International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-10 Issue-3, February 2021

Estimation of the Influence of the N, P and K Fertilizer Nutrients Consumption on the Tur Yield in India using Data Mining Techniques

A.Vijay Kumar

Abstract*: India has a great pressure to meet its food and other domestic need. The enormous increase in population despite of the decelerate in the increase rate of the population and significant income growth, insist an additional 2.5 million tons of food grains per annum according to the Agriculture policy: Vision 2020 document prepared by the Indian Agriculture Research Institute, New Delhi. The most needed food grains production in Indian is much less than that in the other areas of the world. Considering that the frontiers of expansion of cultivated area are almost closed in the region, the future increase in food production to meet the continuing high demand must come from the increase in yield. The factors that generally promote yield in India are fertilizer nutrients consumed, rainfall, temperature, pesticides sprayed, moisture in the air, moisture in the soil and humidity etc. Here an attempt is made to know the influence of the fertilizer nutrients consumed on the tur crop yield in India using data mining techniques so for which a dataset is prepared with the tur yield, fertilizer nutrients consumed like, Nitrogen, phosphorus, and potassium which are collected from the secondary sources like Department of agriculture and Cooperation, India and Fertilizer statistics, Fertilizer Association of India. The experiment results proved that there is an extremely negligible negative influence on the fertilizer nutrients consumed in India, during the study period.

***Keywords*: Classification, Clustering, Correlation, Data Mining, Estimation, Regression.**

I. INTRODUCTION

Data mining in agriculture is a potential research area for the young researchers since there is an emerging gap between the crop yield and population in India so efforts should be to reduce the gap among the two by increasing the crop yield with some strategic move. The common factors that generally promote the yield in India are fertilizer nutrients applied, rainfall, temperature, humidity, soil potentiality, quality of seeds, moisture in the air, moisture in the soil and pesticides applied etc. Tur is most commonly called as Arhar or red gram needs moist and warm climate during germination (30-350C), to some extent lesser temperature during active vegetative growth (20-25 0 C) but about 15-18 0 C during flowering and pod setting, however, at development time it needs higher temperature of around 35-40 0C. Water scarcity, intense rains, coolness are very harmful for the crop. Hailstorm or rain at development costs the entire crop. The soil type also plays a major role in the crop growth, for example sandy loam to clayey loam soil is best suited for the crop. Soil must be extremely bottomless, fine drained and without soluble salts in them. Tur is the next main pulse in the country after chana. The ability of red gram to produce high economic yields under soil moisture deficit makes it an important crop in rain fed and dry land agriculture. Red gram is a native of India as evident from the presence of several wild relatives and diverse gene pool along with ample evidence in historic literature. India contributes for nearly 90% of world's total red gram production. However, it is gaining importance in African countries due to its adaptability to limited moisture conditions. In the present paper an effort is made to estimate the influence of the fertilizer nutrients, nitrogen, phosphorus and potassium on the tur crop yield in India. To estimate the influence of the fertilizer nutrients consumed on the tur crop yield in India, a data set is prepared with the tur crop yield, fertilizer nutrients consumed like, n, p and k. Using the dataset an experiment is conducted to know the influence of the fertilizer nutrients consumed on the tur crop yield in India using statistical analysis techniques.

II. TUR YIELD GROWTH RATES

There is neither outright growth nor reduction in tur yield during the study period. For the better understanding of the tur yield trend yield and its growth rates are represented in the tabular and chart form. The growth rates are represented in the curve form that shows there are ups and downs in the tur yield during the considered period of time. For the better understanding of the yield trends, tur yield and growth rates in the yield are mentioned against each five years. There is a maximum growth in the tur yield in 2005-06 crop years, and the very less growth rate is found during 1955-1956 crop year. Similarly, a maximum reduction in the tur yield is found in 1965-1966 crop year and minimum reduction is found in 1995-1996 crop year.

