

AquaChain: A Blockchain-Based Framework for Transparent Water Footprint Tracking in Agricultural Supply Chains

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RESEARCH QUESTION

How can blockchain technology be used to create a transparent, verifiable, and scalable system for tracking agricultural water footprints?

BACKGROUND

Agricultural water footprint data is fragmented and difficult to verify and lacks transparency. AquaChain addresses this by integrating global datasets with a blockchain-based framework for secure and transparent tracking.

IMPACT STATEMENT

Improves transparency and accountability in agricultural water usage through verifiable, tamper-proof blockchain records.

WHY BLOCKCHAIN?

Transparency
→ Immutable and verifiable records

Traceability
→ Track data using transaction IDs

Security
→ Cryptographic integrity & tamper resistance

WATER FOOTPRINT CALCULATION

$$\text{Total Water Use} = \text{Production} \times (\text{Green} + \text{Blue} + \text{Grey})$$

Green: rainwater, Blue: irrigation water, Grey: pollution-adjusted water.

USER INTERACTION FLOW

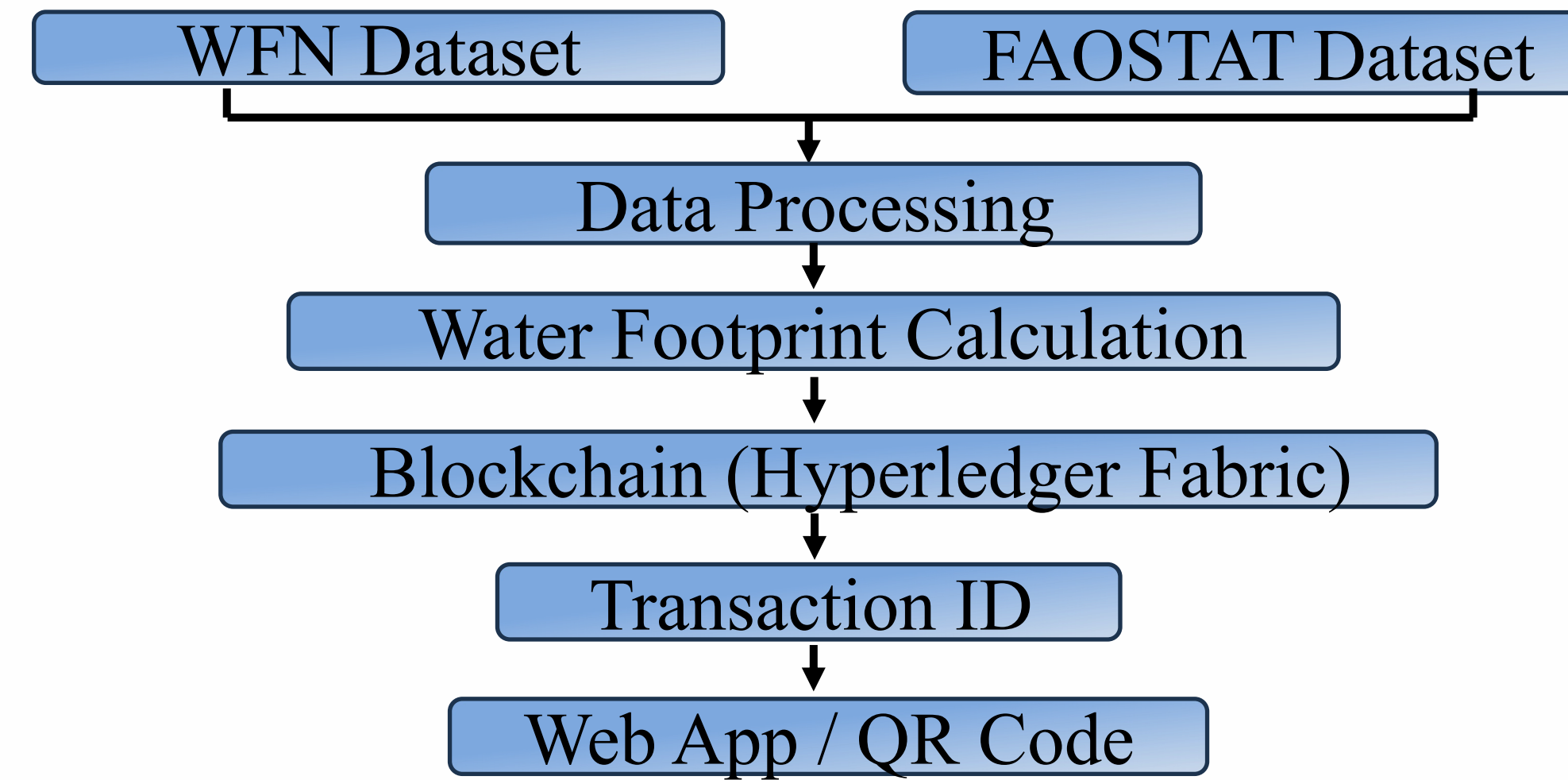
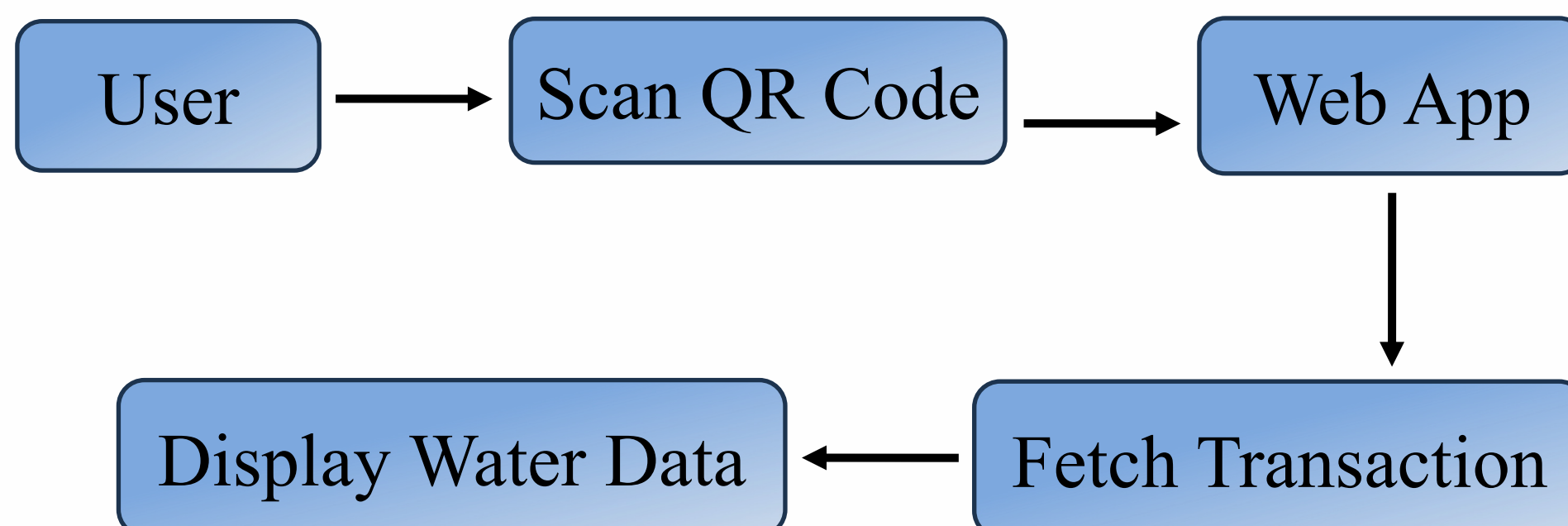


Fig: AquaChain workflow from data processing to blockchain-based user access.

Blockchain Implementation

Stores dataset hashes + metadata for integrity and traceability. Uses Hyperledger Fabric (permissioned, scalable).

METHODOLOGY

- Integrated Water Footprint Network and FAOSTAT datasets
- Computed crop-specific water usage across regions
- Processed data off-chain for scalability
- Stored cryptographic hashes on blockchain
- Enabled traceability using transaction IDs

AquaChain Output	
Country:	India
Crop:	Wheat
Production:	110.55 million tons
Water Footprint (m ³ /ton)	
Green	633.94
Blue	1171.19
Grey	295.05

Fig: Display of processed blockchain data to users on the website.

RESULTS/PROGRESS

- Successfully integrated WFN and FAOSTAT datasets
- Extracted crop-specific water footprint values
- Designed hybrid off-chain and on-chain architecture
- Developed a functional data processing prototype
- Successfully processed and validated water footprint data for crop-region combinations (e.g., wheat in India).

CONCLUSION & FUTURE WORK

AquaChain demonstrates how blockchain enhances transparency in water footprint tracking. Future work includes full integration, real-time updates, and QR-based access.



Fig: QR-enabled system for accessing verified water footprint data through a mobile interface.

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