

Increasing Trend of Using Chemical Fertilizers, Pesticides and Increase in Deaths due to Neoplasm and Diseases of the Digestive Systems in India

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Abstract- Increasing agricultural productivity is necessity of time for fulfilling food demand of increasing human population. As a consequence of it, more use of chemical fertilizers and pesticides is unavoidable unless and until availability of alternative options to them and /or inculcating culture of organic farming among farmers. One of the consequence of excessive use of chemical fertilizers and pesticides is harm to human health is one of its worst consequence. We study statistically trend in agricultural use of chemical fertilizers and pesticides in India. Also we observe trend in number of deaths due to 'neoplasm and diseases of the digestive systems' in India. We statistically show that there is high degree of correlation between use of chemical fertilizers, pesticides and deaths due to neoplasm and deaths due to diseases of the digestive systems in India.

Keywords – Chemical fertilizers, pesticides, human health, Neoplasm, diseases of the Digestive System.

I. INTRODUCTION

India has heavy population pressure and it dependence on agriculture. Agriculture is the primary source of livelihood for about 58% of India's population [11]. In this research article we statistically study increasing trend in use of chemical fertilizers and pesticides over the years 2000-2019 . We also study statistically increase in number of deaths due to neoplasm and number of deaths due to diseases of the digestive systems' in India over the same years.

The rest of the paper is organized as follows. In section II, we tabulate extracted statistical data about use of chemical fertilizers and pesticides in agriculture over the years 2000-2019. We also tabulate extracted statistical data about number of deaths due to neoplasm and diseases of the digestive systems in India over the years 2000-2019.

Let X_1 = Total Fertilizers used for agriculture in India (in Tonnes), X_2 = Total Pesticides used for agriculture in India (in Tonnes); Y_1 = Number of deaths in India due to Neoplasm and Y_2 = Number of deaths in India due to diseases of the digestive systems.

In section III, we obtain scatter diagram and also compute correlations between the pair of variables (X_1, Y_1), (X_1, Y_2), (X_2, Y_1) and (X_2, Y_2). We test statistical significance of these correlation values.

Discussion and concluding remarks are given in section IV.

II. ARRANGEMENT OF STATISTICAL DATA

This research article is based on secondary data. Data on use of chemical fertilizers and pesticides in India during the years 2000 to 2019 is selected from website of Food and Agriculture Organization (FAO) of United Nations [1, 2]. Independent data for same years on number of deaths due to neoplasm and number of deaths due to diseases of the digestive systems in India is selected from publications of Office of The Registrar General, India [7, 8, 9].

2.1 Statistical Data on Use of Chemical Fertilizers and Pesticides –

Table No. 1 below shows data on use of chemical fertilizers and pesticides in India during the years 2000 to 2019.

2.2 Statistical Data on Number of Patients suffering from Neoplasm and Disease of Digestive Systems –

We refer Statement 2.8: Growth in Medical Certification as a part of total registered deaths during the years 2000-2019 from publications of Office of The Registrar General, India [7, 8, 9]. Among these registered deaths, we find number of deaths due to neoplasm and number of deaths due to diseases of the digestive systems

separately for the same years. We refer Statement 3.5: Percentage distribution of leading cause groups of deaths [7, 8, 9] . It is tabulated as given below in Table No. 2.

