MARKET INTELLIGENCE FOR AGRICULTURAL COMMODITIES USING FORECASTING AND DEEP LEARNING TECHNIQUES

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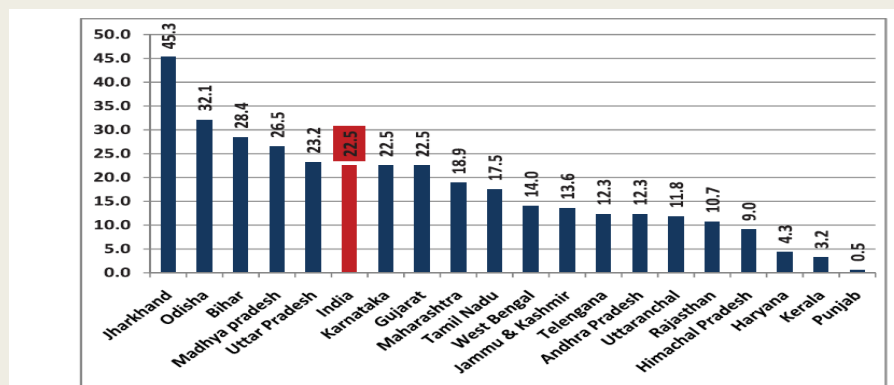
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Background and Motivation

Source: Estimated from unit level Consumption Expenditure Survey data 2011-12, NSSO.

Farmer suicides up 42% between 2014 & 2015 Source:ToI

States with highest number of farmer suicides in 2015		
State	No. of suicides	Share of total (%)
Maharashtra	3,030	37.8
Telangana	1,358	17
Karnataka	1,197	14.9
Chhattisgarh	854	10.7
Madhya Pradesh	581	7.3
Andhra Pradesh	516	6.4

Source: NCRB

"In the past, the emphasis has been on agricultural output, rather than on farmers' incomes. I've set the objective of doubling the farmers' income by 2022,"

The Prime Minister at Bloomberg India Economic Forum, Mar 2016

Agriculture: Doubling Farmer's Incomes
Four-point action plan to double the incomes of India's farmers
1. Remunerative prices for farmers by reforming the existing marketing structure;
2. Raising productivity;
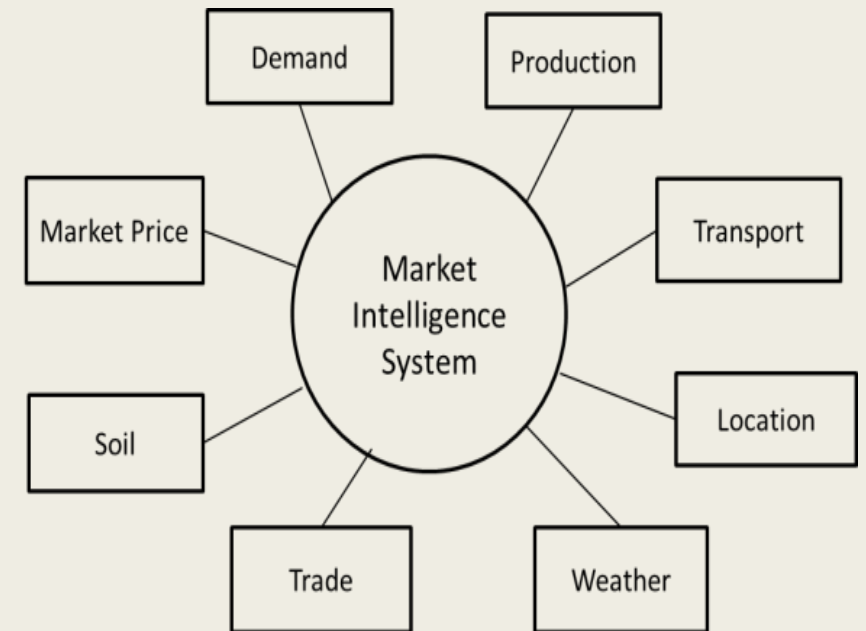3. Reforming agriculture land policy; and
4. Relief measures.

Ref: https://thewire.in/133387/mission-2022-ails-indian-farmer/

- Swapnil Shrivastava and Supriya N. Pal, A Framework for Next Generation Agricultural Marketing System in Indian Context, WIECON, 2019.
- Swapnil Shrivastava and Supriya N. Pal, A Big Data Analytics Proof of Concept for Maximizing Farmer's Income, ICSAC, 2018.

Market Intelligence

- Market Intelligence is not a technique but a process comprising of
  - *collecting agricultural data,*
  - *transforming it into information,*
  - *extracting insights and*
  - *disseminating them to farmers, agriculture departments and market functionaries*

  for decision making.

- It comprises of insights for crop selection, market demand, commodity price prediction and so on.

