls include safe water, properly treated organic amendments, appropriate worker hygiene, clean harvesting equipment, separation of raw and finished products, and hygienic transportation and storage. These measures should be applied irrespective of certification status.

4.2 Mycotoxins and storage-related hazards

Mycotoxins are toxic substances produced by certain fungi. They can contaminate agricultural commodities, particularly cereals, nuts, spices, and other crops under favourable conditions for fungal growth. Contamination is more likely if drying is poor, moisture content is high, there is insect damage or storage is inadequate.

Farmers, aggregators, processors and retailers should maintain appropriate moisture levels, use appropriate storage facilities, monitor susceptible commodities and comply with applicable limits for contaminants and toxins.

4.3 Cross-contamination during handling and distribution

Even a crop that is grown to organic standards can be compromised in its identity and safety by mishandling after harvest. Quality and safety problems can arise from mixing organic and non-organic produce, using contaminated equipment, storing products with inappropriate materials or transporting commodities in unsanitary conditions.

5. Organic Certification and Regulatory Assurance in India

5.1 The Indian regulatory framework

India has established a regulatory framework for organic food under the Food Safety and Standards (Organic Foods) Regulations, 2017. FSSAI recognises two certification systems within this framework: the National Programme for Organic Production (NPOP), implemented under the Ministry of Commerce and Industry, and PGS-India, or the Participatory Guarantee System, implemented under the Ministry of Agriculture and Farmers Welfare (FSSAI, n.d.).

The Jaivik Bharat identity mark helps consumers identify organic food products authenticated under the applicable national framework. Consumers should also pay attention to relevant certification information and FSSAI labelling requirements.

5.2 Third-party certification and participatory assurance

NPOP provides a framework for organic production certification and is relevant to domestic and export-oriented supply chains. PGS-India uses a participatory approach involving producers and other stakeholders under a decentralised assurance system.

The two systems serve different institutional needs, and their suitability depends on the producer group, market channel, product, and applicable regulatory requirements. Participatory systems may be especially relevant to organised groups of small farmers, while third-party certification can support market channels that require independently documented conformity assessment.

Neither system should be presented as a substitute for contaminant testing where testing is required or justified by risk. Certification

establishes compliance with defined organic standards; separate food-safety controls are needed to address hazards that organic production rules do not automatically eliminate.

5.3 Traceability and accountability

Traceability refers to the ability to follow a product and its relevant records through different stages of the supply chain. It can connect a finished product with the farm, producer group, certification records, processing facility, and distribution channel.

FSSAI's organic-food framework recognises traceability as part of maintaining organic integrity. When complete and available, traceability can help investigate suspected mislabeling, identify affected product lots and support corrective action.

Traceability in practice Batch codes Production details at farm level Input registers Harvest dates Aggregation records Processing details Distribution documentationWhile electronic instruments can enhance records accessibility, their effectiveness relies on accurate data entry, reliable validation and cost-effective implementation.

6. Trust of Consumers in Organic Food

6.1 Objective and subjective safety

Consumers want organic because they expect better health, protection of the environment and less exposure to chemicals. But perceived safety is not the same as measured safety.Some consumers may think organic food is all chemical free. Others may think that the certification guaranties better nutritional value. Such assumptions can lead to unrealistic expectations. All food consists of chemical substances, and the relevant safety question is whether a food contains harmful contaminants at levels that present an unacceptable risk. Organic production can reduce some sources of contamination, but it cannot guarantee the absence of every hazard.

Consumer education should communicate both the strengths and the limitations of organic farming. Balanced information is more likely to create durable confidence than broad claims that organic food is always safer or healthier.

6.2 Authenticity and mislabelling

A central challenge in organic markets is the possibility that products may be sold as organic without meeting the applicable standards. If consumers cannot distinguish between certified products and unsupported claims, it could erode trust in legitimate producers.

The problem is mitigated by certification marks, available verification information, proper labeling and regulatory enforcement. Consumers should be able to understand what a certification claim means and how the product's organic status can be verified.

Producers and retailers also have a responsibility to avoid unsupported claims such as “zero chemicals,” “completely toxin-free,” or “guaranteed pesticide-free” unless such statements are properly substantiated and permitted by applicable rules.

6.3 Transparency and communication

Consumer trust develops when product claims are consistent with verifiable practices. Production methods, certification, geographic origin, testing and handling details may reduce uncertainty.

Transparency does not mean publishing every technical detail on a product label. Rather, it means providing accurate, accessible information and making supporting records available through appropriate channels.

