

A Statistical Comparison of Organic and Inorganic Fertilizers for Sugarcane in Kolhapur District

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Abstract: In this study, two independent samples are taken from sugarcane growing farmers of Kolhapur district who use organic and inorganic fertilizers. These are called organic system and inorganic system farming. The collected information's are analyzed statistically (Mukhopadhyay 2006). It has been found that organic system is significantly better than inorganic system in respect of net gain and growth of gain. It is also observed that among the organic system of farming, proportion of joint family is significantly higher than the nuclear family and the farming system is depending on the type of family. But there is no significant relation between the type farming and level of education.

Index Terms: *organic system, inorganic system, pie-chart, Z-test for mean, proportion, Chi-square test of independence*

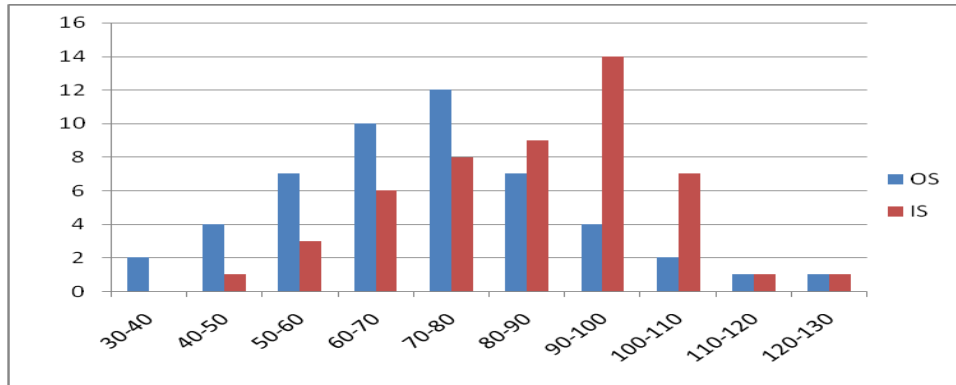
1. Introduction: Organic farming is system of farm management to create an eco-system which achieves sustainable productivity without using chemical fertilizers and pesticides. It creates impressive effects on environmental and social aspects in the society. Sharma (2005), Palanippan and Annadurai (2003) gave theory and practice of organic system of farming. Dahama (2005) discussed the organic farming for sustainable development. Koli and Gosavi (2011) compared the organic system with inorganic system subjectively. The impact of organic farming on Economics of sugarcane cultivation in Maharashtra was studied by Kshirsagar (2011), Thakur and Sharma (2005) gives organic farming for sustainable agriculture and meeting the challenges of Food security in 21st Century. The main crop of Kolhapur district is sugarcane and the farmers are using both organic and inorganic fertilizers. In this study, two independent samples each of size 50 is taken from the farmers growing sugarcane using organic and inorganic fertilizers in Kolhapur district. These are often called organic and inorganic system of farming. The collected information are classified according various characteristics such as annual expenditure, income, net gain per acre, type of family and level of education of decision maker of the family for these two system of farming. It is also obtained the average net gain of organic farming during various years after inception. (Bishop, Fienberg and Holland.1975). These classified data are presented graphically in order to highlight the defined characteristic of these two systems. The comparison of parameters of above stated characteristics of these two systems are made statistically (Mukhopadhyay, 2006). In accordance with the analysis it is observed that the average net gain per acre is significantly higher in organic system than inorganic system. There is a very high positive correlation between average net gain and the number of years after inception of organic system. The study indicates that large number of organic farmers belongs to joint family, but there is no significant difference in the level of education and type of farming.

2. Methodology and Analysis: The Kolhapur district is the major contributor of sugarcane in state of Maharashtra. The total area under sugarcane cultivation is more than 113900 hector, in that about 2766 hectors of land is under organic system of farming. In this study two independent sample each of size 50 is selected from 409 villages of Kolhapur district among organic and inorganic system of farming. The collected data is classified according to the characteristics expenditure, income and net gain per acre of these two systems and the corresponding frequency distributions and their statistical analysis are as follows

(i)**Analysis of expenditure per acre:** The distribution of expenditure per acre in organic (OS) and inorganic (IS) system is

