The AI-Kisaan Mandi: Transform Indian Agricultural Markets through Machine Learning, Blockchain and Digital Infrastructure

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ABSTRACT

Now day the farmers are totally depends on the APMC(Agricultural produce market committee) or the brokers to sold there grown crop, and GOVT helps to farmer to connect or expand the Agricultural trade across the global or India on the e-NAM(National Agricultural Market) to gain more profit's on every trade instead of APMC or BROKER.There is predefined limitations or disadvantages like disjointed transportation or logistics, Limited instrument or resource to quality assessment, Hamper settlement, inadequate money flow, and etc..

This paper represent the pure concept of agricultural with Computer vision, Predictive crop analysis, Block chain that create a smart contact, AI it leads the farmer for bright future, and Public infrastructure to modernise agriculture market as The AI-Driven Kisaan Mandi.The proposed to develop the infrastructure integrates intelligent price forecasting, AI-based financial incorporation to improve transparency, Centralised payment system , Sustainable profit on every trade, Efficiency, and Farmer contributions throughout the agricultural value chain.

INTRODUCTION

The Bharat has developed APMC empire where most farmers and agricultural trade has been depend's from Last many decades. The APMC market was introduce in 1960s for small-scale farmers to victimise local trading cartels, although citizens were slowly developed or moved to local Mandi system but there has lot of inadequacies. The small-scale farmers was touch 86% of Bharat's operative grown crop holding, and they were experiencing disjointed supply chain, insufficient market information, high duty tax on transaction's and synchronised non value adding mediator.

When ever the farmers were moving towards on Mandi system the prices were persistence within conventional Mandis is frequently influenced by the Brokers to gain more profit themselves, there for the resulting in unfair prices and profit was deducted from farmer's. There has lot of thing on this marketplace that's why the farmer's restrict theirselves to involve or participate in regulated market. To decline these challenges or face, The Government of Bharat Establish the e-NAM (National Agriculture Market) as a Future of an Bharat it integrated with Agriculture Produce Market Committee (APMC), so the farmers can trade digitally with biased money flow.

Through a e-NAM the Government introduce terms of registration Farmer, Trader, Trade volume, Farmer producer organisation's and mounting trade value, and many several identified things that might effect on the e-NAM. The government extract or collected the information about farmer's but at point of investigation real market they were find several things (disjointed transportation, inadequate grown crop quality, advancedness technology, delay on digital payment, although the insufficient money flow that's indicate unsold out grown crop by farmers.)

The AI-driven Kisaan Mandi help's to redirect or point the limitations by combining intelligent price forecasting, AI-based financial incorporation to improve transparency, Centralised payment system , Sustainable profit on every trade, Efficiency, and Farmer contributions throughout the agricultural value chain.

