Production function analysis by using Cobb-Douglas
Production Function was used as the analytical approach for the
present study. The Cobb-Douglas Production Function is generally
accepted by most of the Agricultural Production Economists;
partly because of the better fit it provides and also because
of the computational ease with this particular algebraic form
and the additional information regarding returns to scale which
it provides.

In choosing independent variables for inclusion in
the functional equation, in all those cases where two independent
variables were highly correlated, only one of these was retained
with a view to eliminate the effect of multi-collinearity. The
equations were fitted using least square method of regression
for which the data were processed with the help of electronic
computer, available in the Department of Agricultural Economics
and Statistics, Chandra Shekhar Azad University of Agriculture
and Technology, Kanpur. Standard errors of the regression
coefficients were examined and only those variables whose coeffi-
cient value was higher than its standard errors were selected
for the subsequent runs.
(i) **Crop Production as whole**

The general form of production function equation for crop production taken as a whole was as below:

\[ y = ax_1 x_2 x_3 x_4 x_5 \]

Where,

- \( y \) = Total gross income of crops in Rs. per hectare.
- \( x_1 \) = Expenditure on human labour in Rs. per hectare.
- \( x_2 \) = Expenditure on bullock labour in Rs. per hectare.
- \( x_3 \) = Expenditure on seed in Rs. per hectare.
- \( x_4 \) = Expenditure on manure & fertilizers in Rs. per hectare.
- \( x_5 \) = Expenditure on irrigation Rs. per hectare.
- \( a \) = Constant.
- \( b_1 \) ... \( b_5 \) = Regression coefficients of respective variables.

(ii) **Important individual crops**

The important crops under study were maize, sugarcane planted, sugarcane ratoon and wheat. The production function were fitted on the same lines as in the case of crop production as a whole. The functional form and variables taken into account remained unchanged.

(iii) **Milk Production**

In case of milk production, the functional equation form was:

\[ y = ax_1 x_2 x_3 \]
Where,

\[ y = \text{Total gross income from milk in Rs. per hectare.} \]
\[ x_1 = \text{Expenditure on human labour in Rs. per hectare.} \]
\[ x_2 = \text{Expenditure on fodder.} \]
\[ x_3 = \text{Expenditure on concentrates.} \]
\[ a = \text{Constant.} \]
\[ b_1 \ldots b_3 \text{ are regression coefficients of respective variables.} \]

(iv) **Farm business as a whole**
(Crop + milk enterprise combined)

The general form of the production function equation for crop + milk production as a whole was:

\[ y = ax_1 x_2 x_3 x_4 x_5 x_6 x_7 x_8 \]

Where,

\[ y = \text{Total gross income from crop + milk production in Rs. per hectare.} \]
\[ x_1 = \text{Expenditure on human labour on crop production in Rs. per hectare.} \]
\[ x_2 = \text{Expenditure on bullock} \]
\[ x_3 = \text{Expenditure on seed} \]
\[ x_4 = \text{Expenditure on manures & fertilizers} \]
\[ x_5 = \text{Expenditure on irrigation} \]
\[ x_6 = \text{Expenditure on human labour in milk production in Rs. per hectare.} \]
\[ x_7 = \text{Expenditure on fodder} \]
\[ x_8 = \text{Expenditure on concentrates} \]
a = Constant

b_1 ... b_8 Regression coefficients of the respective values.

The Cobb-Douglas function equations obtained for crop production as a whole, for important individual crops, for milk production and for farm business as a whole worked out as below:

(1) CROP PRODUCTION AS A WHOLE

1st size group (0-1 hectare) \( y = 1.3155x_1 (1.069) x_2 (.0508) x_3 (.0457) \)
\( x_4 (.1257) x_5 (.1129) \)
\( R^2 = .7009 \)

2nd size group (1-2 hectares) \( y = 1.0536x_1 (1.050) x_2 (.1277) \)
\( x_3 (.0704) x_4 (.0946) x_5 (.0702) \)
\( R^2 = .7612 \)

3rd size group (2-3 hectares) \( y = 1.4215x_1 (1.170) x_2 (.0527) \)
\( x_3 (.0630) x_4 (.0566) x_5 (.1874) \)
\( x_5 (.0605) \)
\( R^2 = .8149 \)

4th size group (3-4 hectares) \( y = 1.486 x_1 (.0820) x_2 (.0562) \)
\( x_3 (.0388) x_4 (.1938) x_5 (.1344) \)
\( R^2 = .7795 \)
5th size group \[ y = 2.0480x_1 + 1.648 \cdot x_2 + 0.728 \cdot x_3 + 1.192 \cdot x_4 + 1.117 \cdot x_5 \]

\[ R^2 = 0.8996 \]

Overall \[ y = 1.4558x_1 + 0.0805 \cdot x_2 + 0.551 \cdot x_3 + 0.611 \cdot x_4 + 1.280 \cdot x_5 \]

\[ R^2 = 0.7932 \]

