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Agricultural Crop Recommendations based on Productivity and Season

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Abstract*—As a coastal state, Tamil Nadu faces uncertainty in agriculture which decreases its production. With more population and area, more productivity should be achieved but it cannot be reached. Farmers have words-of-mouth in past decades but now it cannot be used due to climatic factors. Agricultural factors and parameters make the data to get insights about the Agri-facts. Growth of IT world drives some highlights in Agriculture Sciences to help farmers with good agricultural information. Intelligence of applying modern technological methods in the field of agriculture is desirable in this current scenario. Machine Learning Techniques develops a well-defined model with the data and helps us to attain predictions. Agricultural issues like crop prediction, rotation, water requirement, fertilizer requirement and protection can be solved. Due to the variable climatic factors of the environment, there is a necessity to have a efficient technique to facilitate the crop cultivation and to lend a hand to the farmers in their production and management. This may help upcoming agriculturalists to have a better agriculture. A system of recommendations can be provided to a farmer to help them in crop cultivation with the help of data mining. To implement such an approach, crops are recommended based on its climatic factors and quantity. Data Analytics paves a way to evolve useful extraction from agricultural database. Crop Dataset has been analyzed and recommendation of crops is done based on productivity and season.

Keywords —*Recommender System, Machine Learning and Data Science, Knowledge Discovery in Databases, Naive Bayes*

I. Introduction-Agriculture

Tamil Nadu being 7th largest area in India has 6th largest population. It is the leading producer of agriculture products. Agriculture is the main occupation of Tamil Nadu people. Agriculture has a sound tone in this competitive world. Cauvery is the main source of water. Cauvery delta regions are called as rice bowl of Tamil Nadu. Rice is the major crop grown in Tamil Nadu. Other crops like Paddy, Sugarcane, Cotton, Coconut and groundnut are grown. Bio-fertilizers are produced efficiently. Many areas Farming acts as major source of occupation.

Agriculture makes a dramatic impact in the economy of a country. Due to the change of natural factors, Agriculture farming is degrading now-a-days. Agriculture directly depends on the environmental factors such as sunlight, humidity, soil type, rainfall, Maximum and Minimum Temperature, climate, fertilizers, pesticides etc. Knowledge of proper harvesting of crops is in need to bloom in Agriculture. India has seasons of

1. Winter which occurs from December to March
2. Summer season from April to June
3. Monsoon or rainy season lasting from July to September and
4. Post-monsoon or autumn season occurring from October to November.

Due to the diversity of season and rainfall, assessment of suitable crops to cultivate is necessary. Farmers face major problems such as crop management, expected crop yield and productive yield from the crops. Farmers or cultivators need proper assistant regarding crop cultivation as now-a-days many fresh youngsters are interested in agriculture.

Impact of IT sector in assessing real world problem is moving at a faster rate. Data is increasing day by day in field of agriculture. With the advancement in Internet of Things, there are ways to grasp huge data in field of Agriculture. There is a need of a system to have obvious analyzes of data of agriculture and extract or use useful information from the spreading data. To get insights from data, it has to be learnt.

II. Knowledge Discovery in Databases

Extracting knowledge from the data set is the process of mining. It aims to give accurate results to farmers. It finds hidden patterns. It discovers useful knowledge from the tremendous data set. It is one of the processes in Knowledge Discovery in Databases (KDD).

Apart from the KDD process, in recent days with the development in IT world, Machine Learning has emerged to handle big volume of data and involves high performance computing too. Application of Machine Learning in Agriculture peaks up day by day. Machine Learning techniques are used in crop management, livestock management, water management and soil management [18].

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One kind of machine leaning technique is using a recommendation algorithm. They provide personalized products in E-Commerce. These recommendation concepts are used in agriculture in this paper to provide crops to sow. Simple Data Analytics is used on crop dataset and personalization of agricultural crops are suggested to famers.

III. Recommendation System

Recommender systems have lent its hands to users to choose items they like. Recommendation system is the approach to provide the suggestions to the users of their interest. This can be practiced for agricultural use too.