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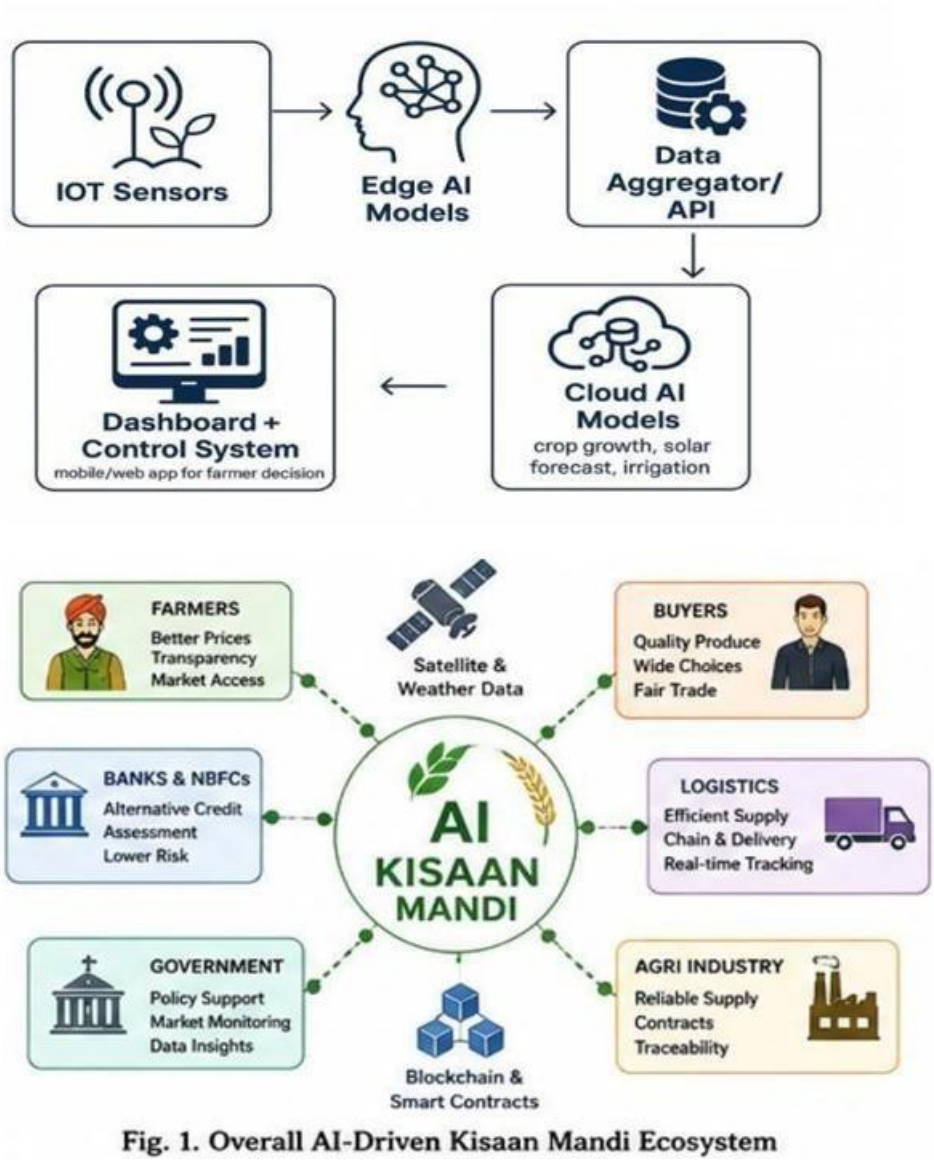

Fig. 1. Overall AI-Driven Kisaan Mandi Ecosystem

2.Smart quality checks and on-the-ground AI:

In the agricultural market we need to present or clarify the quality of grown crop with help of CNNs(convolutional neural networks) and YOLO(Object-detection AI-System) could be able to unambiguous quality report.

REAL TIME,Now farmer's can check or allocate the grade of grown crop, and instantly check the health of grown crop and detect pests on the field by latest technology available at affordable smart device's or mobile phone.

A Facilitated models now time trimming or compressing large AI model with unwanted data points or parameters, so the smart device could work properly within faster accuracy, intently predict diseases, and affordable price.

Despite of Individual, temper-resistant quality certification, comprehensive quality assessments, raw material commodities and automation on the quality of fresh fruits and vegetables, delivered or introduced by the Intello labs and AgNext technologies.

More-ever, these model are trained within supervised data and reinforcement method. Although there are possible outcomes for crush or interrupted when hostile weather , rapid market fluctuations and many-more. So the their predictive reliability tends to degrade.

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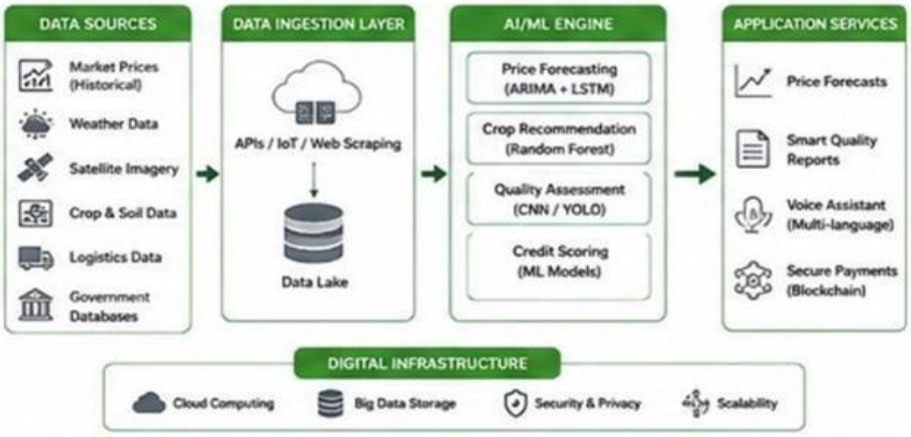