Producer organisations, retailers, food-safety authorities, and certification bodies should communicate clearly about the meaning of organic certification, the limitations of residue testing, and the difference between organic integrity and general food safety.

7. An Integrated Framework for Food Safety and Consumer Trust

7.1 Preventive production management

The first component involves preventing contamination at source. Measures include suitable site selection, soil and water assessment, the use of compliant agricultural inputs, appropriate compost treatment,

integrated biological pest management, and hygienic harvesting.

Preventive measures are often more effective and economical than relying exclusively on testing finished products. They should be adapted to crop-specific hazards and local environmental conditions.

7.2 Risk-based monitoring and testing

The second component is targeted monitoring. Crop, production environment, input history, intended market, previous contamination findings and applicable regulatory requirements should inform testing priorities.

Parameters tested for may include pesticide residues, toxic metals, microbial pathogens and mycotoxins. Not every product requires an identical testing programme; monitoring should be proportionate to identified risks and supported by competent laboratories.

Test results should be interpreted against the appropriate legal standards and analytical limitations. A single negative sample cannot prove that every product from a farm or supply chain is free from contaminants.

7.3 Certification and traceability

The third component links organic production claims to documented evidence. Certification ensures that the appropriate organic standard has been met and traceability means that products can be tracked and problems traced back.

Producer groups and aggregators should maintain trustworthy records and set up procedures to handle non-conforming products.

7.4 How to engage consumers effectively

The fourth element is effective product information communication. Labels shall comply with applicable regulations and shall state relevant certification status.When communicating with consumers, avoid making absolute safety claims and help them understand the value and limitations of organic certification.

Retailers can build consumer confidence by making public who their suppliers are, by checking product identities and by being open about how they will respond to consumer concerns.

7.5 Continuous improvement and accountability

The final component is continuous improvement. Contamination incidents, audit findings, consumer complaints, and laboratory results should inform changes in production and handling practices.

Responsibility should be shared among farmers, producer organisations, input suppliers, processors, retailers, certification bodies, regulators, and consumers. Such shared accountability helps connect sustainable production with measurable food-safety outcomes.

The framework can be summarised as follows: Prevent contamination → Monitor identified risks → Verify organic integrity → Maintain traceability → Communicate transparently → Improve continuously.

This sequence is a conceptual framework developed for the present chapter, not a previously validated empirical model.

8. Implications for India and North-East Indian Agriculture

India's organic sector includes diverse farming systems, producer organisations, certification arrangements, and market channels. The implications of organic farming for food safety therefore vary by region and commodity.

For North-East India, organic value chains involving crops such as ginger, turmeric, rice, fruits, and vegetables may benefit from integrated management of production, aggregation, processing, and marketing. These commodities should not be assumed to be contaminant-free because they are produced in a region associated with traditional farming practices. Real safety is in the farm environment, inputs, water quality, handling and storage.

Food-safety issues should be added to organic production techniques in capacity-building programs for farmers. Training should cover input selection, compost preparation, pesticide-

drift prevention, safe water, hygienic harvesting, and storage management.

Second, farmer producer organisations and cooperatives can support collective recordkeeping, group-level internal controls, access to testing services, and communication with buyers. Shared facilities may help reduce the cost of compliance for small and marginal farmers, although the financial feasibility of each arrangement requires local assessment.

Third, regional value chains should strengthen post-harvest handling. Product quality and safety may be impacted by drying, cleaning, grading, packaging and storage. This is especially relevant for crops that are dried, powdered, or processed before reaching consumers.

Fourth, state agricultural departments, universities, food-safety authorities, certification organizations and producer groups can work together to develop locally appropriate monitoring and extension programs.

Finally, market development needs to be backed by credible evidence. Claims made to consumers, such as reduced pesticide exposure, environmental sustainability, or regional origin must be consistent with available certification records and test results.This approach can help to identify real organic products and promote confidence in local agricultural enterprises.

9. Limitations

Environmental pollution: Organic production cannot control pollution from outside the farm, such as polluted soil, water and atmospheric fallout.

INPUT MANAGEMENT Poorly sourced or inadequately treated manure and compost can introduce contaminants or pathogens.

Costs of monitoring: Laboratory testing, certification and documentation and traceability can be expensive in terms of money and administration, especially for small producers.

Information asymmetry: Consumers may find it difficult to tell the difference between certified products and products with unsupported organic claims.

Evidence varies by crop type, geographic location, definitions of contaminants, analytical methods and sampling procedures. These differences constrain direct comparison and generalization.

Risk of over-promising: Organic certification as a promise of total safety may result in false confidence and a subversion of food-safety practices understood by consumers.

