Analysis of Factors Affecting Rubber Cultivation in Kerala

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Abstract— Knowledge Discovery and Data Mining (KDD), an interdisciplinary area, focuses on methodologies, and extract useful knowledge from data. Data Science field comprises of everything related to data cleansing, preparation, and analysis.This combines statistics, mathematics, programming, problem-solving and capturing data in cleverly inventive ways. Data science looks at things differently, in the activity of cleansing, preparing and aligning the data.Hevea brasiliensis, the rubber tree is the source of Natural Rubber (NR) which is the most versatile raw material of nature, having multifarious uses This paper analyses and studies the factors that affect the yield of rubber in Kerala. This study is aimed at providing an analysis related to yield and economy for the rubber growing farmers of each district of Kerala. In future the rubber knowledge database created can be used to predict the crop yield and can be used to analyze the prediction in profit by considering different economic attributes as constraints. This can be integrated under GIS with climatic and nutrient parameters to derive useful predictive information for the rubber growing farmers.

Index Terms— Knowledge Management , Data Analysis, Hevea brasiliensis, Yield, Soil Fertility, Climate, Market Price, Agriculture

1 INTRODUCTION

Manual analysis and interpretation is the traditional method of turning data into knowledge. Manual probing of a data set is slow, expensive, and highly subjective. As the data volumes grow dramatically, this becomes completely impractical in many domains.

According to [1] Knowledge management is essentially about getting the right knowledge to the right person at the right time. Knowledge management also include the creation of new knowledge, and focus on knowledge sharing, storage, and refinement. It is very important to remember that knowledge management is not only about managing knowledge for knowledge's sake. Knowledge Discovery and Data Mining (KDD) focus upon methodologies for extracting useful knowledge from data. The challenge of extracting knowledge from data draws upon research in statistics, databases, pattern recognition, machine learning, data visualization, optimization, and high-performance computing, and delivers, advanced business intelligence and web discovery solutions

Data analysis or data analytics inspects, cleanses, transforms, and model data with the goal of discovering useful information, suggest conclusions, and support decision-making. Data analyses have multiple angles and approaches, and encompass diverse techniques under a variety of names, in many domains.

Exploratory Data Analysis (EDA) analyses data sets and summarize their main characteristics, often using visual methods.EDA differs from initial data analysis (IDA), which focuses narrowly on checking the assumptions required for model fitting and hypothesis testing, and handling missing values and making transformations of variables as needed. EDA encircle IDA.

Hevea brasiliensis, the rubber tree is the source of Natural Rubber (NR) which is the most versatile raw material of nature, having multifarious uses. Natural rubber is obtained from latex of Hevea. The performance of Hevea is best in the tropics having an equatorial monsoon climate, and is potentially, cultivated well in laterites, lateritic and red soils of India which is formed under wet-dry climate. As a perennial crop having a long gestation period, and a life cycle of more than 25 years, seasonality in production has a very critical importance. More than any of the individual effect, the composite effect of different environment variables, influences the yield of rubber. The pivotal role of climate change and soil nutrients affects the productivity of Hevea. The yield performance is also related to the soil organic content and fertility. The meteorological parameters also affect the growth and yield of Hevea. The rise in temperature may reduce the productivity. Temperature and rainfall are the most critical climatic factors for the growth and production of Hevea.Monthly rainfall of 125mm will be adequate that it can compensate for the evapo-transpiration of 3-5mm per day of mature rubber tree crop. Agriculture is a significant domain that needs knowledge sharing and Decision Support System (DSS), that it helps farmers to make decision, so that their problems can be solved

2 RELATED WORKS

According to M.Gunasundari, Dr.T.Arunkumar, Ms R.Hemavathy a crop yield prediction model Works on an adaptive cluster approach over dynamically updated historical crop data set. Crop knowledge base is constructed with set of relations. They used Bee Hive Clustering approach (classifies crop yield to various class for particular region.) The yield was classified to, find the better crop for a region, and yield prediction is done by prediction rules. The performance of CRY was found better in implementation using clementine. Feature selection has its major role in pre-processing the crop information. Set of multiple prediction rules are created and crop yield is predicted by taking environmental parameters also into consideration [9].