Fig. 2. Proposed System Architecture of AI Kisaan Mandi

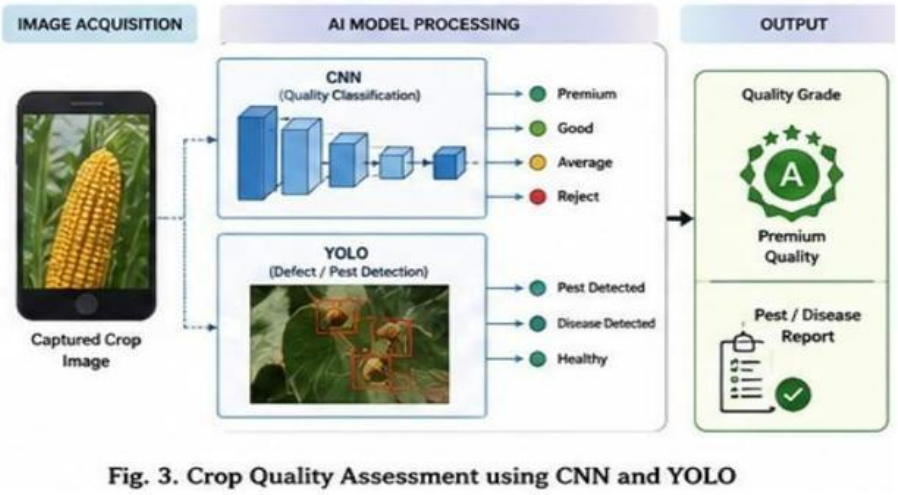
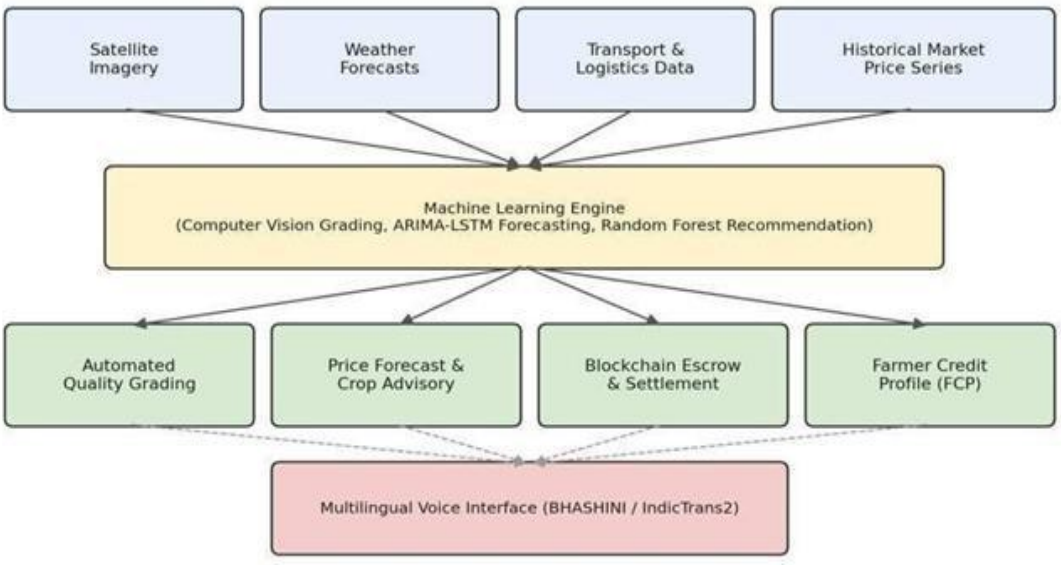


Fig. 3. Crop Quality Assessment using CNN and YOLO

The Kisaan Mandi Approach:

To point drawback's above, Kisaan Mandi fuses the satellite imagery, weather forecasts, transport and logistics data, and decades of market price data on the single ML engine. Whenever we diverse this element subsequently then able to produce or accurate model that meet the climate conditions, marketplace fluctuations and at ground level agricultural activity. Figure 1 summarises the overall system architecture, from raw data ingestion through to the four downstream services offered to farmers.