(ii) Individual crops

I. Maize \[ y = 0.192x_1 + 0.0685 \cdot x_2 + 0.521 \cdot x_3 + 0.0809 \cdot x_4 \]

\[ R^2 = 0.9268 \]

II. Sugarcane planted \[ y = 49.470x_1 + 0.1024 \cdot x_2 + 0.514 \cdot x_3 + 1.289 \cdot x_4 \]

\[ R^2 = 0.8686 \]

III. Sugarcane ratoon \[ y = 9.716x_1 + 0.0960 \cdot x_2 + 0.0810 \cdot x_3 \]

\[ R^2 = 0.7140 \]

IV. Wheat \[ y = 25.44x_1 + 0.1131 \cdot x_2 + 0.0658 \cdot x_3 + 0.0710 \cdot x_4 \]

\[ R^2 = 0.8473 \]
(iii) **Milk production**

\[ y = 101.85x_1^{0.04333} x_2^{1.580} x_3^{0.3801} \]

\[ R^2 = .7571 \]

(iv) **Farm business as a whole**

(Crop + milk production combined on overall basis)

\[ y = 1.5269x_1^{0.1226} x_2^{1.056} x_3^{1.088} x_4^{0.2907} x_5^{0.2144} x_6^{0.0507} x_7^{0.1093} x_8^{0.2351} \]

\[ R^2 = .7051 \]

**Coefficient of multiple determination**

(i) **Crop production as a whole**

Examination of \( R^2 \) for production equation of crop production as a whole indicates that variations in expenditure on human labour, bullock labour, seed, manure and fertilizers and irrigation accounted for 70% to 89% on different size groups of farms, of variability in the logarithms of gross farm income. An intersize group examination of \( R^2 \) shows that variations in expenditure on human labour, seed, manures and fertilizers and irrigation accounted for 70.09% of variability in gross income on 0-1 hectare size group, 76.12% in 1-2 hectares, 81.49% in 2-3 hectares, 77.95% in 3-4 hectares and 89.96% in 4 & above hectares size group.
(ii) Individual crops

The coefficient of multiple determination \( R^2 \) were found higher for maize, wheat, and sugarcane planted while it were lower for sugarcane ratoon. In maize, wheat, and sugarcane planted the \( R^2 \) came to .9268, .8473, and .8686 respectively indicating that variation in independent variables i.e. human labour, bullock labour, seed, manures, and fertilizers and irrigation included in the equations explained more than 92%, 84%, and 86% of the variations in the gross output value of the corresponding crops. In case of sugarcane ratoon crop 71% of the variation in output value were accounted for by variation in human labour, bullock labour, seed, manures, and fertilizers and irrigation.

(iii) Milk production

Examination of \( R^2 \) for milk production equation indicates that variations in expenditure on fodder (green and dry fodder), human labour, and concentrates in milk production were up to 75%.

(iv) Farm business as a whole (Crop + milk production)

In case of farm business as a whole, the \( R^2 \) came to .7051, which indicates that the variations in expenditure on human labour, bullock labour, seed, manures & fertilizers, irrigation, fodder, and concentrates accounted for 70.51% variability in the logarithms of gross farm income from crop + milk production as a whole.
Elasticity of production of farm inputs

(i) Crop Production

The regression coefficients in the Cobb-Douglas function (which is linear in logs) denote the elasticity of production for the inputs concerned. Each coefficients indicates the percentage increase in per hectare farm or crop returns associated with one per cent increase in the quantity of corresponding resources, holding other resources in the equation constant.

The elasticity of production coefficients along with test of significance and standard error are given in Table IX-1. The elasticity for all the input factors appearing in the equation are positive and significant.

Table IX-1: Elasticity of production, standard error and coefficient of multiple determination for farm business as a whole, size groupwise.

<table>
<thead>
<tr>
<th>Size groups</th>
<th>Human 'Bullock'</th>
<th>'Labour'</th>
<th>'Labour'</th>
<th>Seed 'Manures &amp; Irrigation'</th>
<th>'Fertilizer'</th>
<th>'Return to scale'</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1 hectare</td>
<td>.2718</td>
<td>.1078</td>
<td>.1039</td>
<td>.3237</td>
<td>.2793</td>
<td>.7009</td>
</tr>
<tr>
<td>Regression coefficient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.E.</td>
<td>.1069</td>
<td>.0508</td>
<td>.0457</td>
<td>.1257</td>
<td>.1129</td>
<td></td>
</tr>
<tr>
<td>1 - 2 hectares</td>
<td>.2336</td>
<td>.1656</td>
<td>.1654</td>
<td>.2142</td>
<td>.2504</td>
<td>.7612</td>
</tr>
<tr>
<td>Regression coefficient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.E.</td>
<td>.1050</td>
<td>.1277</td>
<td>.0704</td>
<td>.0946</td>
<td>.1120</td>
<td></td>
</tr>
</tbody>
</table>

..continued...
A size groupwise examination shows that production elasticities for human labour were higher on small farms and showed a declining trend with the increase in size of farms. It came highest being .2718 on 0-1 hectare size group and lowest being .1634 on 3-4 hectares size group. In case of production elasticities for bullock labour and seed, these were more or less equal (varying from .103 to .176) on different size groups of holdings. As regards elasticities for manures and fertilizers and irrigation no definite trend was observed for different size groups of farms.

