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Study of input and output parameters on energy requirement in cotton crop production

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ABSTRACT : The present research work has been carried out in Akola district, the aim of this research was to determine the energy input and output involved in cotton production. The operations considered were land preparation, sowing, intercultural, harvesting and crop residue management etc. The inputs like human power; bullock powers for traditional operation were studied in entire work of the research. The non significant relationship of this variable with output energy indicates that this variable did not affect output energy of farm. The other variables were found to be highly and positively significant with the output energy. Variables namely area under cultivation, power sources, irrigation, hoeing and input energy showed highly significant with yield and output energy and contributed 82 per cent variation in production and 92 per cent contribution in variation with output energy.

KEY WORDS : Input output parameters, Energy requirement, Cotton crop

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Effective use of energy is one of the conditions for sustainable agricultural production. Energy budgets for agricultural can be used as building blocks for life cycle assessments that includes agricultural crop production and serve as a first step towards identifying crop production processes that benefit most from increasing efficiency. Enhanced input of energy and improvement in its quality play an important role in the development of all technologies including those associated with agricultural production. Investigation on the use of energy per unit area for different crops are very important particularly at times when the country is facing energy crisis undertaking investigation, which will forecast requisite data on the issues, will certainly be most welcoming and acceptable. It becomes necessary to study energy use pattern and also to study the possibility of optimizing the returns by re-allocation of energy input resources.

Economy of Vidarbha farmers mainly depend upon production of cotton. There are two categories of cotton crop namely, *Gossipum hirsutum* (American) and *Gossipum arborium* (Deshi) sown in Vidarbha. For these, American and local cotton there are various high yielding hybrid verities adopted by farmers. Energy forms one of the most crucial inputs in agriculture. The patterns of energy use in agriculture are crucially linked with the level of technology adopted. It also depends upon the cropping pattern which differs from region to region. Study on the use of energy in agriculture has received a great deal of emphasis in recent years with the increasing modernization of traditional agriculture, energy in agriculture vales according to the type of farming area, the size of farm and level of technology. With the introduction of high yielding varieties, there has been an increased productivity per hectare. Such desired result, however, could be achieved only through adoption of package of improved practices and timely completion of various farm operations.

Sufficient energy is needed in right form and the right time for adequate crop production. Energy is regards as a factor for crop production. The findings of the study also indicate the energy use pattern in cotton crop, factor of production, and its restricted availability affects the economy adversely. The study was focused on the energy use pattern on farms (small, medium, large) and their impact on crop yield for various energy inputs in total cost of production. The new production technologies require a large quantity of inputs, such as fertilities, irrigation, plant protection chemicals, and electricity. The application of these inputs demand for increasingly higher use of energy from human, animal and machinery. Detailed energy censuses and resources availability surveys have been conducted in Akola district.

METHODOLOGY

The present study was undertaken in Akola district of Maharashtra State. The district was selected purposively, as Akola is contributing major cotton growing area in Vidarbha region, in which seven Panchayat Samiti were selected. Soil type of study area was medium black cotton soil.

Sampling plan and sampling technique :

The present study was an attempt to find out level and use of energy pattern and economics. For that purpose a proper sampling plan and technique was followed. The samples for the study from each Panchyat Samiti of Akola district were selected. Five villages were selected randomly from each of these Panchyat Samities for the study. Thus 35 villages had been selected from seven Panchayat Semites of Akola district. In this way data were collected from 525 respondents

The design of study was three stage stratified random sampling. Akola district is divided in to seven Panchayat Samities. From each Panchayat Samiti five villages were randomly selected. The questionnaire so developed was discussed with the experts for proper and accurate finding to get information and data from the respondent.

Conceptual model of the study is shown in Fig. A.

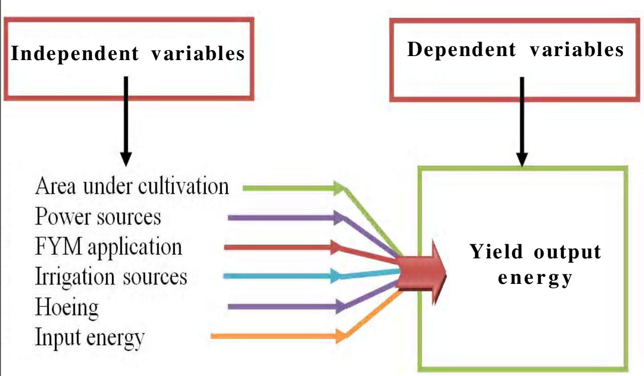

Fig. A: Conceptual model of the study

Statistical techniques used :

Co-efficient of correlation (r) :

The co-efficient of correlation (r) was worked to find out relationship of independent variables with dependent variables. The significance of calculated co-efficient of correlation (r) was tasted against the table value of 'r' at n-2 degree of freedom. The relationship was considered to be significant if the calculated value of 'r' was greater than the table value at either 0.01 or 0.05 level of probability.

