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Blockchain-Supported Traceability for Transparent Local Food Supply Chains

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Abstract

Local and short food supply chains are increasingly valued for their potential to connect consumers more directly with producers, retain economic value within regional communities, reduce information distance, and communicate the geographic and production identity of food. Their relatively short physical structure, however, does not automatically guarantee transparency. Local foods may still pass through multiple producers, collection centers, processors, storage facilities, distributors, retailers, restaurants, schools, and institutional buyers, creating information gaps concerning origin, production method, quality, handling, certification, batch identity, and movement. Blockchain-supported traceability provides a potential mechanism for addressing these gaps by maintaining tamper-resistant records of defined supply-chain events while allowing authorized participants to share product information across organizational boundaries. This conceptual review examines how blockchain can support transparent local food supply chains without assuming that blockchain alone guarantees truthful information. Recent scholarly evidence was synthesized with particular attention to short supply chains, alternative food networks, consumer information needs, technology adoption, interoperability, QR-based communication, and real-world implementation.

The analysis indicates that permissioned or consortium blockchain models are generally more compatible with localized producer networks than unrestricted public-chain architectures because governance, cost, privacy, participant identity, and data access can be controlled more effectively. A recently documented Slovenian short food supply-chain case involving 12 farms illustrates practical integration of blockchain, QR codes, digital identities, delivery records, business information systems, and consumer-facing provenance information.. Effective local-food traceability therefore requires verified identities, standardized data fields, practical validation mechanisms, interoperable information standards, farmer-friendly interfaces, proportionate data governance, and affordable implementation. The study proposes that blockchain should be treated as a supporting trust infrastructure embedded within local food governance rather than as an isolated technological solution. When appropriately designed, such systems can strengthen provenance assurance, consumer communication, recall capability, producer visibility, coordination, and accountability while preserving the relational character that makes local food networks distinctive.

Keywords: Blockchain; food traceability; local food systems; short food supply chains; transparency; provenance; QR codes; digital agriculture; consumer trust; supply-chain governance

1. Introduction

The renewed interest in local food systems reflects a broader attempt to reconnect food production with place, producers, consumers, and regional economies. Short food supply chains are typically characterized by reduced organizational or geographical distance between agricultural producers and final users compared with conventional long multi-tier distribution systems. Their value proposition frequently depends on claims concerning local origin, freshness, direct producer relationships, production practices, authenticity, and community benefit. Yet shortening physical distance does not automatically eliminate informational distance. When consumers purchase food from a local shop, cooperative, digital marketplace, restaurant, public institution, or regional distribution center, they may still be unable to determine precisely where a product was produced, when it was harvested, how it was processed, whether certification claims are current, or which organizations handled it before sale.

Traceability addresses this informational challenge by creating an identifiable relationship between a physical product and the events associated with its production, transformation, movement, storage, and sale. In food systems, traceability becomes particularly important because origin and process information may be linked with safety, quality, authenticity, sustainability, cultural identity, and price. Recent research on sustainable food supply-chain transparency shows that stakeholders do not demand all information equally. Burgess, Sunmola, and Wertheim-Heck identified 14 information needs and grouped them into product and quality information, production and processing information, and sustainability information. Quality and safety were highly prioritized, followed by product origin and nutrition or ingredient information.

The challenge is therefore not merely to collect more data but to provide credible, relevant, understandable, and appropriately verified information. Local-food supply chains may rely heavily on interpersonal trust. A consumer may know a farmer personally, recognize the farm name, or rely on a retailer with a strong local reputation. As these systems expand beyond direct farm-gate transactions, however, interpersonal trust becomes more difficult to maintain. Digital traceability can supplement relational trust by making a defined history of the product accessible even when producer and consumer do not meet directly.