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Hybrid Forecasting Model:

The Kisaan Mandi used two formula to analyse goods prices, an ARIMA(Autoregressive Integrated Moving Average) algorithm detect or capture the Agricultural cycle of prices based on demand or historical form, Seamlessly attention on the LSTM (Long Short-Term Memory) network system leftover, difficult to predict the fluctuations, by to gathering these elements for forecasting accurately measured by 15-25% as compare to traditional SARIMA (Seasonal Autoregressive Integrated Moving Average) baseline. The results to combining these model as price forecast are strong, and climate-related variable. Despite the random forest model generate crop guidance report with reached at 96% above accurate.

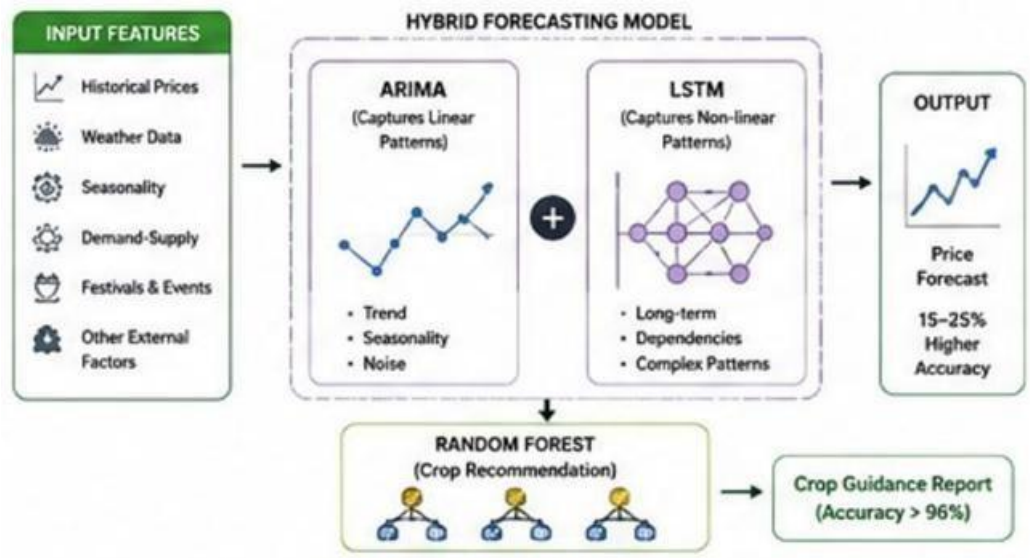


Fig. 4. Hybrid ARIMA–LSTM Price Forecasting Framework

Natural Language and the Voice Pipeline:

Using kisaan Mandi farmer can speak directly to their phone in his own language. The system understand the requirement and give response in their own language. This is enabled by India's BHASHINI project. Using open source translation software, BHASHINI is able to take farming information and technical answers and translate them into any regional language without distortion of meaning. example: If I speak in a Hindi language so the system Send back a response in a Hindi language.

how it works:

STEP 1: The query is entered by the farmer.

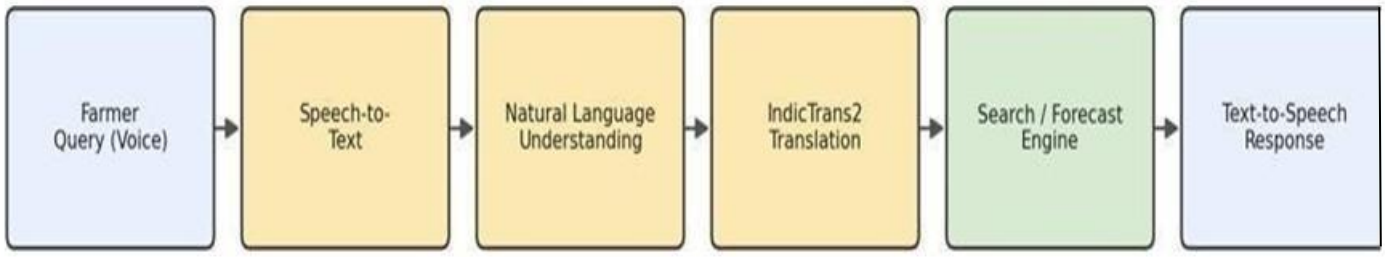
STEP 2: Speech to text.