	Yield of the Tur	Growth rates of the Tur
1950-51	788	0.00
1955-56	814	3.30
1960-61	849	4.30
1965-66	678	-20.14
1970-71	709	4.57

Manuscript received on March 13, 2019.
Revised Manuscript received on January 21, 2021.
Manuscript published on February 28, 2021.
*Correspondence Author
Dr. A. Vijay Kumar*, Associate Professor, School of Computer Science and Engineering, Jain (Deemed to be University), Bangalore, Karnataka, India.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/)

1975-76	786	10.86
1980-81	689	-12.34
1985-86	767	11.32
1990-91	673	-12.26
1995-96	670	-0.45
2000-01	618	-7.76
2005-06	765	23.79
2010-11	799	4.44
2015-16	823	3.25

Table TF1: Growth rates of the Tur crop yield

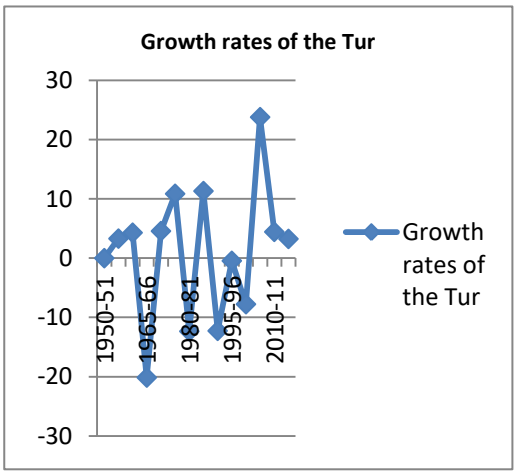

Figure TF1: A chart view of the relationship between yield and growth rate of the Tur

III. THE INFLUENCE OF FERTILIZER CONSUMPTION ON THE TUR YIELD

To measure the influence of fertilizer nutrients consumption on yield of the tur during the period 1950-2016, a dataset with fertilizer nutrients consumed and tur yield is prepared. On the dataset, statistical analysis is performed using some data mining tools. Results of the experiment proved that there is no such correlation between fertilizer nutrients consumption and yield of the tur. According to the statistics, it is known that the fertilizer consumption is increased every year but yield of the tur is not increased proportionate to that. The following table shows the dataset of the NPK nutrients applied and the tur yield

Year	N	P	K	Tur-Yield
1950	58.7	6.9	-	788
1955	107.5	13	10.3	814
1960	210	53.1	29	849
1965	574.8	132.5	77.3	678
1970	1487	462	228	709
1975	2148.6	466.8	278.3	786
1980	3678.1	1213.6	623.9	689
1985	5660.8	2005.2	808.1	767
1986	5716	2078.9	850	722
1987	5716.8	2187	880.5	685
1988	7251	2720.7	1068.3	779
1989	7386	3014.2	1168	763
1990	7997.2	3221	1328	673
1991	8046.3	3321.2	1360.5	588
1992	8426.8	2843.8	883.9	652
1993	8788.3	2669.3	908.4	762
1994	9507.1	2931.7	1124.7	644
1995	9822.8	2897.5	1155.8	670
1996	10301.8	2976.8	1029.6	756
1997	10901.8	3913.6	1372.5	551
1998	11353.8	4112.2	1331.5	787
1999	11592.7	4798.3	1678.7	786
2000	10920.2	4214.6	1567.5	618
2001	11310.2	4382.4	1667.1	679
2002	10474.1	4018.8	1601.2	651
2003	11077	4124.3	1597.9	670
2004	11713.9	4623.8	2060.6	667
2005	12723.3	5203.7	2413.5	765
2006	13772.9	5543.3	2334.8	650
2007	14419.1	5514.7	2636.3	826
2008	15090.5	6506.2	3312.6	826
2009	15580	7274	3632.4	671
2010	16558.2	8049.7	3514.3	723
2011	17300.3	7914.3	2576.5	799
2012	16821.1	6653.0	2062.2	661
2013	16750.3	5633.0	2099.0	776
2014	16946.2	6098.0	2532.2	813
2015	17274.2	6454.3	2876.3	750

Table T2: Fertilizer nutrients consumed and the Tur yield dataset

(FERTILIZER NUETRIENTS N, P, K IN 000 TONES)
(YIELD 0000 KG/Hectare)
Sources: Directorate of Economics and Statistics, Department of Agriculture and Cooperation and Fertilizer statistics, Fertilizer Association of India, Govt. of India.

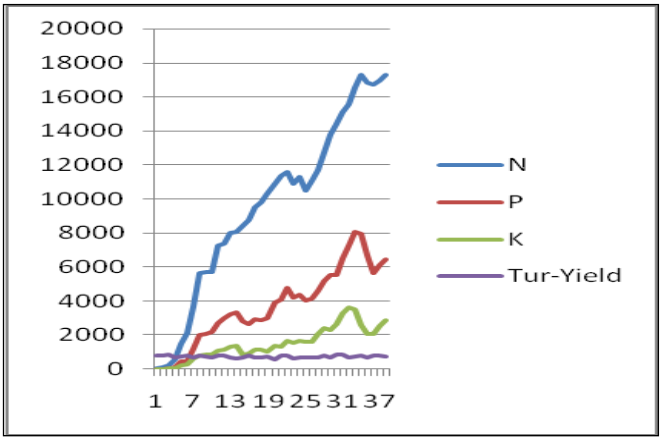

Figure TF2: The tur yield and NPK nutrients applied.