Based upon the factors of agriculture, farmers are given with ideas for their cultivation process. New techniques to increase crop cultivation can also be recommended. Pesticides, fertilizers can also be recommended. Hybrid Recommender system built by Agaji Iorshase [14] to recommend agricultural products solves issues like serendipity, ratio diffusion and ramp-up.

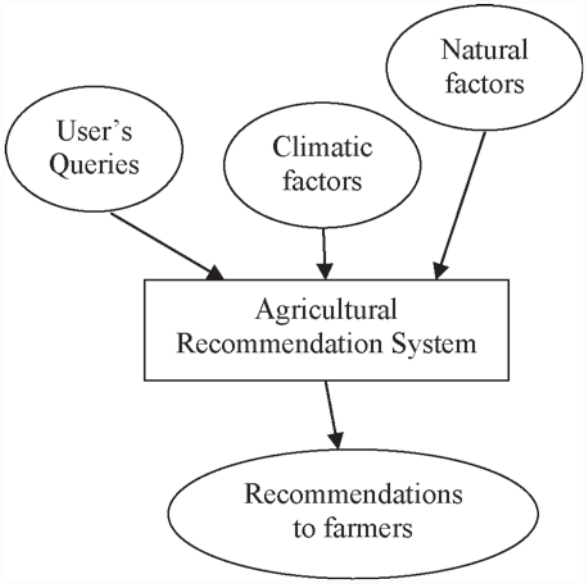

Fig 2: Agricultural Recommendation

This system uses both collaborative and content-based filtering [15] approach of recommender system. Datasets are collected for the food products of Benue State of Nigeria. Proposed method provides better quality.

IV. Agricultural Recommendation Techniques

Many crop prediction yield models have been developed. Clustering approaches such as k-means, k-means++ are used to perform grouping of data as clusters to predict crop yield is used [1].

Tripathy et al., [2] provided a system to have management of pesticides for crop cultivation using data mining process.

Essential parameter for agriculture analysis is nature of soil. Diverse varieties of soil are available in this India. Crops are cultivated depending on the type of soil in the land. The role of soil in improving crop cultivation is discussed [3]. Data mining techniques are applied to analyze the soil parameter.

JRip, J48 and Naive Bayes techniques are applied [4] which produces more reliable results in analyzing red and Black soil.

Impact of parameters of agriculture in crop management is studied to improve productivity [5]. Neural networks, soft computing, big data and fuzzy logic methods are being used to examine the agricultural factors.

Pritam Bose [6] developed a SNN model to have a spatiotemporal analysis with crop estimation.

An automatic system to gather the information about soil nature, weather conditions was developed [7] with clustering techniques to extract the knowledge and use it by farmers in crop cultivation.

Communicating through ICT bridges the gap among agriculturists e.g., Mobile devices, in today's world shares knowledge quickly. Semantic Web based Architecture [8] with GIS technologies helps farmers to learn about the crop ideas in short span of time. GIS sends data about the climatic conditions and geographic factors. This information can then be viewed by farmers through any ICT device. Economic Development of the universe [9] can be known through GIS and Spatial technologies.

To dig the knowledge from a huge knowledge base of agriculture, suitable techniques must be used. Among the techniques, Data Mining has key role. By applying mining, hidden useful knowledge is extracted as well as future predictions can be made. Data gained is classified; Associated and Clustered [10] in aim to make farmers to choose between crops; acquire new farmers and correlate the crops.

Prediction of crops was done according to farmer's experience in the past years. Although farmer's knowledge sustains, agricultural factors has been changed to astonishing level. There comes a need to indulge engineering effect in crop prediction. Data mining plays a novel role in agriculture research [11]. This field uses historical data to predict; such techniques are neural networks, K-nearest Neighbor. K-means algorithm does not use historical data but predicts based on-computing centers of the samples and forming clusters. Computational cost of algorithm acts as a major issue. Use of Artificial Neural Network is a boon to agriculture field which computes accurately even with more input. An architecture developed in [11] uses input; selects needed features; classification and association rule mining is applied and visualized.