STEP 3: Natural language understanding determines the focus of the request.

STEP 4: Translates as required in IndicTrans2.

STEP 5: Forecasts the answers in the system or searches the answer in the system database.

STEP 6: Once the processing is done, it will converted back to the result and a speech engine will speak it out.



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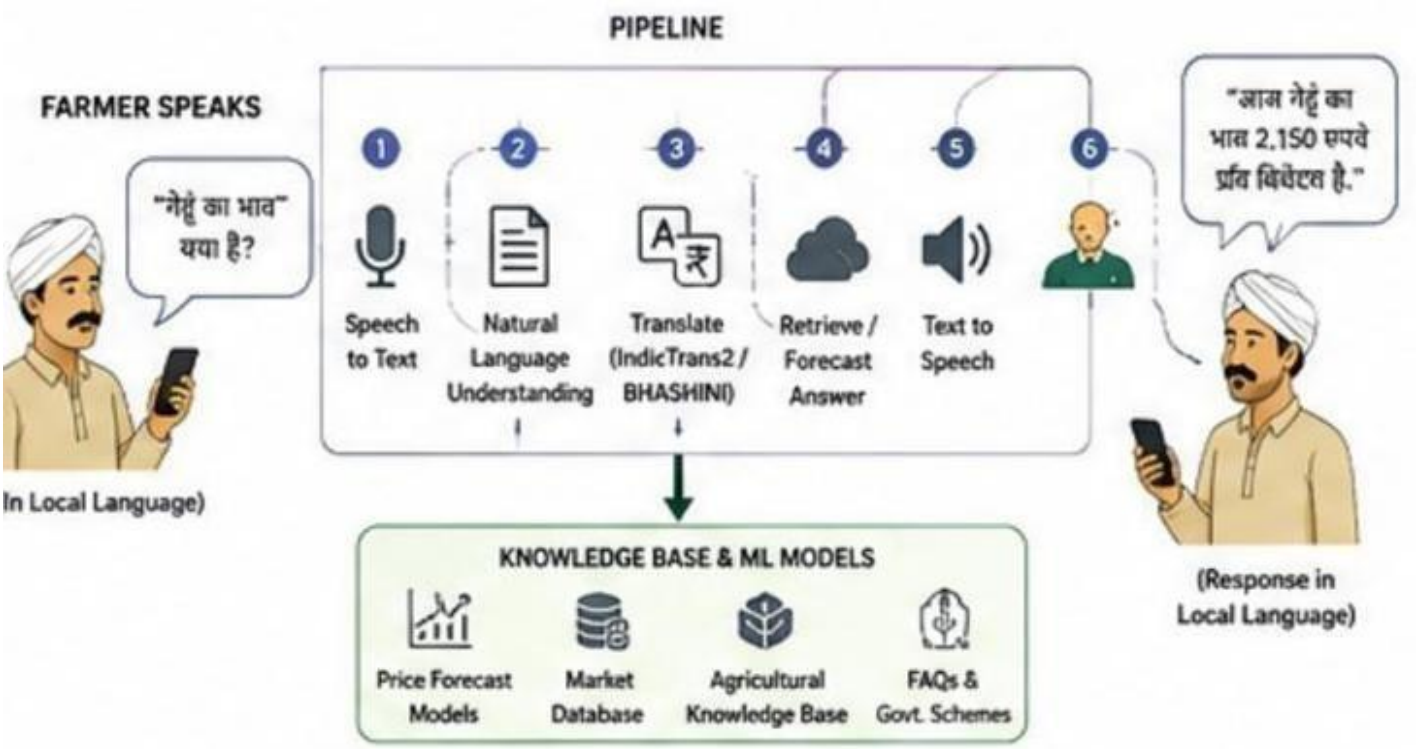

Fig. 5. Multilingual Voice Processing using BHASHINI

Kisan-eMitra: A real-world example

This approach is Follow from a Kisan-eMitra platform which is developed by Wadhwani ai in collaboration with google.org, Bhasin, NIC and samagra. it interacts with the farmers in their local language and provides customized up-to-date responses on registration, payments, land records, KYC and crop insurance.it handles more than 13,000 queries/day and over 2.6 million queries till date and it has Increase the efficiency of solving farmer issue.