Table No. 1

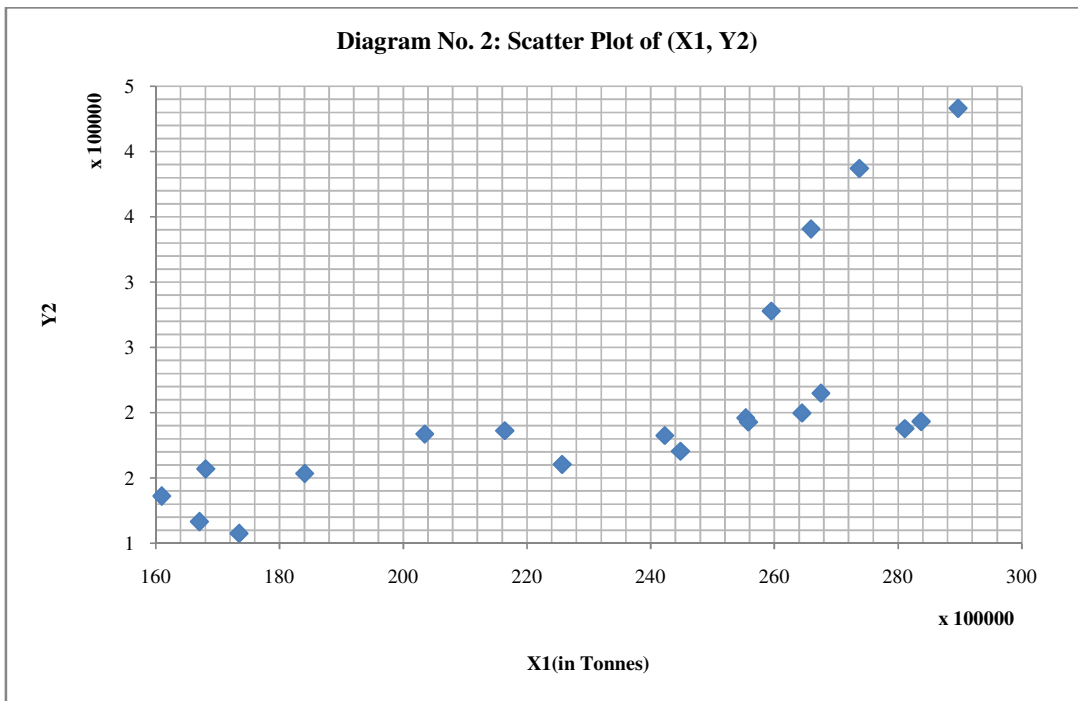
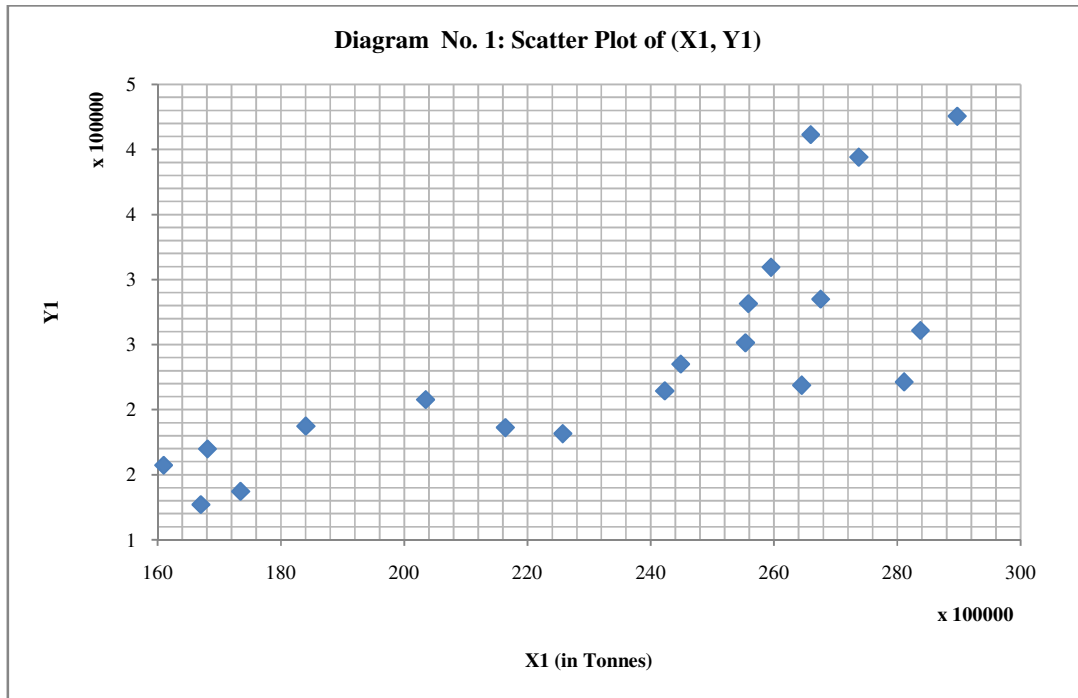
Year	Nitrogen (in Tonnes)	Phosphate (in Tonnes)	Potash K (in Tonnes)	Total of Fertilizers: X1 (in Tonnes)	Pesticides X2: (in Tonnes)
2000	10920200	4214600	1567500	16702300	44958
2001	11310175	4365119	1669017	17344311	43720
2002	10469210	4029134	1597647	16095991	42483
2003	11077861	4131912	1597439	16807212	41245
2004	11712729	4633145	2060796	18406670	35113
2005	12723910	5209967	2413504	20347381	35342
2006	13760868	5550200	2331051	21642119	37423
2007	14417665	5518072	2635371	22571108	27423
2008	14863815	6051820	3312802	24228437	14485
2009	15558372	7249010	3638144	26445526	28707
2010	16450653	8195773	3463818	28110244	40094
2011	17367540	8409634	2596512	28373686	55540
2012	16820900	6653400	2061800	25536100	52980
2013	16750100	5633500	2098900	24482500	45620
2014	16949600	6098900	2532900	25581400	56268
2015	17372300	6978800	2401500	26752600	56720
2016	16735400	6705400	2508300	25949100	58634
2017	16958000	6854100	2778800	26590900	63406
2018	17628200	6967900	2779100	27375200	59670
2019	18863900	7464800	2640900	28969600	61702