- Market Price are influenced by several economic (e.g. demand, production) and environmental factors(e.g. climate, irrigation type).
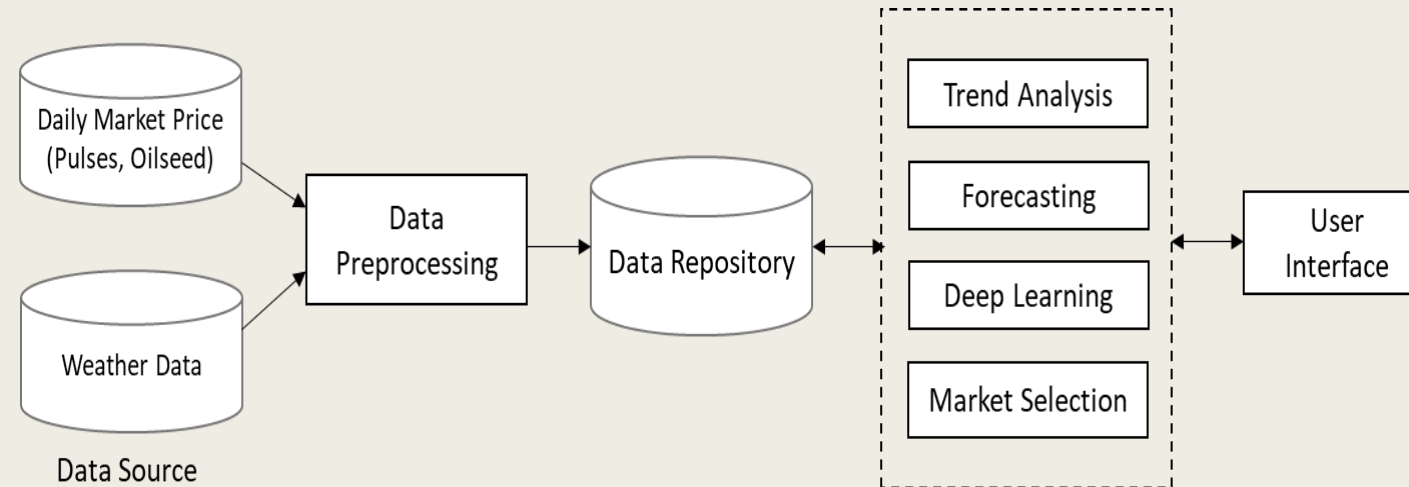
Market Intelligence and Predictive Analytics Techniques

A comprehensive system, which would fetch, interlink, transform and analyze relevant data from various ministries/departments/organizations spread across the country to generate precise, appropriate and timely Market Intelligence.

- Market Intelligence is not just about monitoring the trend (Agmarknet and eNAM) , but making predictions about the future with certain level of confidence.

- The agricultural and related data such as daily market price, weather information and soil quality are time series in nature.
    - *Time Series data is a sequence of well defined data points measured at certain interval of time.*

- The forecasting and deep learning techniques are appropriate for prediction based on time series data.

Design and Implementation

- Design and implementation of Market Intelligence System PoC with available daily market price and weather dataset for few agricultural commodities.

- The system provides trend analysis, short term as well as long term market price predicion and market selection as insights for farmers.
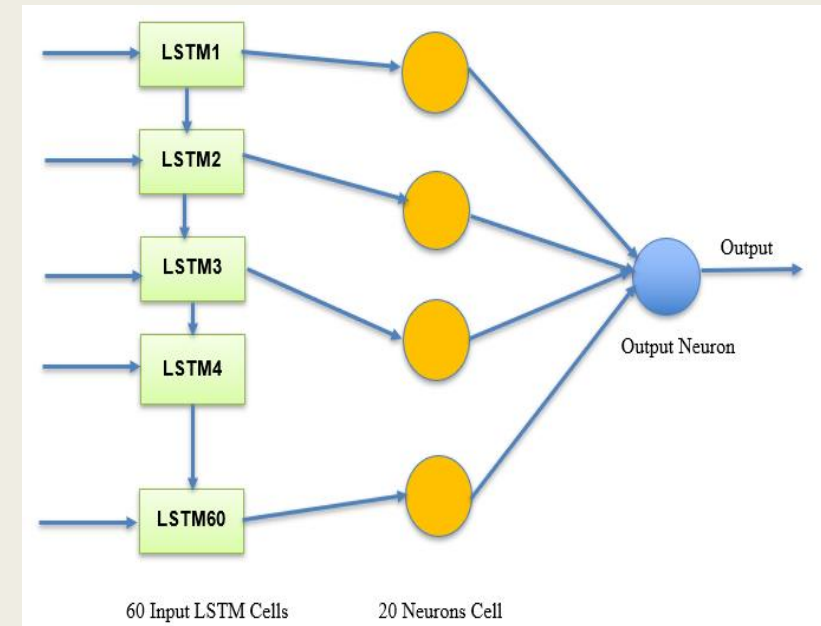
Short Term Prediction

- Forecasting is used to anticipate the future and develop appropriate strategies.