Practical Use: imagine a farmer quiring receiving the answer 'what is the price of wheat today? And will it rise next week?

Follow the platform as it works on numbers, analyze the data, find the forecasts, and reports back on the trends for non technical users.

Blockchain Payments and Cartel Detection:

Despite having intelligent trading and pricing systems, the Financial instruments of smart Kharid, payment and settlement, are still the biggest nightmare: slow processing, paperwork, hidden charges, and investor mistrust continue to hurt the farmers. Kisaan Mandi addresses this by locking in the payment through Blockchain, Smart Contracts. A transaction deposit automates the clearing and settlement processes: As soon as a buyer agrees a graded lot, the money is sent into escrow.

Once delivery is confirmed, funds are released to the farmer automatically. If there are issues, the money is held until referred to an arbiter. In case of no complaint within 72 hours, the funds allocated lock automatically clears to the farmer. Platforms for live systems already using a combination of Ethereum and IPFS for individual, improve security, receive payment and settlement.

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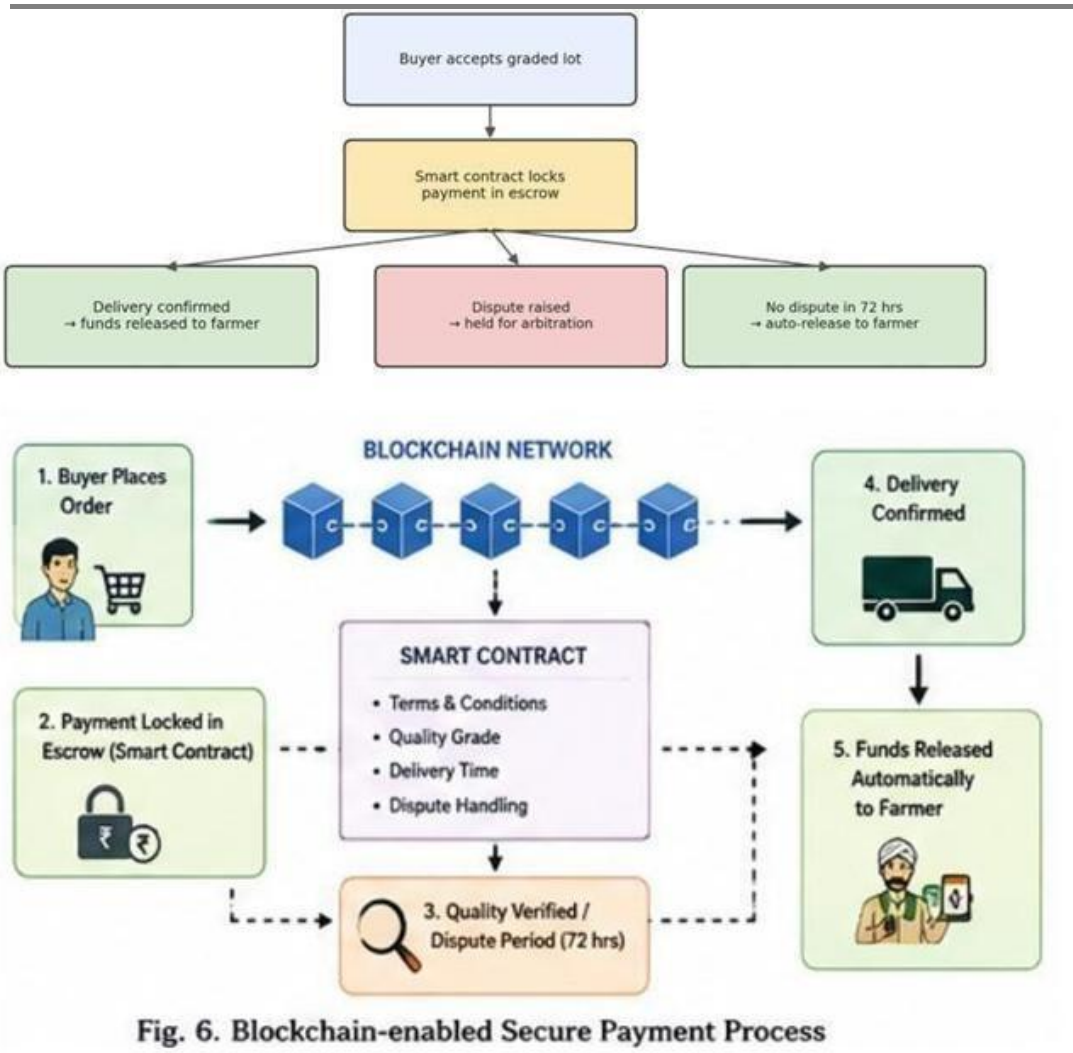