The relationship between independent variable and dependent variables will be calculated with the help of following given formula of co-efficient of correlation and of significance.

$$r = \frac{\sum XY - N(Mx)(My)}{[\sum X^2 - N(Mx)^2][\sum x^2 - N(My)^2]}$$

where,

r	=	Co-efficient of correlation
x	=	Score of independent variables
y	=	Score of independent variables
Σxy	=	Sum of product of 'x' and 'y' series
Σx^2	=	Sum of squared 'x' values
Σy^2	=	Sum of squared 'y' values
N	=	Number of respondents
Mx	=	Mean of X series
My	=	Mean of Y series

Multiple linear regression analysis :

The regression equation of y on x is expressed as follows.

Y = a + bx

where a and b are the contents which determine the position of line completely. These parameters are called the parameters of the line.

Regression equation of X on Y.

$$X - X = r\frac{6xs}{} Y - Y$$

X is the mean of x series

Y is the mean of y series

$r\frac{6x}{6y}$ Is known as the regression co-efficient of X on Y

The regression co-efficient of X on Y is denoted by the symbol bxy or bl. It measures the change in x corresponding to a unit change in Y. When deviations are taken from the means of X and Y the regression co-efficient of X on Y is calculated as follows.

$$bxy \text{ or } r\frac{6x}{6y} = \frac{\sum xy}{\sum y^2}$$

Regression equation of Y on X.

$$Y - Y = r\frac{6y}{6x}(X - X)$$

$r\frac{6y}{6x}$ Is the regression co-efficient of Y on X

It is denoted by byx or br. It measures the change in Y corresponding to unit change in X. When deviations are taken from actual means the regression co-efficient of Y on X can be obtained as follows.

$$r\frac{6x}{6y} = \frac{\sum xy}{\sum y^2}$$

The value of the conflation co-efficient is calculated as

r = bxy * byx

Path analysis :

Path analysis helps us to identify the independent variables affecting the dependent variables directly as well as indirectly. Path analysis was employed to isolate the direct and indirect effect of independent variables on each of dependent variables.Path co-efficients was considered to be significant if calculated 't' value was greater than table 't' value at either 0.01 or 0.05 level of probability.

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Rational analysis :

To study the relationship of the characteristics of the independent variables on dependent variable and to find out their influence and to isolate their direct and indirect effect for analysis of the data, the correlation, multiple regression and path analysis was carried out.

Correlation analysis :

Relationship and influence of selected characteristics of respondent on yield :

The correlation analysis was done to find out the relationship of the selected characteristic of the respondent on yield. A closer look at 'r' values in Table 1 brings in to light that selected characteristic namely, area under cultivation, power sources, FYM application, irrigation, number of hoeing, and input energy showed highly and positively significant in relation with their yield.

The present finding with regard to relationship between the characteristics of the selected variable on yield leads to partial acceptance of the hypothesis formulated for the purpose of study. The hypothesis stands accepted in respect of area under cultivation, power sources, FYM application, irrigation, hoeing and input energy toward energy requirement

Table 1: Co-efficient of correlation between selected characteristic on yield

Sr. No.	Characteristics	Coefficient of correlation 'r'	Cal. 't' value
1.	Actual land cultivated area	0.8330**	34.04
2.	Power sources	0.4181**	10.52
3.	FYM application	0.1314**	3.03
4.	Irrigation	0.8435**	35.91
5.	Hoeing	0.8435**	8.08
6.	Input energy	0.8625**	38.97

* and ** Indicate significance of value at P=0.05 and 0.01, respectively

Table 2: Co-efficient of correlation between selected characteristic on output energy

Sr. No.	Characteristics	Co-efficient of correlation 'r'	Cal 't' value
1.	Actual land cultivated area	0.9329**	59.28
2.	Power sources	0.4405**	11.22
3.	FYM application	0.0779*	1.78
4.	Irrigation	0.8552**	37.45
5.	Hoeing	0.1966**	4.58
6.	Input energy	0.9119**	50

* and ** Indicate significance of value at P=0.05 and 0.01, respectively

Table 3: Regression analysis showing relative contribution of independent variable influencing output energy

Sr.No.	Variables	Regression co-efficient
1.	Actual land cultivated area	10.966 (0.9384)
2.	Power sources	2.1466 (1.7045)
3.	FYM application	3.3391 (1.2990)
4.	Irrigation	0.07575 (0.0119)
5.	Hoeing	18.815 (2.255)
6.	Input energy	0.00016 (0.000148)

R^2=0.8210

in cotton crop production.

Relationship and influence of selected variable on output energy :

A closer look at 'r' values in Table 2 brings in to light that selected variable FYM application show significant relationship with output energy. The Null hypothesis in case of this variable has therefore, to be accepted. The non significant relationship of this variable with output energy indicates that this variable did not affect output energy of farm. The other variables were found to be highly and positively significant with the output energy.

Multiple linear regression analysis for independent variable on yield :

Thus, the variable area under cultivation, power sources, irrigation, FYM application, hoeing and input energy contributed to the extent of 82.10 per cent variation in yield. From the result obtained in Table 3 it can be concluded that six variable area under cultivation, power sources, irrigation, FYM application, hoeing, and input energy were significant and major determinant in yield.