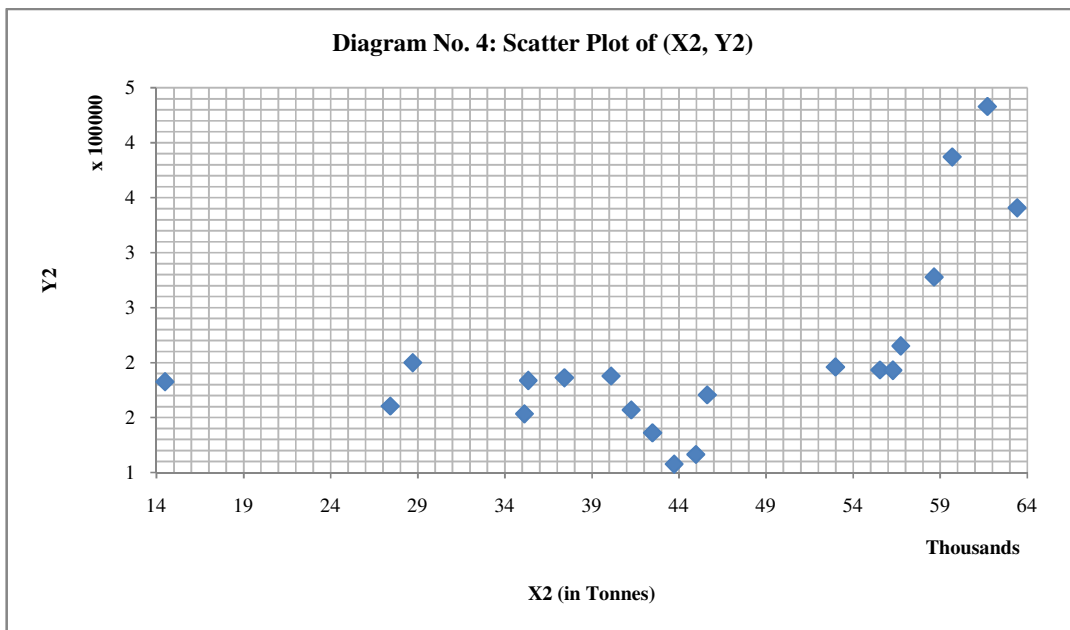
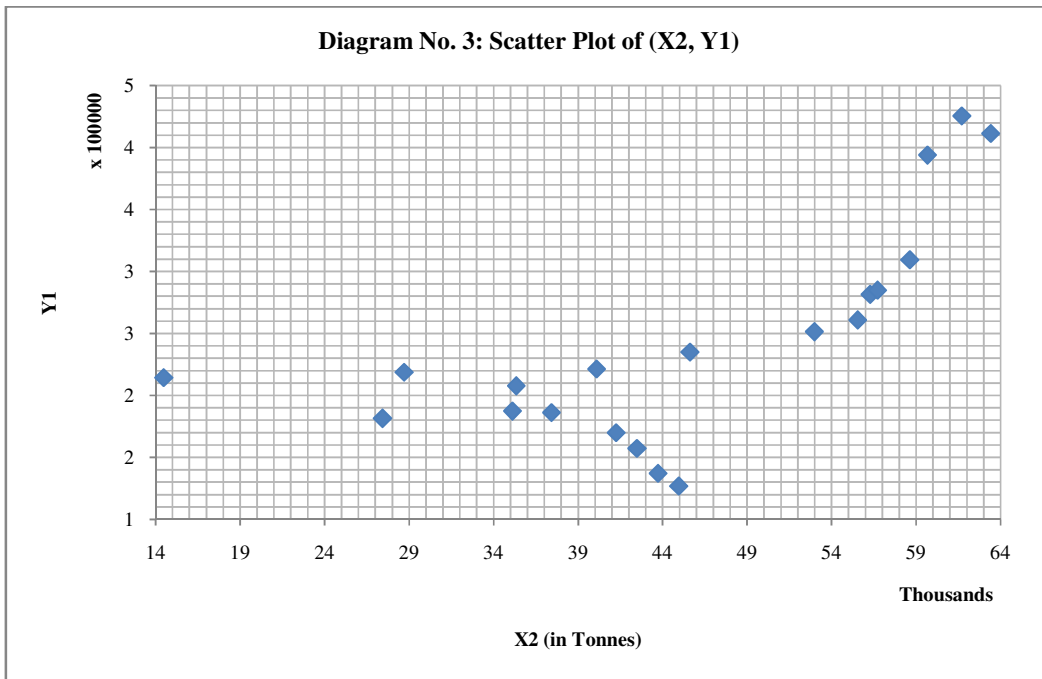
Table No. 2