Fig. 6. Blockchain-enabled Secure Payment Process

Alternative Credit Assessment:

- Most farmers don't have credit history, bank statements, or land papers in their name.
- Their income changes with the seasons and the weather — it's not steady month to month.
- Cash transactions don't go to credit bureaus.
- Relationship-based lending often requires physical bank branches which are often not present in rural areas. That excludes many small farmers who work land they don't own in a legal sense, or who have plots too tiny to attract a bank's interest. Kisaan Mandi does not ask "What is in your ownership?"

It looks at such matters as:

- Your sales history over time – what you've sold
- How much you grow, season after season, your yields
- How good your produce is – quality scores, checked using computer vision (basically a camera + AI grading your crop instead of a person).
- How you save or invest – Any money activity you have done in the platform.

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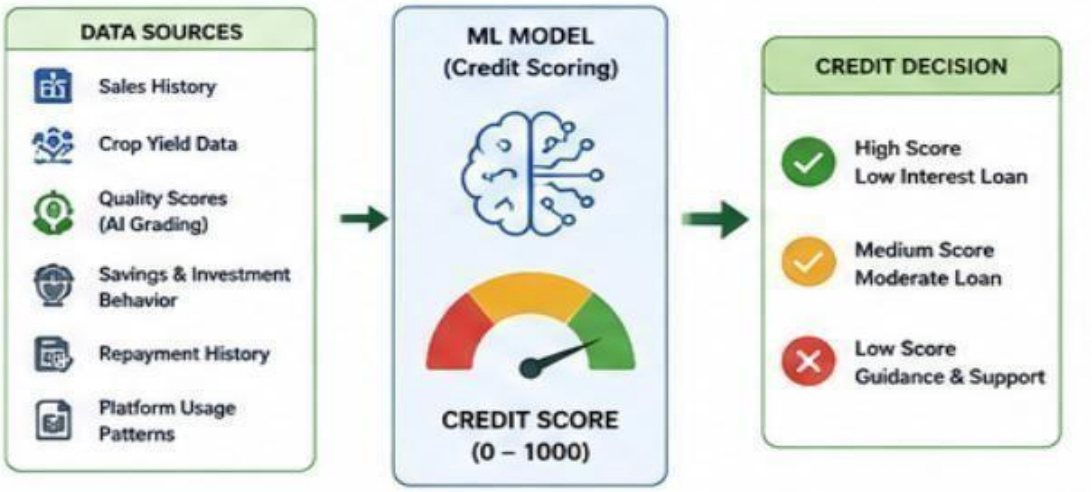


Fig. 7. AI-Based Farmer Credit Assessment Model

Digital Infrastructure for Farm Loans (DIF):

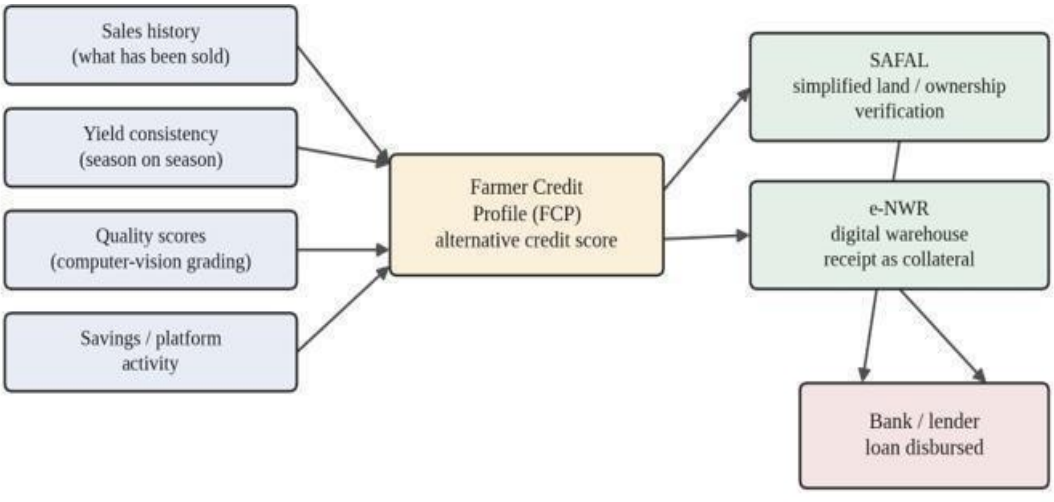
Government-built shared digital systems that securely move a farmer's ID, money, and records between apps such as Kisaan Mandi and banks.