The correlation between the fertilizer nutrients consumed and yield of the Tur

The correlation between, n, p, k and tur is -0.144, -0.093 and -0.23 respectively.

Retrieval Number: 100.1/ijeat.D6046048419
DOI:10.35940/ijeat.D6046.0210321
© Copyright: All rights reserved.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication
© Copyright: All rights reserved.

According to the study it is proved that there is no positive relationship between the fertilizer nutrients consumed and yield of the tur, instead of that there is a negligible negative relationship between them.

Correlations

		TURYIELD	N	P	K	YEAR
Pearson Correlation	TURYIELD	1.000	-.144	-.093	-.023	-.251
	N	-.144	1.000	.975**	.921**	.963**
	P	-.093	.975**	1.000	.963**	.913**
	K	-.023	.921**	.963**	1.000	.872**
	YEAR	-.251	.963**	.913**	.872**	1.000
Sig. (2-tailed)	TURYIELD	.	.417	.602	.898	.153
	N	.417	.	.000	.000	.000
	P	.602	.000	.	.000	.000
	K	.898	.000	.000	.	.000
	YEAR	.153	.000	.000	.000	.
N	TURYIELD	34	34	34	33	34
	N	34	34	34	33	34
	P	34	34	34	33	34
	K	33	33	33	33	33
	YEAR	34	34	34	33	34

**. Correlation is significant at the 0.01 level (2-tailed).

Table T3: Pearson Correlation between Tur yield and Fertilizer nutrients consumed

IV. RESULTS OF THE REGRESSION ANALYSIS OF NPK NUTRIENTS APPLIED AND THE TUR YIELD IN INDIA

Results of the regression analysis is also indicates that there is a negligible negative relationship between fertilizer nutrients and yield of the tur in India during the research period.

Variables entered/removed

Mode	Variables Entered	Variables removed	Method
1	K,N,P	.	ENTER

Table T4: Variables Entered / Removed

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	223	.050	-.049	75.5808

Table T5: Model Summary

Coefficients

Mode	Unstandardized Coefficients		Std. Coefficients	t	Sig
	B	Std Err	Beta		
1 (const	745.056	31.81		23.419	.000
NPK	-1.38E-02	.013	-.886	-1.08	.289
	2.295E-02	.041	.669	1	.577
	1.147E-02	.054	.148	.564	.833
				.213	

Table T6: Coefficients

The Tur yield and fertilizer nutrient N regression result

Independent variable	Dependent variable	Method	R*R	d.f	Sig	b0	b1	Std err
Fertilizer Nutrint N	Tur Yield	Linear reg	.514	28	.000	391.800	.0160	29.67

Table T7: The Tur yield and fertilizer nutrient N regression result

The following equation represents the linear regression curve, the variable x represents independent variable and y represents dependent variable.

Y=391.800 +.0160X --- (1)

The following graph represents the linear regression between tur yield and fertilizer nutrient N.

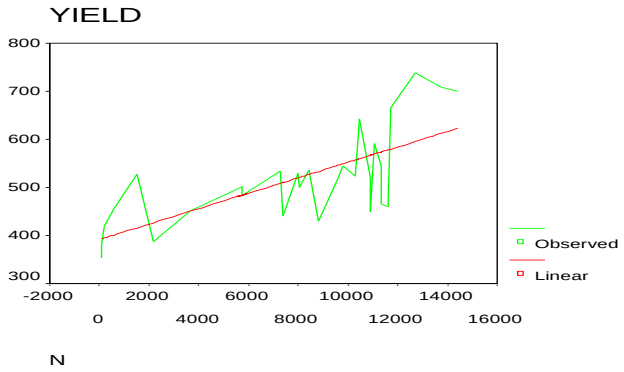

Figure TF3: Tur yield and fertilizer nutrient N regression curve

Independent variable	Dependent variable	Method	R*R	d.f	Sigf	b0	b1	Std err
Fertilizer Nutrient P	Tur Yield	Linear reg	.548	28	.000	396.640		33.99

Table T8: The Tur yield and fertilizer nutrient P regression result

The following equation represents the linear regression curve, the variable x represents independent variable and y represents dependent variable.