According to ShankerMeti , B.Pradeep , James Jacob, S.M.Shebin , M.D.Jessy natural Rubber(Hevea brasiliensis)is

the world's important economic crop.This was a study for estimating total area under NR cultivation in Kerala and Kanyakumari district of Tamilnadu and to Asses the spatial distribution of NR area over different classes of elevation, slop and soil management units. Satellite images classified using K-means clustering algorithm in Geomatica software. Raster to vector conversion tool used to extract district – wise rubber area. This was used for overlay analysis in GIS for better interpretation and visualization. Satellite based NR area was compared with ground survey statistics and variations reported. [10]

Toms Joseph, K.Tharian George proposed an alternative approach to evaluate yield performance to develop a commercial yield performance index (CYPI) Yield characteristics and managerial factors which influence the relative profitability directly or indirectly was included. CYPI was constructed using different variables .CYPI= (MDYM $_i$/MDYM $_n$)MDYM (Mean Discounted Yield in Monetary terms) estimates Adjusted for the managerial factors and yield characteristics influencing profitability.They have concluded that CYPI is a more reliable indicator of the economic performance of Hevea.[6]

S.KDey, K.R Vijayakumar, D.B.Nair, and P.Subramanian, conducted at the Central Experiment Station, kerala(humid climate)and Regional research station dapchari,Maharastra (dry sub-humid climate).Trees were tapped following the 1/2s d/2 6d/7 system yield was recorded from 25 trees by cup coagulation method for three years .Initial flow rate (F),Plugging Index(P),and dry rubber content(Cr)were recorded for all clones.The average vapour pressure (VP),Maximum Temperature (Tmax),Minimum temperature (TMin) was recorded for both stations .Large variation in yield was noticed throughout the year at both the locations .Average yield of three years showed that in sub-humid climate ,clone RRIM 600 was yielding higher, whereas PB235 recorded higher yield in humid climate.[5]

According to A.K.Krishnakumar, M.Karthikakuttyamma, B.Datta, S.N Potty the growth of hevea is influenced by soil physical,Chemical and mineralogical properties .Different experimental stations were taken into consideration.Morphological, physical , physio-chemical , chemical ,clay mineralogical analysis of soil was done in all stations .Organic matter status and available nutrient content was found. According to the soil types the stations were sub grouped. [8]
T.Sailajadevi, R.B Nair, S,K Dey, A,S Devakumar, J.Licy, M.R Sethuraj, R.Kothandaraman made observations at RRI,Kottayam in a clone evaluation trial laid there. 4 hybrid clones in 11 year old plantation was selected. Yield, Initial flow rate, Dry rubber content, plugging index were measured. Observations were made at weekly intervals from January to July 1996.Soil moisture was determined at 0-15, 15-30 cm depth on previous and same day of yield analysis. Rainfall and weather parameters were recorded. Influence of these on 4 clones was analyzed.Path coefficient analysis was used to understand the direct and indirect effects of environmental factors on yield through yield components.

3 PRIME FACTORS THAT CAN AFFECT THE PERFORMANCE OF HEVEA

3.1 Meteorological Factors

The composite effect of environment variables also influences the rubber yield. The fundamental elements that influence rubber cultivation are rainfall, temperature, sunshine, relative humidity and wind.