SAFAL (Simplified Application For Agricultural Loans):

- It facilitates land details with less paperwork.
- Small farmers are often caught at the first hurdle, proving ownership of the land helps farmers to get loans with minimum assets.

e-NWR (Negotiable Warehouse Receipt):

- A digital receipt showing a farmer has stored crops in a government approved warehouse.
- That slip can serve as collateral to a bank loan.
- The quality of crops is graded, not estimated.



Alternative credit assessment: platform-derived signals feed the Farmer Credit Profile (FCP), used with SAFAL and e-NWR to access formal bank loans.

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Comparing Market Models: APMC Mandis:

shop land inspections, on-spot bidding, payments through cash and credits according to your physical possession.

e-NAM:

Lab quality tests, Easy-to-use bidding apps, Digital payments and Warehouse linkages.

Kisaan Mandi :

Automated grading, multilingual speech interface, deep-learning prediction of prices, secured blockchain based contracts, machine- learned credit bureau. The new model transforms the market from a transactional structure to a genuine service ecosystem-a place where everyone from farmers to bankers and governments can hook in and work together in real time.

	APMC Mandi	e-NAM	Kisaan Mandi
Quality assessment	Visual, on-spot inspection	Lab-based quality tests	Automated CV grading
Price discovery	Local bidding, broker-influenced	App-based bidding	ARIMA-LSTM price forecast
Payments & settlement	Cash / credit, manual	Digital payments	Blockchain escrow
Language access	Local language only (informal)	Limited language support	Multilingual voice (BHASHINI)
Credit access	Informal, collateral-based	Not addressed	AI credit score (no collateral)

Fig. 6. Comparison of APMC Mandi, e-NAM, and Kisaan Mandi across quality assessment, price discovery, payments, language access, and credit access.

COMPARATIVE ANALYSIS OF AGRICULTURAL MARKET MODELS

	APMC MANDIS	e-NAM	KISAAN MANDI
Quality Assessment	Manual Inspection	Lab Based	AI Automated Grading
Price Discovery	Local & Opaque	Digital Bidding	AI Forecast + Digital Bidding
Language Support	Local (Limited)	English / Hindi	Multi-language Voice Interface
Payment System	Cash / Credit	Digital Payments	Blockchain Smart Contracts
Credit Access	Limited	Limited	AI-based Credit Scoring
Transparency	Low	Medium	High (End-to-End)
Inclusion	Low	Medium	High (Farmer Centric)

Fig. 8. Comparative Analysis of Agricultural Market Models

What It'll Take to Scale :

- To take Kisaan Mandi national, India needs:
- The universal AI Grading System to develop testing properties from all around the nation.

- It requires the system to operate offline devices.
- Robust rules on data privacy based on consent to protect farmer data records.
- Policy reforms balance the rules, fees, and payments between all the states.

e-NAM 2.0: The Next Step

e-NAM 2.0 the future of Indian farm marketing for AI integrated open network for all over India. It is India's online farm market. It connects systems of trading and service supplying.

It connects everything a farmer needs.

CONCLUSION

Kisaan Mandi displays how artificial intelligence, blockchain, voice translation, and digital infrastructure most of agriculture has already improved over decades but a few stubborn gaps remain (unfair grading, price cheating, language barriers, lack of trust).

Crops get graded on quality, not guesswork. Prices get sharper, harder to game. Farmers use the system in their own language, no new interface to learn.

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