Year	Number of Registered Deaths	% Deaths due to Neoplasm	% Deaths due to Disease of Digestive Systems (K00- K92)	Number of Deaths due to Neoplasm: Y1	Number of Deaths due to Disease of Digestive Systems (K00- K92): Y2
2000	3528338	3.6	3.3	127020	116435
2001	3708015	3.7	2.9	137197	107532
2002	4251632	3.7	3.2	157310	136052
2003	4355607	3.9	3.6	169869	156802
2004	4258440	4.4	3.6	187371	153304
2005	4829664	4.3	3.8	207676	183527
2006	4327664	4.3	4.3	186090	186090
2007	4219770	4.3	3.8	181450	160351
2008	4560525	4.7	4.0	214345	182421
2009	4755054	4.6	4.2	218732	199712
2010	4813552	4.6	3.9	221423	187729
2011	4829664	5.4	4.0	260802	193187
2012	5026056	5.0	3.9	251303	196016
2013	4608075	5.1	3.7	235012	170499
2014	5212660	5.4	3.7	281484	192868
2015	5374824	5.3	4.0	284866	214993
2016	6312828	4.9	4.4	309329	277764
2017	6426595	6.4	5.3	411302	340610
2018	6911197	5.7	5.6	393938	387027
2019	7596849	5.6	5.7	425424	433020

III. SCATTER DIAGRAMS AND COMPUTATION OF CORRELATION

By using data from Table No. 1 and Table No. 2, we visualize relationship between pair of variables (X1, Y1), (X1, Y2), (X2, Y1) and (X2, Y2) through their respective scatter plots as shown below in Diagram No 1 to 4.





Also, by using data from Table No. 1 and Table No. 2, we compute correlation coefficients between each pair of variables (X1, Y1), (X1, Y2), (X2, Y1) and (X2, Y2); values of Z-Statistic for these pair of variables and p-Value for each observed value of Z-Statistic for testing significance of correlation. All these computed values are summarized below in Table No. 3.

Table No 3

Pair of Variables:	(X1, Y1)	(X1, Y2)	(X2, Y1)	(X2, Y2)
Correlation :r(x,y):	0.7690	0.6732	0.6877	0.5933
Z-Statistic:	4.1969	3.3668	3.4780	2.8150
p-Value:	0.0000	0.0008	0.0005	0.0049

IV. DISCUSSION AND CONCLUSION

All the above scatter plots show that there is positive correlation between each pair of variables (X1, Y1), (X1, Y2), (X2, Y1) and (X2, Y2). That is as value of variable X_i increases, on an average value of variable Y_j also increases for $i, j = 1, 2$.

Table No. 3 shows extent of correlation between each pair of variables (X1, Y1), (X1, Y2), (X2, Y1) and (X2, Y2). We have used Z-Statistic for testing significance of these correlations. Since p-Value for each observed Z-Statistic is almost zero, we conclude that correlation between every pair of variables (X_i, Y_j) for $i, j = 1, 2$ is highly significant.

Above correlations are not merely statistical significant values but these are due to cause of variables X which affects on variables Y, [5, 6, 10, 12]. That is, increase in trend of applying chemical fertilizers and/ or pesticides are directly affecting on human health and increases number of deaths due to neoplasm and deaths due to diseases of digestive systems. Although chemical fertilizers and pesticides are well known for their effectiveness, their impact on soil and environment, and presence of residue in food products are matters of concern. For sustainable agricultural development and to protect human health and environment from adverse effect of chemical fertilizers and pesticides, alternative methods are necessary. It is need of time to inculcate organic farming and/or controlled use of chemical fertilizers and pesticides should be prompted among Indian farmers.

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