Blockchain has emerged as one possible digital infrastructure for this purpose. In supply-chain applications, blockchain can operate as a shared ledger in which authorized parties submit records that are cryptographically linked and collectively maintained. Its main attraction for traceability is not simply decentralization but the ability to create a historical record whose subsequent unauthorized alteration is difficult to conceal. Blockchain-based systems can therefore strengthen confidence that a recorded event has not been silently edited after the fact.

This capability is relevant where supply-chain participants have different incentives or operate independent information systems. A farmer may record harvest information, a processor may add transformation data, a distributor may document shipment, and a retailer may provide the final consumer-facing product identity. Instead of relying on a single organization to maintain the complete historical record, a distributed or permissioned ledger can provide a shared reference across participating organizations.

2. Literature Review, Research Gap and Methodology

Research on blockchain in agri-food systems has expanded rapidly because food supply chains involve multiple actors, fragmented records, product transformation, perishability, authenticity risks, and regulatory requirements. Chiaraluce and colleagues observed that research on high-value agri-food chains has focused strongly on food safety, fraud prevention, origin assurance, and traceability, particularly in product categories where provenance contributes substantially to value.

The literature also indicates growing attention to the interaction between blockchain and complementary digital tools. IoT sensors can capture temperature, humidity, storage, transport, or environmental data. QR codes can connect consumers to a digital product record. RFID and other identifiers can support automatic recognition of batches or units. Blockchain performs a different role by supporting integrity, sequencing, and controlled sharing of the resulting records. The distinction is important because blockchain does not itself sense temperature, identify a physical apple, inspect a certification document, or determine whether a product was genuinely grown at a claimed location.

Digital traceability research similarly indicates that effective systems require interoperability. Food-system actors may already use accounting software, warehouse-management systems, enterprise databases, point-of-sale tools, certification platforms, and mobile applications. A blockchain platform that requires every actor to abandon existing software and duplicate all data manually may increase rather than reduce administrative burden. The practical objective should therefore be to connect traceability records with existing business processes.

The GS1 EPCIS standard provides one relevant approach to structured supply-chain visibility by enabling organizations to share event-based information using a common traceability language. EPCIS 2.0 is intended to support supply-chain visibility by representing information about what happened, when, where, and in what business context. Such standards are important because blockchain immutability alone does not make records semantically interoperable. Two systems may securely record data yet remain unable to interpret one another if they use different product identifiers, event definitions, units, and naming conventions.

Research also demonstrates that technology adoption depends on more than technical capability. Toader and colleagues examined blockchain-platform adoption using an extended technology-acceptance framework and found that organizational and partner readiness, performance expectations, effort expectations, and perceived trust influenced intention to adopt blockchain-supported agri-food platforms. Their research drew on respondents from agri-food companies in multiple European countries, showing that willingness to use the technology is strongly associated with the organizational environment in which it is introduced.

Mbadlisa and Jokonya reached related conclusions through a systematic review of adoption factors. Their analysis identified cost, scalability, firm size, knowledge, management capability, policy conditions, and stakeholder participation as relevant influences. Cost was among the most frequently identified technological barriers in their reviewed literature, while organizational size and limited knowledge were significant organizational concerns.

These concerns become especially important in local food chains because small farms and small processing businesses may have limited information-technology capacity. The economic burden of blockchain cannot be assessed simply by examining transaction fees. Costs can arise from hardware, smartphones, labels, software integration, data entry, training, maintenance, network management, cybersecurity, system updates, identity management, and verification procedures.

Burgess, Sunmola, and Wertheim-Heck provide a particularly relevant contribution because their study focused on information needs in alternative and sustainable food supply chains rather than assuming that every possible data field should be placed on a blockchain. Their mixed-method research identified 14 information needs and demonstrated that quality and safety, origin, and nutritional or ingredient information were particularly important. This finding has practical implications for system design. A farmer-facing traceability platform should avoid turning transparency into an uncontrolled collection of data that are expensive to maintain but rarely used.