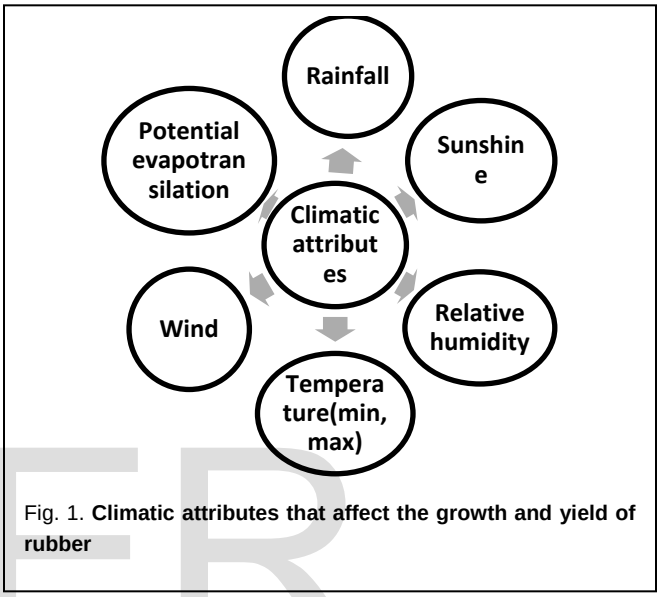

Fig. 1. **Climatic attributes that affect the growth and yield of rubber**

3.2 Soil Fertility

The growth of Hevea is influenced by physical, chemical and mineralogical properties of soil. The removal of nutrients through crop is less in rubber when compared to that of other crops. To ensure optimum growth and yield and to protect the sustainability of the system, analysis and maintenance of soil fertility through application of fertilizers is important. The four components of soil are inorganic or mineral materials, organic matter, water and air.

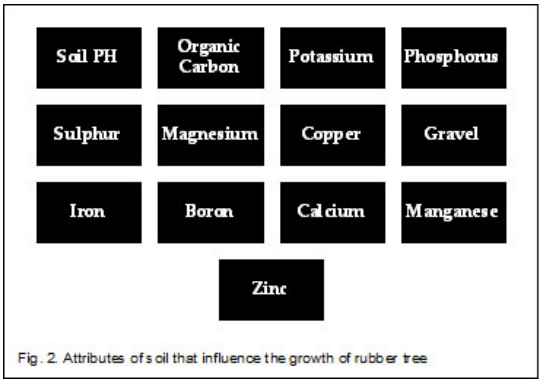

Fig. 2. Attributes of soil that influence the growth of rubber tree

4 CULTIVATION AREA, PRODUCTION, RAINFALL: DATA ANALYSIS

Data published by rubber board (RRI,Kottayam) regarding each districts of Kerala are taken into consideration .The following list of data are manipulated with an analytics software tool.

- *District wise yearly production in tonnes from 2001 to 2016*
- *District wise area of rubber cultivation in hectares from 2001 to 2016*
- *District wise rainfalls in Millimetres from year 2012 to 2016*

4.2 Cultivation Area

In order to find the trend of the data we first make the scatter plot of the area cultivated in Thiruvananthapuram district. The scatter diagram shows an exponential trend.

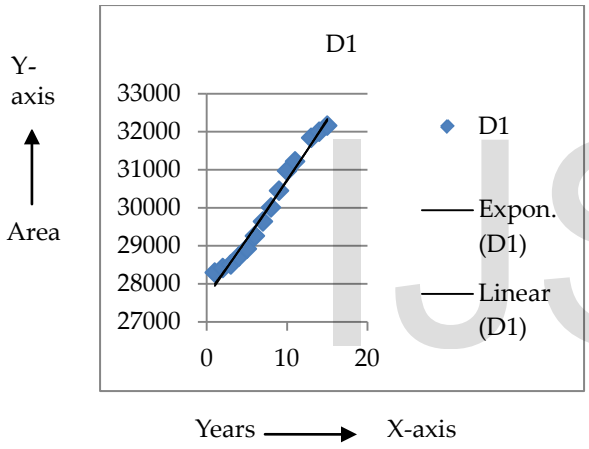

Fig. 3. Scatter plot of the area cultivated in Thiruvananthapuram district.

Further to confirm this we fit both the linear regression and exponential trend using ordinary regression method and the result confirm that the exponential model is the best fit as both the R square and F is greater for the exponential model. F(F Value),df(Degree of freedom)b1(slope),sig(significance)

TABLE 1

MODEL SUMMARY AND PARAMETER ESTIMATES

Dependent Variable: THIRUVANANTHAPURAM

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.035	.438	1	12	0.521	41471598	-290.179
Exponential	.058	.740	1	12	0.407	41792795	-.010

The independent variable is year.