EXP(000)	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120-130
No of OS	02	04	07	10	12	07	04	02	01	01
No of IS	00	01	03	06	08	09	14	07	01	01

(a)The corresponding bar chart is

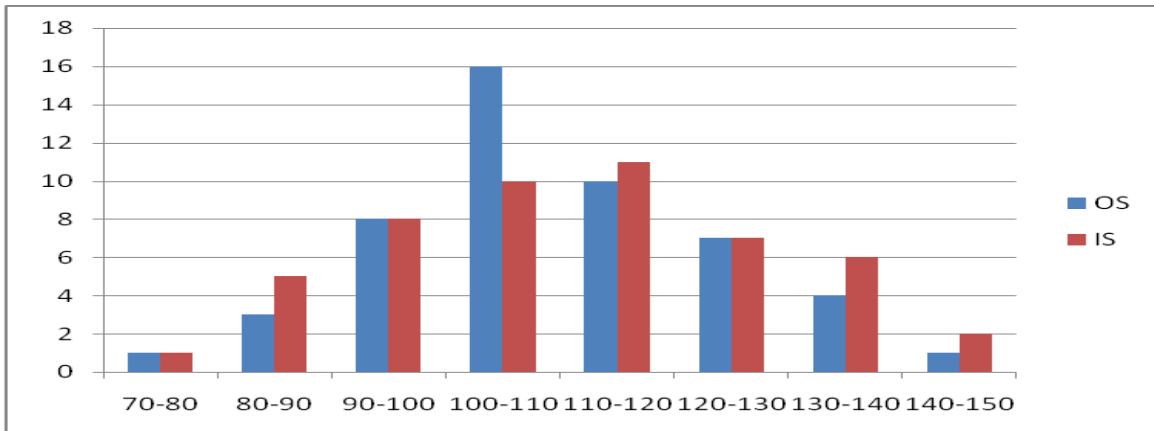


(b)Testing of hypothesis for equality of mean expenditure for organic and inorganic system of farming: Let μ_1 be the mean expenditure per acre for organic system of farming and μ_2 be the mean expenditure per acre for inorganic system of farming. The sample means are $m_1=72.2, m_2=85.4$ and standard deviations are $s_1=19.1875$ and $s_2 =16.84755$ thousands respectively. The hypothesis are $H_0:\mu_1 = \mu_2$ against $H_1:\mu_1 < \mu_2$.The value of Z-test statistic is $Z_0=-3.6554$.At level of significance $\alpha=.05$ the critical value is $Z_{0.05}=-1.64$ and $Z_0 < -1.64$, therefore reject H_0 .The sample modes are $M_{os}=72.8571$ and $M_{is}=94.1667$,therefore the corresponding value of coefficient of skewness are $S_{k(os)} = -0.03425$ and $S_{k(is)} = -0.5204$.This shows that $S_{k(os)} > S_{k(is)}$

(ii) **Analysis of income per acre:** The distribution of annual income per acre in organic (OS) and inorganic (IS) systems is,

Income(000)	70-80	80-90	90-100	100-110	110-120	120-130	130-140	140-150
No of OS	01	03	08	16	10	07	04	01
No of IS	01	05	08	10	11	07	06	02