The recent Green Point study provides an unusually direct empirical bridge between these conceptual issues and operational local-food practice. Before introduction of its digital traceability system, producers submitted paper delivery notes that required manual entry into the business-information system. The blockchain-supported model enabled digital acceptance and automated transfer of relevant delivery information. Products were connected with QR codes, and consumers could access origin, production, certification, logistics, and related product information through mobile devices.

The same study also demonstrates why claims about blockchain completeness must remain cautious. Input suppliers were outside the authenticated blockchain network, meaning that upstream seed or input information could not be independently verified. The authors explicitly distinguished the integrity of recorded downstream information from complete seed-to-consumer traceability. This limitation represents one of the most important conceptual lessons for the broader field.

The principal research gap is therefore no longer whether blockchain can technically record food-supply-chain events. Numerous architectures and pilot systems have already demonstrated that capability. The more important gap concerns the design of proportionate blockchain-supported traceability for local food networks where economic resources, technological skills, data requirements, trust relationships, and volumes differ from large-scale supply chains.

A second gap concerns the difference between transparency and visibility. Visibility means that information can be seen. Transparency requires that stakeholders understand the relevance, origin, credibility, and limitations of that information. Showing consumers a long blockchain transaction identifier does not create meaningful transparency. A short explanation of producer identity, location, production date, certification, and batch journey may provide far greater practical value.

A third gap concerns governance. Many technology-focused studies emphasize cryptography and system architecture but devote less attention to who determines mandatory data fields, who verifies identities, who corrects genuine mistakes, how disputes are handled, who pays for system operation, and who controls access to commercially sensitive data. These questions become central in producer cooperatives and community-oriented local food systems.

The present research therefore uses a structured narrative review and conceptual synthesis rather than presenting itself as a completed systematic review or empirical experiment. Relevant peer-reviewed literature published primarily from 2022 through August 11, 2026 was considered together with selected foundational traceability research and official interoperability standards. Search concepts included blockchain food traceability, local food supply chains, short food supply chains, alternative food networks, agri-food blockchain adoption, consumer transparency, food provenance, QR-code traceability, blockchain governance, and interoperability.

The analytical corpus emphasized studies that contributed direct evidence on blockchain-supported food traceability, technology adoption, transparency requirements, local-food implementation, or standardized data exchange. The Green Point operational case was included because it directly corresponded with the present title and provided recent empirical evidence of blockchain integration in a short food supply chain.

Table 1: Selected Evidence Used in the Conceptual Synthesis

Study	Research Focus	Main Relevance to This Paper
Burgess, Sunmola, and Wertheim-Heck, 2020	Information needs in blockchain-enabled sustainable food chains	Shows that transparency should prioritize useful product, safety, origin, processing, and sustainability information
Chiaraluce et al., 2020	Blockchain in high-value agri-food chains	Highlights traceability, food safety, fraud prevention, and provenance
Mbadlisa and Jokonya, 2019	Blockchain adoption factors	Identifies cost, scalability, organizational capacity, knowledge, and policy as adoption constraints
Toader et al., 2018	Organizational blockchain adoption	Shows importance of partner preparedness, usefulness, effort, and trust
Charlebois et al., 2021	Digital traceability across agri-food systems	Supports the importance of digital traceability for transparency and consumer confidence
Vitaskos et al., 2015	IoT and blockchain food traceability	Demonstrates integration of product tracking with complementary digital technologies
Apeh and Nwulu, 2017	Blockchain, traceability, and sustainability	Shows continued research emphasis on traceability and sustainability while recognizing adoption challenges
Balaic et al., 2012	Operational blockchain-enabled local food market	Provides direct evidence from a short food supply chain involving local farms, QR codes, digital records, and consumers

Source: Author synthesis of the cited scholarly literature. This table summarizes the analytical corpus and does not represent new empirical observations.

The study evaluates blockchain-supported local food traceability through six interdependent dimensions: information relevance, record integrity, physical-digital verification, interoperability, governance, and adoption feasibility. These dimensions are used as conceptual lenses rather than numerical performance variables.For potential future field validation, a five-question stakeholder instrument is proposed. It was not administered as part of this review.