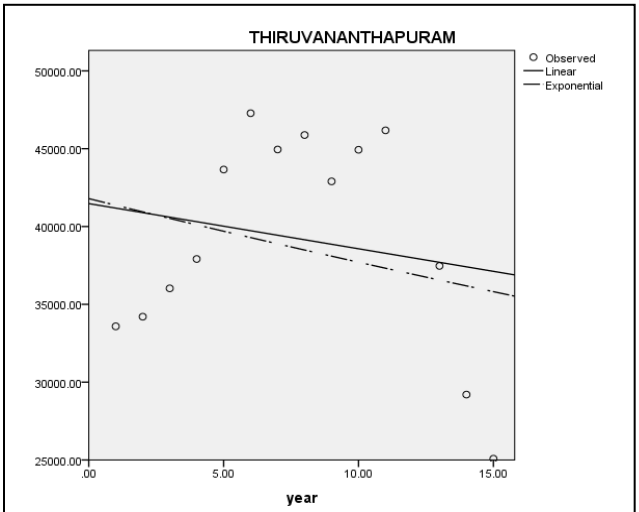

Fig. 4 Representation of model Summary

This will be the situation for all the data. Since the relation is exponential the best growth rate is exponential or compound growth rate.

TABLE 2

EXPONENTIAL GROWTH RATE (EG) FOR AREA CULTIVATED FOR DIFFERENT DISTRICTS OF KERALA

SNO.	DISTRICTS	EG
1.	THIRUVANANTHAPURAM	**1.03**
2.	KOLLAM	**0.12**
3.	PATHANAMTHITTA	**0.49**
4.	ALAPPUZHA	**1.37**
5.	KOTTAYAM	**0.21**
6.	IDUKKI	**0.48**
7.	ERNAKULAM	**0.47**
8.	THRICHUR	**1.30**
9.	PALAKKAD	**2.17**
10.	MALAPPURAM	**5.56**
11.	KOZIKODE	**1.90**
12.	WYNAD	**4.26**
13.	KANNUR	**2.82**
14.	KASARGODE	**3.71**