(a)The corresponding bar chart is,

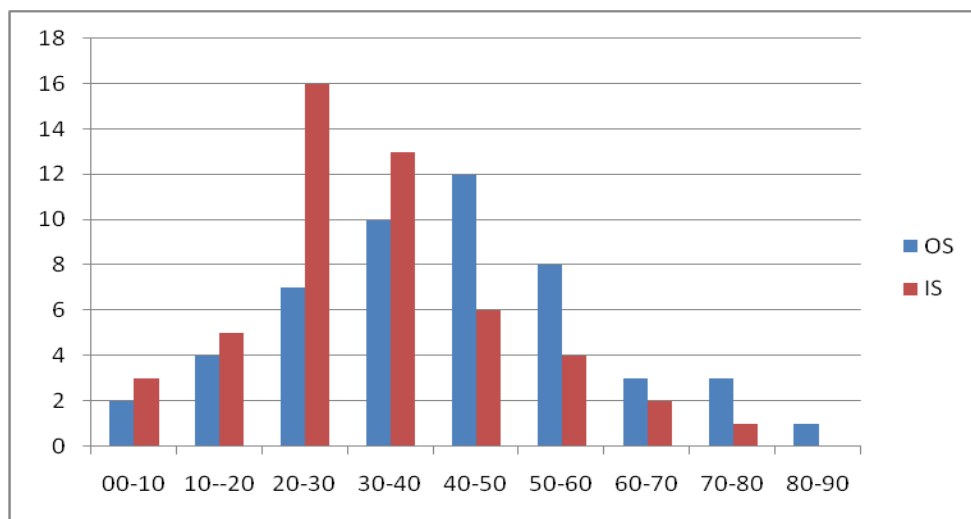


(b) Testing of hypothesis for equality of mean income for organic and inorganic system of farming: Let μ_1 be the mean income per acre for organic system of farming and μ_2 be the mean income per acre for inorganic system of farming. The sample means are $m_1=109.6, m_2=111.0$ and standard deviations are $s_1=14.725488$ and $s_2 =16.970563$ thousands respectively. The hypothesis are $H_0:\mu_1=\mu_2$ against $H_1:\mu_1<\mu_2$. The value of Z-test statistic is $Z_0=-0.4409$. At level of significance $\alpha=.05$ the critical value is $Z_{0.05} =-1.64$ $Z_0>-1.64$, therefore accept H_0 .

(iii) Analysis of net gain per acre: The distribution of net gain per acre in these two systems is,

Net gain	00-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
No of OS	02	04	07	10	12	08	03	03	01
No of IS	03	05	16	13	06	04	02	01	00

(a) The corresponding bar chart is,

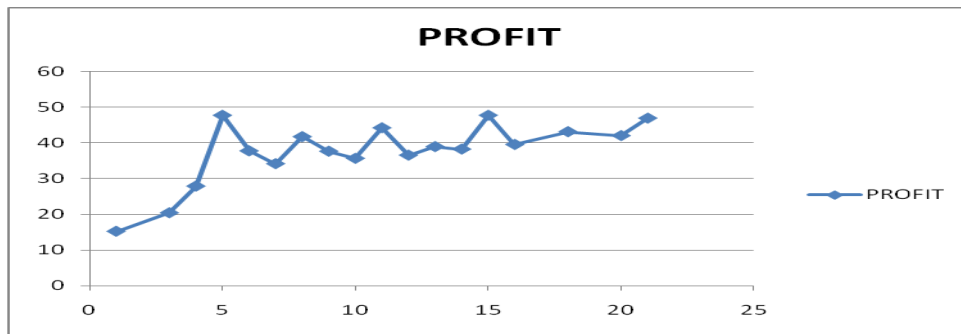


(b) Testing of hypothesis for equality of mean net gain for organic and inorganic system of farming: Let μ_1 be the mean net gain per acre for organic system of farming and μ_2 be the mean net gain per acre for inorganic system of farming. The sample means are $m_1=41.6, m_2=32.8$ and standard deviations are $s_1=18.06765$ and $s_2 =15.2696$ thousands respectively. The hypothesis are $H_0:\mu_1=\mu_2$ against $H_1:\mu_1>\mu_2$. The value of Z-test statistic is $Z_0=2.6304$. At level of significance $\alpha=.05$ the critical value is $Z_{0.05}= 1.64$ and $Z_0>1.64$, therefore reject H_0 .

(iv) Distribution of average net gain and number of years after inception:

Years	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21
Av. gain	15.2	20.4	27.9	47.8	37.8	34.2	41.8	37.7	35.7	44.3	36.6	39	38.3	47.8	39.6	43.2	42.1	47

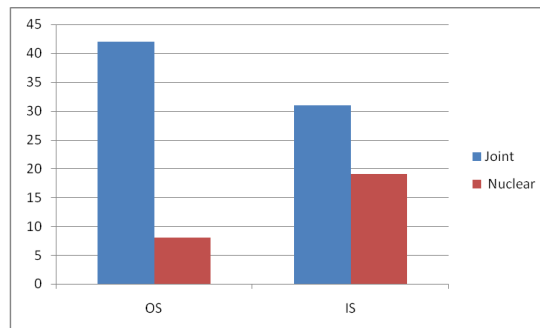
The correlation coefficient between these characteristics is **0.683887**



(v) **Analysis of type of family and type of farming:** The 2X2 contingency table representing the type of family and farming type is as follows.