Bangladesh has its high production as rice. Statistical Methodologies has been used to predict its crop production. Shakil Ahamed [12] applied clustering and classification techniques on 15 districts of Bangladesh to recommend for yield and planting of crops. Factors implementing crop yield were considered. They are

a. Environmental factors-rainfall, humidity, Minimum and maximum temperature
b. Biotic factors-soil pH and salinity
c. Area factors-irrigated or cultivated

Their accuracy lies between 90 to 95 percent in prediction but still recommends a large dataset to have efficient recommendation.

Crop and Yield Prediction Model suggested by Shreya S. Bhamose [13] used Modified k-means clustering algorithm predicts the amount of harvest of crops and also water requirement for crops. In addition, a disease prediction module is developed for tomato crop which identifies blight disease in tomato and intimates to farmers.

Recommendation system acts as a good engine to provide suitable items to users considering other factors. This is extended to have its support to agricultural sector [15]. Combining Internet of Things with this recommendation engine makes the farmers to have their suggestion about crops efficiently. Sensors have been fixed to observe temperature, NPK, soil moisture and humidity. Content based recommendation technique has been focused and it predicts and assists farmers to know "which" crop to choose and "how" to grow it.

Web based Recommendation system developed by Kiran Shinde [17] assists farmers to choose crops for rotation and proper fertilizers. Multi-tier client-server architecture is used for processing data. Random Forest Algorithm with a rating system is used for crop identification which shows 90% accuracy for the dataset collected. FP-Tree is constructed to know about the possible crops to sow in the field. It takes the yield of crops as input to suggest a proper crop for farmers. Based on the soil analysis report, fertilizers have been recommended to farmers considering Nitrogen, Phosphorus, Potash and Sulphur nutrients.

V. Crop Recommendation Based On Production

Crop production depends on many agricultural parameters. Proposed work is based on the production of crops in previous years, crops can be recommended to the farmers.

This kind of suggestions will make farmer to know that whether that particular is yielding a good production in recent years. Production of crops may become less due to any crop disease, water problem and many other factors.

While considering about the production, farmers may get knowledge about which crop is in high volume in the market in that year. Based on this farmer can take decision of trend on crops in recent years.

Farmers will be given recommendation by considering the season of crop production.

Tamilnadu Agriculture Dataset of about 1,20,000 records were taken. It contains fields like crop year, crop name, District, Season, Area cultivated and production. Recommendations were given to user based on the production of crops, season when the crops cultivated.

	Crop_Year	Season	Crop	Area	Production
0	1997	Kharif	Banana	5619	183740.0
1	1997	Kharif	Horse-gram	6849	3040.0
2	1997	Kharif	Onion	2813	37188.0
3	1997	Kharif	Sesamum	1598	580.0
4	1997	Kharif	Small millets	63	50.0
..	...	...	...	...	...
537	2013	Whole Year	Sugarcane	1170	121181.0
538	2013	Whole Year	Sweet potato	2	42.0
539	2013	Whole Year	Tapioca	340	10174.0
540	2013	Whole Year	Tobacco	100	159.0
541	2013	Whole Year	Turmeric	1203	6472.0

Fig 3: Data Extraction for Coimbatore District

With data about many districts, Coimbatore district data was shown in Fig 3. Crop varieties of Coimbatore were high in number.

Procedure:

1. Load the data
2. Split the data based on districts D
3. For every district D, split data into crops (C)
4. For every C,
   a. Recommend based on production, P
   b. Recommend based on season, S

VI. Experimented Results

District level data were analyzed and recommendations were given.