Multiple liner regression analysis of independent variable outputs energy :

From Table 4 It was observed that when regression analysis was carried out with variable namely actual area under cultivation, power sources, Irrigation, FYM application, hoeing, and input energy the value of co-efficient of determination (R^2=0.9208). Thus, these variables contributed to the extent of 92.08 per cent in variation in output energy.

Path analysis :

The path analysis were carried out with six variable namely area under cultivation, power sources, irrigation, FYM application, hoeing, and input energy and yield as dependent variable to estimate the direct effect produced by each of independent variable as well as indirect effect produced by

Table 4 : Regression analysis showing relative contribution of independent variable influencing output energy

Sr. No.	Variables	Regression co-efficient
1.	Actual land cultivated area	48612.16 (2191.02)
2.	Power sources	6517.02 (3979.53)
3.	FYM application	7385.55 (3032.76)
4.	Irrigation	138.16 (27862)
5.	Hoeing	24241.4 (5266.4)
6.	Input energy	1.1405 (0.2448)

R^2=0.9208

Table 5: Direct and indirect effect of independent variable on yield

Sr. No.	Independent variables	Correlation co-efficient 'r'	Direct effect	Rank order	Total indirect effect	Rank order
1.	Area under cultivation	0.8330**	0.5143	I	0.3157	IV
2.	Power sources	0.4181**	0.0262	VI	0.3919	III
3.	FYM application	0.1314**	0.0496	V	0.0818	VI
4.	Irrigation	0.8435**	0.281	II	0.562	II
5.	Hoeing	0.3333**	0.1872	III	0.1467	V
6.	Input energy	0.8625**	0.089	IV	0.7735	I

* and ** Indicate significance of value at P=0.05 and 0.01, respectively

Table 6: Direct and indirect effect of independent variable on output energy

Sr. No.	Independent variable	Correlation co-efficient 'r'	Direct effect	Rank order	Total indirect effect	Rank order
1.	Area under cultivation	0.9329**	0.6492	I	0.2837	IV
2.	Power sources	0.4405**	0.0265	VI	0.4197	III
3.	FYM application	0.0798*	0.0312	V	0.0467	VI
4.	Irrigation	0.8552**	0.1462	II	0.7090	II
5.	Hoeing	0.1966**	0.0686	III	0.1279	V
6.	Input energy	0.9119**	0.1800	IV	0.7319	IV

* and ** Indicate significance of value at P=0.05 and 0.01, respectively

them through other variables on yield.

It is apparent from Table 5 that the variables namely area under cultivation (0.5143), irrigation (0.2814), hoeing (0.1872), input energy (0.0890), FYM application (0.0496), and power sources (0.0262) had exerted maximum positive direct effect on yield on descending order of magnitude. The FYM application and power source were found to have exerted least direct effect on yield.

In so far as total indirect effect of independent variables on performance as dependent variable was concerned, it was observed from Table 5 that the variable namely, input energy (0.7735), irrigation (0.5620), power sources (0.3919), area under cultivation (0.3157), hoeing (0.1461), and FYM application (0.0818) had exerted maximum positive indirect effect on yield in descending order of magnitude.

In so far as total direct effect of the independent variables on output energy as dependent variable was concerned, it was observed from Table 6 that the variable, namely area under cultivation (0.6492), input energy (0.1800), irrigation (0.1462), hoeing (0.0686), FYM application (0.0312), and power sources (0.0265) had exerted maximum positive direct effect on output energy on descending order of magnitude.

In so far as total indirect effect of independent variables on output energy as dependent variable was concerned, it was observed from Table 6 that the variable namely, Input energy (0.7319), Irrigation (0.7090), power sources (0.4179), area under cultivation (0.2837), hoeing (0.1279), and FYM application (0.0467) had exerted maximum positive indirect effect on output energy descending order of magnitude.

Similar to present investigation michael and Joel (1988) also studied energy inputs to cotton production in Arkansas.

Conclusion :

Independent variables namely area under cultivation ,power sources, FYM application, irrigation, hoeing and input energy showed highly and positively significant on yield as dependent variable and for output energy as dependent variable the independent variable FYM application was found to be significant, at 0.01 level probability and other independent variable namely area under cultivation, power sources, irrigation, hoeing and input energy were observed to be highly significant on output energy at 0.05 level probability.

Regarding regression analysis variables area under cultivation, power sources, irrigation, FYM application, hoeing and input energy was found to contribute to the extent of 82.10 per cent in variation in yield, and contributed 92.08 per cent in variation in output energy.

As for path analysis area under cultivation factor showed maximum direct effect on yield and power sources showed minimum direct effect on yield. The variable input energy showed maximum indirect effect on yield while area under cultivation showed minimum indirect effect. For output energy as dependent variable it was concluded that maximum direct effect on output energy was exhibited from independent variable area under cultivation and minimum direct effect was to be of power sources on output energy. The maximum indirect effect was found to be of input energy and minimum was to be of FYM application on output energy, respectively.

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