To meet these challenges, there is a need for coordination between agricultural extension, certification institutions, laboratories, regulators and market participants.

10. Suggestions for Future Research

One could first conduct comparative studies of pesticide residues and selected contaminants in organic and conventional produce using identical sampling methods, appropriate analytical techniques, and well-defined comparison groups.

Second, research in the regions could examine risks of contamination from characteristics of the soil, water used for irrigation, sources of compost, processing and storage.Research in Northeast India can provide useful evidence for locally relevant commodity and producer groups.

Third, consumer research might investigate the impact of certification marks, traceability information, food-safety claims, and laboratory test results on consumers' willingness to purchase organic products.Studies should distinguish between perceived safety and objectively measured contamination.

Fourth, management research could evaluate the costs and benefits of collective testing, shared certification services and digital traceability among farmer producer organizations.Particular attention could be given to affordability, implementation capacity and the distribution of benefits among smallholders.

Finally, longitudinal studies could assess whether integrated food-safety programs lead

to greater compliance, fewer contamination incidents, greater consumer confidence and improved market access. These questions require empirical testing and cannot be resolved through literature review alone.

11. Conclusion

Organic farming offers a meaningful pathway towards reducing selected sources of chemical contamination in food, particularly where restrictions on synthetic pesticide use lead to lower pesticide-residue occurrence. Existing reviews provide support for this potential benefit. However, the relationship between organic production and food safety is not absolute. Toxic metals, environmental pollutants, contaminated organic amendments, microbial pathogens, mycotoxins, and hazards arising during handling and storage may affect organic as well as conventional food.

The central implication is that organic farming should be treated as one component of a comprehensive food-safety strategy. Its contribution depends on good agronomic practices, appropriate inputs, environmental monitoring, hygienic post-harvest management, suitable testing and food-safety regulation compliance.Certification confirms compliance with standards that define organic. Traceability and transparent labeling help to ensure the integrity of the product and consumer confidence.

In India, NPOP and PGS-India are the recognized mechanisms for organic assurance under the regulatory framework of FSSAI.Such systems can be strengthened through practical farmer training, risk-based monitoring, reliable records and coordinated action among producer organizations, laboratories, regulators and market actors.

Credible, evidence-backed claims are the most sustainable way to build consumer trust. Stakeholders should explain the real benefits of organic production and the control measures needed to deal with the risks that remain, instead of saying that organic food is completely chemical-free or always safer.Thus, organic farming can contribute to safer and more trustworthy food systems when ecological production is coupled with scientific monitoring, accountable supply chains and transparent communication.

References

1.Barański, M., Średnicka-Tober, D., Volakakis, N., Seal, C., Sanderson, R., Stewart, G. B., Benbrook, C., Biavati, B., Markellou, E., Giotis, C., Gromadzka-Ostrowska, J., Rembiałkowska, E., Skwarło-Sońta, K., Tahvonen, R., Janovská, D., Niggli, U., Nicot, P., & Leifert, C. (2014). Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: A systematic literature review and meta-analyses. *British Journal of Nutrition, 112*(5), 794–811. https://doi.org/10.1017/S0007114514001366

2.Food Safety and Standards Authority of India. (n.d.). *Organic food*. https://fssai.gov.in/standards/organic-food

3.Food Safety and Standards Authority of India. (2020). *Frequently asked questions (FAQs) on food safety and standards for organic food*. https://fssai.gov.in/upload/uploadfiles/files/FAQs_Advertising_Organic_Food_06_05_2020.pdf

4.Gomiero, T. (2018). Food quality assessment in organic vs. conventional agricultural produce: Findings and issues. *Applied Soil Ecology, 123*, 714–728. https://doi.org/10.1016/j.apsoil.2017.10.014

5.Rani, L., Thapa, K., Kanojia, N., Sharma, N., Singh, S., Grewal, A. S., Srivastav, A. L., & Kaushal, J. (2021). An extensive review on the consequences of chemical pesticides on human health and environment. *Journal of Cleaner Production, 283*, 124657. https://doi.org/10.1016/j.jclepro.2020.124657

6.Smith-Spangler, C., Brandeau, M. L., Hunter, G. E., Bavinger, J. C., Pearson, M., Eschbach, P. J., Sundaram, V., Liu, H., Schirmer, P., Stave, C., Olkin, I., & Bravata, D. M. (2012). Are organic foods safer or healthier than conventional alternatives? A systematic review.

Annals of Internal Medicine, 157(5), 348–366. https://doi.org/10.7326/0003-4819-157-5-201209040-00007