Table 2: Proposed Five-Item Questionnaire for Future Local Food Traceability Research

No.	Proposed Question
1	How important is verified farm-of-origin information when you purchase locally produced food?
2	Which product information would you most frequently check through a traceability QR code before purchasing?
3	How much confidence would you place in blockchain-supported records when the producer and certification source are clearly identified?
4	What is the main practical barrier to using digital traceability in your local food supply chain?
5	Would you continue using a traceability system if it improved product verification without substantially increasing administrative work or product cost?

3. Blockchain-Supported Traceability in Local Food Networks

A useful local-food blockchain system begins with product identification rather than blockchain itself. Every traceable food product requires a relationship between the physical item and a digital identity. Depending on the commodity, the traceable unit may be an individual packaged product, a crate, processing batch, harvest lot, animal product lot, or delivery consignment. The appropriate level of traceability should reflect practical risk and economic value.

Batch-level identification is often more feasible than individual-item tracking for fresh produce. A farmer harvesting tomatoes from a particular field on a defined date may create one digital batch record. That batch can subsequently be divided into deliveries while maintaining its relationship with the original production event. Excessively granular tracking could impose substantial administrative costs without producing equivalent transparency benefits.

The producer's identity is the next essential component. Blockchain systems are frequently described as reducing the need for trust, but food traceability does not eliminate identity-based trust. If anyone can create a digital identity claiming to represent a farm, the ledger offers limited protection. Permissioned systems therefore require a reliable onboarding mechanism through which farms, processors, transporters, distributors, and retailers are authenticated before they can enter traceability events.

A permissioned consortium architecture is particularly appropriate for local food networks because it allows participating organizations to define governance collectively. The Green Point case used a consortium blockchain model rather than an unrestricted public-chain design and selected a permissioned environment partly to avoid potentially prohibitive transaction costs. This approach also allows participants to determine which information is publicly visible and which is restricted to authorized organizations.

The production record should then capture the minimum data necessary to support a credible product history. Depending on the commodity, this may include production location, product type, planting or production date, harvest date, processing activity, batch number, certification, and delivery details. The objective should not be to transfer every farm record onto the ledger but to identify critical traceability events.

In the Green Point implementation, producers recorded production activities and generated digital delivery notes. The system incorporated timestamps, stakeholder identity, signatures, production or processing region, dates, batch information, and related logistical data. Photographs and supporting digital evidence could be connected through external decentralized storage technologies.

This design illustrates another important principle: large files should not necessarily be stored directly on the blockchain. Photographs, laboratory reports, certificates, invoices, and sensor histories can consume significant storage and may contain sensitive information. A practical architecture can retain these records off-chain while recording cryptographic references or hashes that help verify whether the associated document has been modified.

The transfer stage links product movement with changes in responsibility. A farmer may transfer a lot to a collection center, the center may deliver it to a processor, and the processed product may move to a retailer. Each transfer should record who transferred the product, who received it, which batch was involved, when the event occurred, and what quantity was accepted. This creates a chain of custody.

Digital delivery systems can also reduce repetitive administrative work. Green Point's earlier paper-based process required manual information entry for each delivery. The later traceability model connected digital acceptance records with the existing VASCO business system, allowing relevant data to move into established operational workflows. This integration is important because successful traceability should simplify or replace existing documentation where possible rather than adding an entirely separate reporting burden.

Processing creates additional complexity because one batch may be transformed into several outputs or multiple inputs may be combined. A local juice producer, for example, may receive apples from several farms. If those apples are combined in one processing batch, the system should preserve the relationship between all source lots and the final bottled batch. This type of transformation event is essential if blockchain traceability is expected to support targeted recalls or origin verification.

Blockchain-supported transparency should consequently be tiered. Consumers may access farm name, approximate production location, production method, batch history, certification, and relevant sustainability information. Supply-chain partners may access more detailed logistics and transaction records. Auditors and authorized regulators may receive additional evidence where necessary.