TYPE OF FAMILY	TYPE OF FARMING			TOTAL
	ORGANIC	INORGNIC	TOTAL	
JOINT	42	31	73	
NUCLEAR	8	19	27	
TOTAL	50	50	100	

(a) The bar chart of the above distribution is,

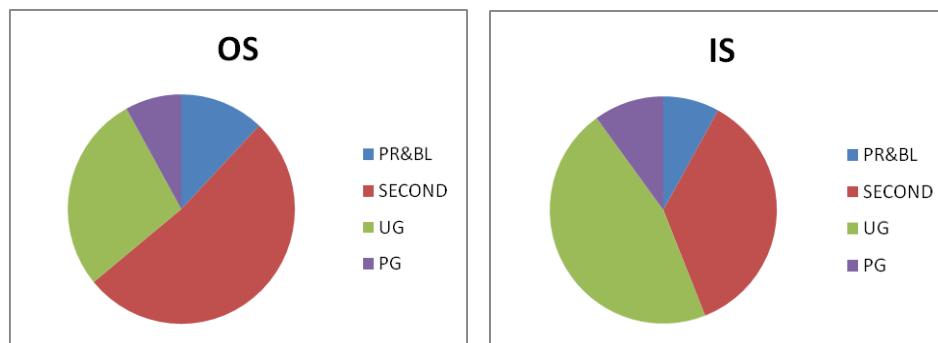


(b) Test for equality of proportions: Let P_1 be the proportion of organic farmers belonging to the joint family and P_2 is the proportion of inorganic farmers belonging to the joint family. The corresponding sample proportions are $p_1=0.84$ and $p_2=0.62$, the hypothesis are, $H_0:P_1=P_2$ against the alternative $H_1:P_1>P_2$. Under H_0 , the value of the Z-test statistic is $Z_0=2.4778$. At level of significance $\alpha=.05$ the critical value is 1.64 and $Z_0>1.64$, therefore reject H_0 .

(vi) **Analysis of level of education and type of farming:** A 2X4 contingency table representing the level of education and type of farming is,

Level of education	Primary and bellow	Secondary	Graduate	PG & other degree
OS system	06	26	14	04
IS system	04	18	23	05

(a) The corresponding pie chart is,



(b) The chi-square test of independence of two characteristics: Let A denote the type of farming and B denote the level of education of the farmers. Then the hypothesis for the test are H_0 : A and B are independent against alternative H_1 : A and B are not independent. Under H_0 , the value of the chi-square test statistic is $\chi^2_0 = 4.1548$. At level significance $\alpha = .05$ the critical value is 7.815 and $\chi^2_0 < 7.815$, therefore accept H_0 .

The proportion of organic farmers having higher (graduation and above) education is $p_1 = 0.36$ and proportion of inorganic farmers having higher education is $p_2 = 0.56$. The value of the test statistic for testing the hypothesis $H_0: P_1 = P_2$ against $H_1: P_1 < P_2$ is $Z_0 = -2.0064$. At level of significance $\alpha = .05$ the critical value is $Z_{0.05} = -1.64$ reject H_0 .

3. Conclusions: (i) The average expenditure per acre by organic system is significantly less than the average expenditure per acre by inorganic system.

(ii) There is no significant difference in the average income per acre in these two systems.

(iii) The average net gain per acre from organic system is significantly greater than the average net gain from inorganic system.

(iv) There is a very high positive correlation coefficient between number of years after inception of organic system and average profit per year. This shows that, there is a very good growth of gain by organic system.

(v) Large number of organic system of farmers belongs to the joint family than the inorganic system of farmers.

(vi) There is no significant difference in the level of education of the farmers of these two systems. But in general level of education of inorganic farmers is higher than organic farmers.

4. Findings: (i) The organic system of farming is only 2.4284% of the total area. This shows that, there is a lack of encouragement for this system of farming.

(ii) Organic system of farming decreases the average annual expenditure year by year after its inception.

(vi) Highly educated farmers prefer inorganic system than organic system.

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