Y=396.640+.0420X --- 2

The following graph represents the linear regression between tur yield and fertilizer nutrient P.

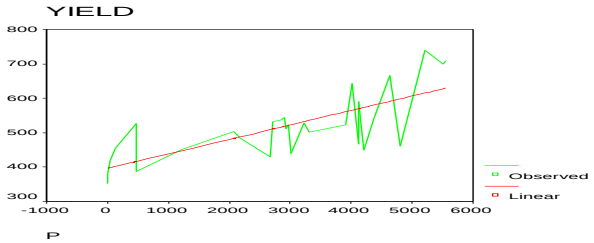

Figure TF4: Tur yield and fertilizer nutrient P regression curve

© Copyright: All rights reserved.

TABLE T9: TUR YIELD AND FERTILIZER NUTRIENT K REGRESSION RESULT

I.V	D.V	M()	R* R	d.f	Sigf	b0	b1	STD.ERR
Fertilizer Nutrient N	Tur Yield	Linear reg	0.514	28	0	391.8	0.016	29.67

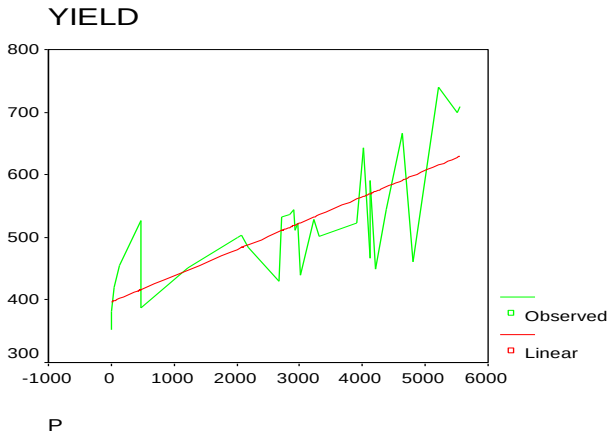

Figure TF5: Tur yield and fertilizer nutrient K regression curve

Table T10: Tur yield and fertilizer nutrient K regression result

IV	DV	M()	R * R	d.f	Sigf	b0	b1	Standard error
Fertilizer Nutrient K	Tur Yield	Linear reg	.646	27	.000	394.517	.1086	49.24

The following equation represents the linear regression curve, the variable x represents independent variable and y represents dependent variable.

$$Y=394.517 +.1086X \quad \text{--- (3)}$$

The following graph represents the linear regression between tur yield and fertilizer nutrient K.

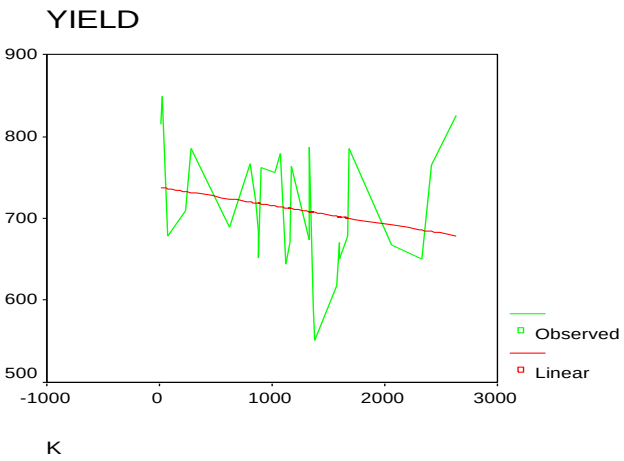

Figure TF6: Tur yield and fertilizer nutrient K regression curve

V. THE TUR YIELD DATA CLUSTERING WITH K-MEANS ALGORITHM

To classify the tur yield data k-means quick clustering with iteration technique is used. The output of the k-means quick data clustering technique is as shown in the figure below. The technique successfully classified the data into clusters. In the process of dividing the data into clusters no case was missed. The thirty three cases are grouped into cluster one and the remaining twenty nine cases are grouped into cluster two. In the first iteration, the center points of the clusters are 1401.40 and 935.90. Later, in the second iteration the center points of the clusters became as 1247.24 and 1085.50. The detailed summary of the classification process in the iterations wise shown in the tables below.