Smart contracts may further automate defined rules. A smart contract could prevent acceptance of a shipment without a valid lot identifier, flag an expired certification reference, record acknowledgment of delivery, or automate defined payment conditions. However, smart-contract automation should be used selectively. Local food supply chains often involve biological variability, seasonal disruption, partial deliveries, quality negotiation, and informal coordination that do not always fit rigid automated rules.

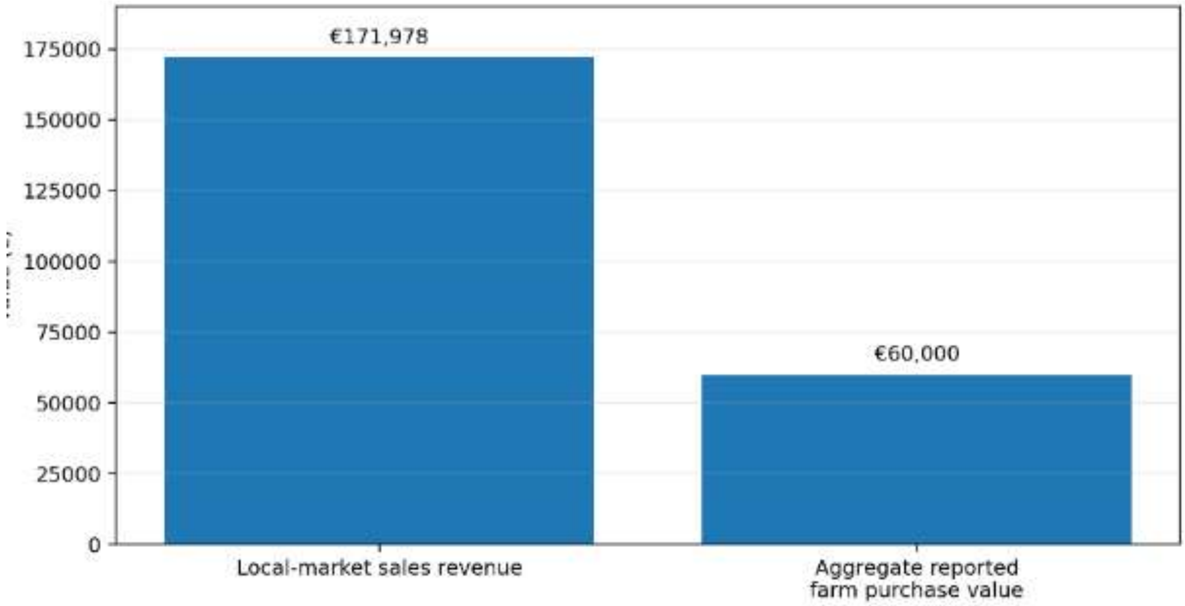
The underlying governance model therefore remains more important than the blockchain code itself. Participants must agree on data ownership, correction procedures, validation responsibility, mandatory fields, access rights, dispute resolution, cost allocation, software maintenance, and consequences of deliberate misinformation.

4. Results and Discussion

The conceptual synthesis indicates that blockchain-supported traceability can provide genuine value in local food chains when it improves the integrity and accessibility of information that stakeholders already need. The strongest benefits arise in provenance verification, coordination, consumer communication, digital documentation, accountability, and the ability to reconstruct product movement.

The most relevant recent empirical evidence comes from the Green Point case. Between 2023 and 2025, 12 farms participated in the local market and used the same traceability infrastructure. More than 50 products were included, and the local market reported €171,978 in sales revenue. The source also reported purchase values of €5,000 for each of 12 participating agricultural holdings in its financial presentation.

Graph 1: Reported Financial Indicators from the Green Point Local Food Case,



Source: Author-prepared graph based on financial indicators reported by Balaic et al. The €60,000 aggregate purchase value is calculated from the source's reported €5,000 purchase value for each of 12 agricultural holdings. The comparison should not be interpreted as a profit calculation because the categories represent different financial indicators and do not include the complete cost structure.