- ARIMA model is a statistical method used for forecasting time series data.

- It is specified by three parameters viz. p, d and q, ARIMA(p,d,q) where
  - *p is the number of auto regressive terms (2)*
  - *d is the degree of differencing (1)*
  - *q is the number of lagged forecast errors (2)*

- It is used in this system for short term (daily, weekly) market price forecasting.

- For example predict daily to weekly market price for a commodity (e.g. Arhar Dal) for a market (e.g. Garhwa) is some city (e.g. Garhwa) of a state (e.g. Jharkhand).
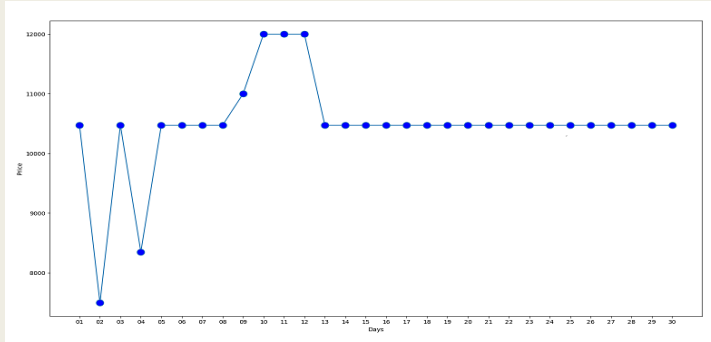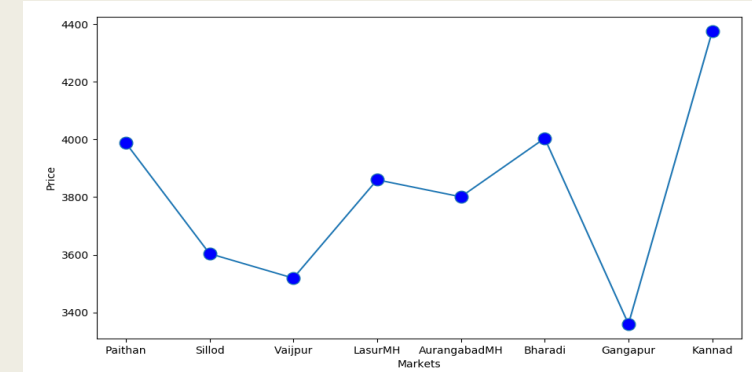
Long Term Prediction

- Deep Learning using Neural Network consists of different layers connected to each other and work on the structure and function of human brain.

- Recurrent Neural Network (RNN) is used for processing sequential data for market price prediction. It considers current input and also previously received input.

- Long Short Term Memory (LSTM) is used in the input layer of the system to learn long term dependency.

- This model is used for long term (monthly) prediction of market price.

Trend Analysis and Market Selection

- Descriptive Analytics includes statistical and visualization methods to derive summary from the historical data.
- The line graph plotting daily market price w.r.t. time provides trend analysis of agricultural commodity price in a market.
- This trend analysis would help the farmer and authorities to monitor the variation in daily market price.

- The Market Selection feature would assist the farmer to identify the market that offers highest price for their agriculture produce.
- The next day price predictions for Groundnut oil in various markets in Aurangabad district of Maharashtra state.
- The market named Kannad is showing the largest predicted return value for Groundnut Oil on the next day.

Challenges

- Highly accurate price and demand prediction model rely on several environmental and economic factors.

- Market Selection involves multiple criteria such as transportation cost, time taken to transport and distance of market from farmer's location.

- Leverage on deep rooted mobile phone network in the country by providing Market Intelligence over mobile app.

- Spread awareness in various agricultural departments regarding potential of agricultural data lying in their custody.

- Provisioning of up-to-date, curated and trustworthy data from data silos.

- Creation of awareness and acceptance for available resources and their utility at the grass root level

Benefits

■ Farmers: prevalent market prices for agricultural produce

- *When to sell? Where to sell? Whether to sell now or later?*

- *Choose cropping patterns for higher value crop produce*

■ Authorities: monitor market price of agricultural commodities

- *Investigate reason for below Minimum Support Price sale*

■ Market Functionaries: identify markets having high demand for agricultural produce

- *Minimize transportation cost*

- *Cut down marketing channels*

Summary

■ Widespread availability of Market Intelligence would bring substantial improvement in financial condition of farmers.

■ Design and implementation of Market Intelligence System PoC with available daily market price and weather dataset for few agricultural commodities.

■ Forecasting (ARIMA) and Deep Learning (RNN) are applied for short term (daily, weekly) and long term (monthly) market price prediction respectively.

■ A robust, efficient and comprehensive Market Intelligence System requires onboarding of various ministries/departments/organizations for real time information e.g. market price, demand, production and land utilization.

■ Though intended for farmers, this system can be extended to enable government authorities, traders and market functionaries to take decisions.

Thank You
Q&A