Initial Cluster Centers

	Cluster	
	1	2
RAINFALL	1401.40	149.600

Table T11: Initial Cluster Centers

Iteration History

Iteration	Change in Cluster centers	
	1	2
1	154.164.000	149.600.000
2		

Table T12: Iteration History

Convergence achieved is due to no or small distance change. The maximum distance by which any center moved is 0.000. The current iteration is 2. The minimum distance between initial centers is 465.50

Final Cluster Centers

	Cluster	
	1	2
RAIN FALL	1247.24	1085.50

Table T13: Final Cluster Centers

Number of Cases in each Cluster

Cluster	12	33.000
		29
Valid		62.0
Missing		.000

Table T14: K means model summary

Retrieval Number: 100.1/ijeat.D6046048419
DOI:10.35940/ijeat.D6046.0210321
© Copyright: All rights reserved.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication
© Copyright: All rights reserved.

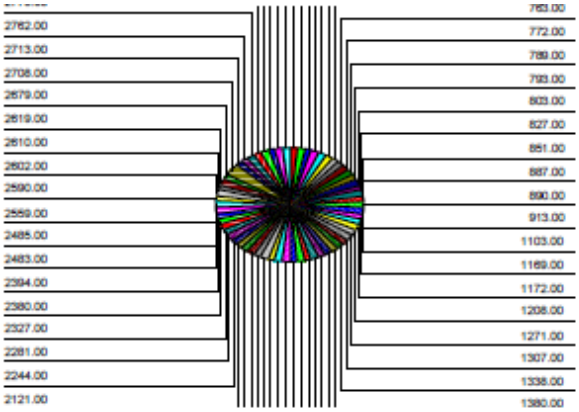

Figure TF7: A Chart view of the tur yield data

VI. CONCLUSION

Of course there are ups and downs in the tur crop yield in India during the study period from 1950-2016 but there is a marginal increase in the yield. The tur yield was very high during the crop year 1960(849 million tons) and very low during the crop year 1997(551 million tons). The main objective of the present research is to find the influence of the fertilizer nutrients consumption on the yield of the tur so focus was on estimating the influence of fertilizer nutrients impact on the tur yield India. In the experiment it is known that there is an extremely negligible negative impact on the yield so it can be concluded as no impact on the yield. To know the exact factors that influenced the tur crop yield in India during the study period it is better to consider other influential factors like pesticides applied humidity, rainfall and temperature etc.

REFERENCES

1. Estimation of the Influence of fertilizer Nutrients Consumption on the Wheat Crop yield in India – a Data mining Approach paper published in the International Journal of Engineering and Advanced Technology (IJEAT), ISSN: 2249-8958, Volume-3, Issue-2, December 2013.
2. Estimation of the Influence of rainfall on the Groundnut yield in India - a data mining approach paper published in the International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622, Volume-4, Issue-7, July 2014.
3. A Data Mining Approach for the Estimation of Climate Change on the Jowar Crop Yield in India was published in the International Journal of Emerging Science and Engineering (IJESE), ISSN: 2319-6378, Volume-2, Issue-2, December 2013.
4. Estimating the influential factors of rice crop in India paper was published in the proceedings of the 2nd International conference on Advanced Computing Methodologies at Gokaraju Ranga Raju Institute of Technology, Bachupally, Hyderabad.
5. M.Becker,K.H.Diekmann,J.K.Ladha,S.K.De Datta,J.C.G.Ottow,"Effect of NPK on growth and nitrogen fixation of sesbania rostrata as a green manure for lowland rice(Oryza sativa L.)" Plant and Soil, April 1991, Volume 132, Issue 1, pages 149-158.
6. http://indiastat.com
7. http://wikipedia.org/wiki/agriculture in India.
8. Hand book of statistics on Indian Economy 2015.
9. Economy Survey 2015.
10. Mucherio.A, Papaorgji.p and Pardalos.P(2009), Data mining in Agriculture (Vol: 34)
11. (Journal Online Sources style) K. Author. (year, month). Title. *Journal* [Type of medium]. Volume(issue), paging if given. Available: http://www.(URL)

AUTHORS PROFILE

Dr. A.Vijay Kumar is working as an Associate Professor in School of Computer Science and Engineering, Jain (Deemed to be University), Bangalore, Karnataka, India. He is having 14 years of teaching experience. He has completed Ph.D in Computer Science and Engineering from Acharya Nagarjuna University, Guntur, Andhra Pradesh, India in 2015. His area of research includes Data Mining, Data Warehousing, Data Sciences, Cryptography and Network Security. He has published several articles in the National and International Journals.

© Copyright: All rights reserved.