The graph is useful because it demonstrates that blockchain traceability can operate within a functioning commercial local-food network rather than only within a laboratory prototype. It does not demonstrate that blockchain caused the reported revenue. No causal inference should be made from the financial values. The importance of the case lies in operational continuity: farms, products, business information, deliveries, QR codes, and consumers were integrated into a traceability environment that remained active beyond the initial development period.

The first major analytical result is therefore that blockchain creates the greatest value when it is integrated with routine supply-chain processes. A stand-alone blockchain database requiring duplicate manual entry is unlikely to achieve sustained adoption. The Green Point experience indicates that integration with existing procurement and business-information systems can reduce repeated entry and improve workflow continuity.

The second result concerns producer visibility. Local farmers frequently compete with products that may be marketed using generalized terms such as fresh, natural, regional, traditional, or locally sourced. Traceability provides a mechanism through which a genuine local producer can attach verifiable identity and production history to the product. The technology therefore has potential to transform provenance from a marketing assertion into a traceable claim.

This is especially relevant in markets where the economic value of food partly depends on its geographic identity. Chiaraluce and colleagues observed that blockchain research has focused strongly on high-value food sectors where authenticity and fraud risk are important. Local food markets face a similar but smaller-scale challenge because the claim of locality itself may contribute to value.

The third result concerns consumer trust. Trust should not be interpreted as a direct consequence of the word “blockchain.” Consumers may neither understand nor care which distributed-ledger protocol is operating behind a QR code. Trust is more likely to emerge when the system communicates information that consumers consider relevant and when the provenance of that information is clear.

Burgess and colleagues' study reinforces this point by demonstrating that food-system stakeholders prioritize concrete information concerning safety, quality, origin, and product composition. Blockchain should therefore remain an infrastructure layer. Consumer communication should concentrate on the food itself.

The fourth result concerns traceability during product problems. A well-designed system can allow stakeholders to identify affected batches without assuming that every product from every producer is involved. This can theoretically reduce the scope of unnecessary withdrawal and accelerate investigation. However, recall effectiveness depends on accurate batch identification and consistent event capture. Blockchain cannot reconstruct an event that was never recorded.

The fifth result concerns fraud deterrence rather than fraud elimination. An immutable record may increase accountability because participants know that recorded statements and signatures remain visible. This may discourage retrospective manipulation. Yet fraud can still occur before data reach the blockchain. A dishonest actor may attach a legitimate QR code to an illegitimate product or submit false production information. Blockchain should therefore be combined with physical controls and verification.

The sixth result concerns interoperability. Local food networks rarely operate in complete technological isolation. Farms may use mobile applications, cooperatives may use spreadsheets, processors may have enterprise systems, and retailers may have point-of-sale software. Standardized identifiers and event models can reduce integration costs. The GS1 EPCIS approach is relevant because it provides a common framework for sharing traceability-event information across organizational systems.

The seventh result concerns adoption economics. Blockchain implementation may be technically feasible but still fail when actors cannot justify the cost. Mbadlisa and Jokonya found cost, scalability, organizational size, knowledge, management competency, policy conditions, and participation to be recurring adoption factors in the literature they reviewed. Local-food systems are particularly exposed to these constraints because individual producers may have small transaction volumes.

Shared-service models may address this challenge. A cooperative, farmers' organization, local market operator, municipality, certification body, or food hub could operate the blockchain infrastructure on behalf of multiple producers. Farmers would then interact through a simple mobile application rather than maintaining blockchain nodes individually.

The eighth result concerns digital inequality. A traceability system designed around continuous high-speed connectivity and advanced digital literacy may exclude precisely the small producers that local food initiatives intend to support. The system should therefore accommodate simple interfaces, intermittent connectivity where possible, local-language instructions, assisted onboarding, and minimal repetitive entry.