	Crop_Year	Season	Crop	Area	Production
0	1997	Kharif	Banana	5619	183740.0
8	1997	Whole Year	Banana	7269	285930.0
50	1998	Whole Year	Banana	6189	243451.0
80	1999	Whole Year	Banana	5619	183740.0
110	2000	Whole Year	Banana	7050	230533.0
155	2002	Whole Year	Banana	6499	212533.0
212	2003	Whole Year	Banana	4983	145880.0
273	2004	Whole Year	Banana	6102	285671.0
303	2005	Whole Year	Banana	8056	395585.0
321	2006	Whole Year	Banana	9948	396393.0
353	2007	Whole Year	Banana	12126	442181.0
383	2008	Whole Year	Banana	9805	487742.0
415	2009	Whole Year	Banana	9617	392089.0
470	2011	Whole Year	Banana	8634	339894.0
529	2013	Whole Year	Banana	7412	324506.0

Fig 4: "Banana" Crop facts

For the experimented results, "banana" crop production is taken into consideration.

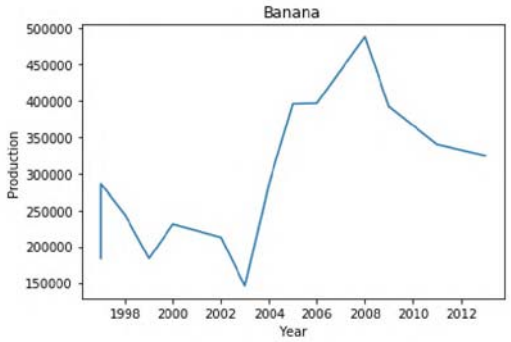

Fig 5: Production of Banana

It is clear from the Fig 5 that, production of banana will not lead farmer to any loss. There was a high production

in the year of 2008. Comparing 2008, 2012 has little diminished but it was not as low as 1990's. It is clear that banana will give a decent production to the farmers.

While considering production, it is also important to know about the season of crop cultivated which is shown in Fig 6.

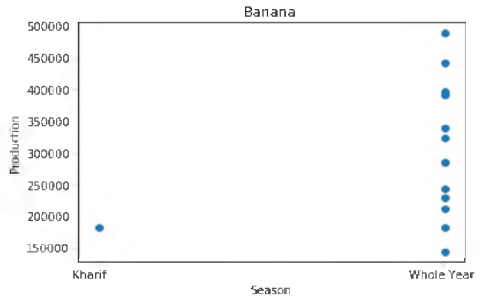

Fig 6: Production of Banana based on Season

From fig 6 it is known that; farmer need not worry about the season for "banana" crop since the production it gives was to a reasonable level for "whole year". With this knowledge, farmers can decide to when to begin cultivation of crops.

Another major fact is farmer should also be keen about the area which is going to be cultivated. Depending on area, production differs from place to place. Production variation with Area is shown in Fig 7.

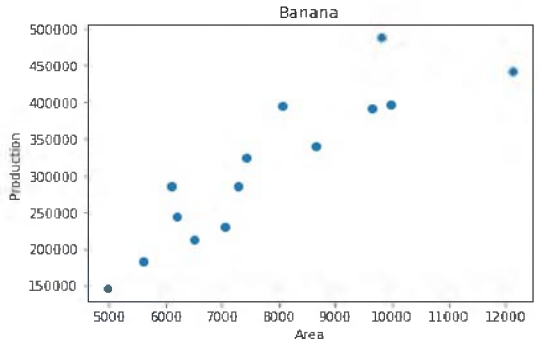

Fig 7: Banana- Area vs Production

These recommendations can be extracted for educating the famers. Pictorial representation shows the farmer a deeper knowledge about the crops to choose for cultivation.

VII. Conclusion

In this paper, significance of management of crops was studied vastly. Farmers need assistance with recent technology to grow their crops. Proper prediction of crops can be informed to agriculturists in time basis. Many Machine Learning techniques have been used to analyze the agriculture parameters. Some of the techniques in different aspects of agriculture are studied by a literature study. Blooming Neural networks, Soft computing techniques plays significant part in providing recommendations. Considering the parameter like production and season, more personalized and relevant recommendations can be given to farmers which makes them to yield good volume of production.

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