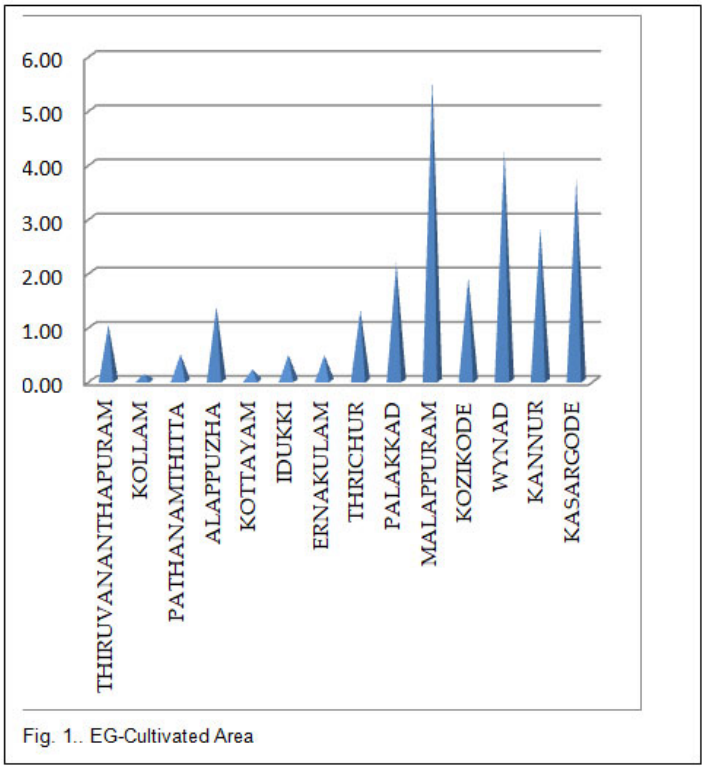

Fig. 1.. EG-Cultivated Area

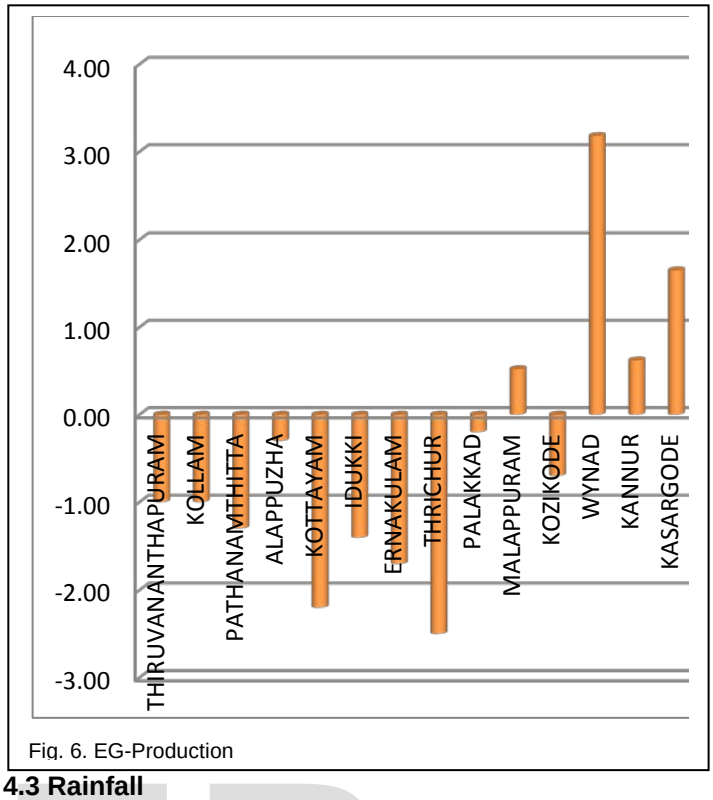

Fig. 6. EG-Production

4.2 Production

Exponential growth rate (EG) for Production is calculated for all districts in kerala.Different districts in state shows a downward trend over the years .The main reasons for this that we analysed are, the fall in rubber pricing ,and the climate change .

TABLE 3
EG FOR PRODUCTION FOR DIFFERENT DISTRICTS OF KERALA

SNO.	DISTRICTS	EG
1.	THIRUVANANTHAPURAM	-1.00
2.	KOLLAM	-1.00
3.	PATHANAMTHITTA	-1.30
4.	ALAPPUZHA	-0.30
5.	KOTTAYAM	-2.20
6.	IDUKKI	-1.40
7.	ERNAKULAM	-1.70
8.	THRICHUR	-2.50
9.	PALAKKAD	-0.20
10.	MALAPPURAM	0.52
11.	KOZIKODE	-0.70
12.	WYNAD	3.18
13.	KANNUR	0.62
14.	KASARGODE	1.65

4.3 Rainfall

Correlation was seen as appropriate to analyze the relationship between the two variables which were interval-scaled and ratio-scaled. Furthermore, correlation coefficients reveal magnitude and direction of relationships which are suitable for hypothesis testing. We used Pearson Correlation to identify the relationship between rainfall and production of rubber and the result is exhibited in Table. Production and rainfall from 2012 to 2016 were taken into consideration.

TABLE 4
EG FOR PRODUCTION FOR DIFFERENT DISTRICTS OF KERALA

SNO.	DISTRICTS	Correlation
1.	THIRUVANANTHAPURAM	-0.22
2.	KOLLAM	-0.19
3.	PATHANAMTHITTA	-0.26
4.	ALAPPUZHA	0.15
5.	KOTTAYAM	0.14
6.	IDUKKI	0.35
7.	ERNAKULAM	0.29
8.	THRICHUR	0.42
9.	PALAKKAD	0.37
10.	MALAPPURAM	0.34
11.	KOZIKODE	0.48
12.	WYNAD	0.47
13.	KANNUR	0.39
14.	KASARGODE	0.67

Two variables are correlated only if the value of the correlation is greater than 0.5 since in this case all the correlation except for the KASARGODE has correlation between rainfall and the rubber production has value less than 0.5. By this analysis KASARGODE district is showing a significant relationship between rainfall and the rubber production. From this it's understandable that only the rainfall parameter, cannot affect the production, different other factors of climate and the soil fertility plays role to determine the yield of rubber.

5 CONCLUSION

Rubber is a perennial crop and remains for long period. The growth and yield of Hevea are influenced by many parameters .The most critical factors that are analysed and found are soil fertility, meteorological factors. In future a rubber knowledge database can be created can be used to predict the crop yield and can be used to analyze the prediction in profit by considering different economic attributes as constraints. This can be integrated under GIS with climatic and nutrient parameters to derive useful predictive information for the rubber growing farmers. GIS is a powerful tool that can be used for integrated analysis of natural resources for decision support.

Efforts are made to exploit the potential of KM to improve and sustain the crop production through precision and climate resilient in Indian agriculture. The National policy for farmers emphasizes the use of KM based information technology at village level for reaching out to the farmers with the correct advisories and requisite information.

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