The ninth result concerns sustainability claims. Blockchain can record evidence related to production practices, certification, transport distance, or input use, but it cannot independently establish that the underlying practice is environmentally sustainable. Sustainability information requires defined measurement protocols and credible verification.

A blockchain entry stating that a farm uses sustainable practices is weaker than a record linking a recognized certification, audited production standard, measured indicator, or documented management practice with the identified batch. Transparency should therefore communicate evidence rather than unsupported labels.

The tenth result concerns power relationships. Local food systems often seek to strengthen farmers' market position by reducing dependence on long chains of intermediaries. Yet digital platforms can themselves become new intermediaries when one technology provider controls identities, data access, consumer interfaces, and pricing. Blockchain does not automatically decentralize economic power.

The final result concerns the limits of transparency itself. More information does not necessarily produce better decisions. Consumers have limited time and attention. A successful traceability system should distinguish essential information from specialist information.The consumer interface could provide a concise provenance summary while allowing deeper access to production details, certifications, and batch history. Regulators and supply-chain partners may require more technical information than ordinary consumers. The same underlying traceability architecture can serve different levels of informational depth.

5. Practical Implications and Future Direction

The practical implication for local food organizations is that blockchain adoption should begin with a traceability problem rather than with a technology procurement decision. A producer network should first determine which claims require verification, which actors contribute data, where information currently becomes fragmented, and which existing records can be digitized.

A local vegetable cooperative concerned primarily with origin verification may require a simpler system than a regional network handling meat, processed foods, allergens, temperature-sensitive products, and certification schemes. Traceability depth should correspond to product risk and information value.The next priority should be the identification of critical tracking events. These include production, harvesting, transformation, transfer, receipt, storage, packaging, and sale where applicable. Each event should have a clear responsible actor and a defined minimum dataset.The information architecture should then distinguish mandatory from optional fields. Mandatory fields should remain limited to those needed for traceability, safety, provenance, legal compliance, or core consumer communication. Additional photographs, sustainability information, producer stories, or extended production details can be added where they create clear value.Participant identity management should be established before the blockchain network becomes operational. Farms and businesses should be verified through an appropriate local authority, cooperative, market operator, certification organization, or other trusted onboarding mechanism.Governance must also define how incorrect records are addressed. Genuine errors are inevitable. The appropriate response is normally to append a transparent correction while preserving the original historical record rather than silently rewriting the blockchain.

System financing deserves equal attention. A network may use cooperative membership fees, transaction-based charges, public support, retail contributions, certification service revenue, or shared digital-infrastructure funding. Whatever model is selected should avoid disproportionate cost burdens on the smallest producers.Blockchain infrastructure should be evaluated against simpler alternatives. A centralized traceability database may be sufficient when one trusted organization legitimately controls the entire network and stakeholders accept that authority. Blockchain becomes more compelling when independent actors require a common historical record but do not wish any single commercial participant to possess unilateral control over it.This comparison is important because blockchain should not be adopted merely for technological visibility. The objective is improved traceability, not the presence of blockchain.

Future systems are likely to integrate blockchain more closely with IoT sensing, standardized product identities, mobile data capture, automated certificates, and intelligent anomaly detection. Yet automated systems should be approached cautiously. A sensor can generate large quantities of data, but an unreliable sensor can produce equally large quantities of incorrect data.

Data verification and calibration therefore remain essential. Advanced analytics and artificial intelligence may eventually identify suspicious volume relationships, impossible transport sequences, unusual temperature histories, or inconsistencies between farm production capacity and recorded sales. Such systems could strengthen fraud detection, but human investigation would still be required before concluding that misconduct occurred.

Recent research also points toward more operational rather than purely conceptual blockchain studies. The 2020 Green Point evidence demonstrates the value of investigating actual short-chain businesses instead of limiting research to proposed architectures. Future studies should therefore measure cost per traceable transaction, farmer workload, consumer QR-code use, error rates, adoption retention, product recall performance, trust outcomes, and the economic value of verified origin information.

6. Conclusion

Blockchain-supported traceability can strengthen transparency in local food supply chains by creating a shared, tamper-resistant historical record of defined production, processing, transfer, and distribution events. Its potential is particularly relevant where local-food value depends on credible claims concerning producer identity, geographic origin, production method, certification, freshness, and community provenance.

Recent evidence demonstrates that blockchain can function operationally in short food networks. The Green Point case involved 12 farms, more than 50 traceable products, QR-code-based consumer access, digital delivery records, business-software integration, and geographically localized distribution. These results show that blockchain-supported traceability is no longer confined to theoretical architecture.

However, blockchain should not be confused with truth generation. The technology can protect the integrity of recorded information after entry, but it cannot guarantee the accuracy or completeness of information that was never independently verified. This limitation is clearly demonstrated by the Green Point case itself, where upstream input suppliers remained outside the authenticated traceability boundary.

Successful systems therefore require verified participant identities, clear chain-of-custody procedures, appropriate product identifiers, standardized event structures, integration with existing business software, proportionate physical verification, consumer-readable interfaces, privacy controls, and transparent governance.

The study further concludes that permissioned consortium architectures are generally more compatible with localized food networks than unrestricted public blockchain models because participating organizations can control governance, access, cost, and commercially sensitive information. This does not imply that one technical platform will suit every local-food network.

Adoption must also remain economically proportionate. Cost, scalability, knowledge, organizational readiness, stakeholder participation, and policy conditions continue to influence blockchain adoption. Shared infrastructure operated through cooperatives, food hubs, local-market organizations, or regional producer networks may therefore be more appropriate than expecting each small farm to maintain independent blockchain infrastructure.

Blockchain should ultimately support rather than replace the social trust that makes local food distinctive. Its greatest value lies in extending credible provenance beyond direct face-to-face relationships and allowing consumers, producers, processors, retailers, and institutions to share a consistent product history.

Transparent local food supply chains will not emerge from blockchain alone. They will emerge when accurate data, appropriate verification, fair governance, interoperable systems, accessible interfaces, and local producer participation are combined within a technology that makes trustworthy information easier to preserve and communicate.

7. Limitations and Future Research

The present study is a conceptual review and does not report an original blockchain deployment, controlled field experiment, or consumer survey. The Green Point financial and operational data are drawn from a recently published external case study and are not results generated by the present author. No causal relationship between blockchain adoption and revenue is claimed.

The literature synthesis was structured and targeted but was not conducted as a formal PRISMA systematic review or meta-analysis. Consequently, future evidence-mapping studies should search multiple bibliographic databases through reproducible queries, document screening decisions, evaluate study quality, and compare blockchain implementations across commodities and geographic regions.

Future empirical studies should examine local food systems before and after traceability implementation. Important outcomes include information-entry time, transaction cost, traceability completeness, recall speed, producer income, administrative burden, consumer scanning behavior, willingness to pay for verified provenance, trust formation, error frequency, and long-term platform retention.

Comparative trials between blockchain-supported and non-blockchain digital traceability systems are especially necessary because blockchain's incremental value can otherwise be overstated.Additional work should examine data governance, interoperability, privacy, digital exclusion, farmer bargaining power, and vendor dependency. Research should also determine whether verified traceability helps small producers capture a greater proportion of product value rather than primarily benefiting retailers or technology providers.

8. Declarations

Conflict of Interest: The sample author declares no conflict of interest related to the conceptual preparation of this manuscript.

Funding: No external funding is reported for this conceptual review.

Ethics Statement: The manuscript does not report original research involving human participants or animals. The five questionnaire items presented in Table 2 constitute a proposed instrument for future research and were not administered. Appropriate ethical approval and informed consent should be obtained before future human-participant studies where required.Data Availability: No original empirical dataset was generated. The financial values used in Graph 1 were derived from the published Green Point case study cited in the manuscript.

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