<table>
<thead>
<tr>
<th>Size Group</th>
<th>Regression Coefficient</th>
<th>S.E.</th>
<th>Coefficient</th>
<th>S.E.</th>
<th>Coefficient</th>
<th>S.E.</th>
<th>Coefficient</th>
<th>S.E.</th>
<th>Constant</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 3 hectares</td>
<td>0.2214</td>
<td>0.1170</td>
<td>0.1383</td>
<td>0.3147</td>
<td>0.2368</td>
<td>0.8149</td>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 - 4 hectares</td>
<td>0.1634</td>
<td>0.1045</td>
<td>0.1235</td>
<td>0.4221</td>
<td>0.2914</td>
<td>0.7795</td>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 &amp; above hectares</td>
<td>0.1872</td>
<td>0.1648</td>
<td>0.1769</td>
<td>0.2586</td>
<td>0.2575</td>
<td>0.8996</td>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>0.1896</td>
<td>0.1122</td>
<td>0.1336</td>
<td>0.3627</td>
<td>0.2022</td>
<td></td>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 5% level of significance
(ii) **Individual crops**

The elasticities of production coefficients with test of significance and standard error for individual crops are given in Table IX-2.

Table IX-2: Elasticity of Production, standard error and $R^2$ for individual crops.

<table>
<thead>
<tr>
<th>Crop</th>
<th>'Human'</th>
<th>'Bullock'</th>
<th>'Labour'</th>
<th>'Labour'</th>
<th>'Seed'</th>
<th>'Manure &amp; Irrigation'</th>
<th>'Return'</th>
<th>$R^2$</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAIZE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regression coefficient</td>
<td>0.1528</td>
<td>0.1209</td>
<td>0.1743</td>
<td>0.3506</td>
<td></td>
<td></td>
<td>0.9268</td>
<td>Decreasing</td>
</tr>
<tr>
<td></td>
<td>S.E.</td>
<td>0.0685</td>
<td>0.0521</td>
<td>0.0809</td>
<td>0.1647</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane planted</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regression coefficient</td>
<td>0.2018</td>
<td>0.1098</td>
<td>0.2633</td>
<td>0.3294</td>
<td>0.2254</td>
<td>0.8686</td>
<td>Increasing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S.E.</td>
<td>0.1024</td>
<td>0.0514</td>
<td>0.1289</td>
<td>0.1530</td>
<td>0.1082</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane Ratoon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regression coefficient</td>
<td>0.1901</td>
<td>0.1675</td>
<td>-</td>
<td>0.3440</td>
<td>0.2367</td>
<td>0.7140</td>
<td>Constant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S.E.</td>
<td>0.0960</td>
<td>0.0810</td>
<td>-</td>
<td>0.1683</td>
<td>0.1124</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regression coefficient</td>
<td>0.2131</td>
<td>0.1412</td>
<td>0.1540</td>
<td>0.4007</td>
<td>0.2687</td>
<td>0.8473</td>
<td>Constant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S.E.</td>
<td>0.1131</td>
<td>0.0658</td>
<td>0.0710</td>
<td>0.1843</td>
<td>0.1240</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 5% level of significance.
It is clear from Table IX-2 that elasticity of production for manures and fertilizers was higher in all the groups, followed by irrigation and human labour. For bullock labour elasticities were almost constant for all crops while for seeds it was highest in sugarcane planted followed by wheat. The elasticity of irrigation was higher on wheat crop followed by sugarcane ratoon and sugarcane planted.

(iii) Milk production

The elasticity of production coefficients alongwith test of significance and standard error are given in Table IX-3. The elasticity for all the input factors appearing in the equation are positive and significant.

Table IX-3: Elasticity of production, standard error and coefficient of multiple determination for milk production enterprise.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>'Fodder'</th>
<th>Human labour</th>
<th>'Concentrate'</th>
<th>( R^2 ) Return to scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression coefficient</td>
<td>.0433</td>
<td>.1580</td>
<td>.3801</td>
<td>.7571 Decreasing</td>
</tr>
<tr>
<td>S.E.</td>
<td>.0181</td>
<td>.0602</td>
<td>.1637</td>
<td>-</td>
</tr>
</tbody>
</table>

* Significant at 5% level of significance.

Table IX-3 indicates that the production elasticity for concentrates was highest being .3801 followed by human labour (.1580) and fodder (.0433).
Farm business as a whole (Crop + milk production)

Table IX-4 shows the elasticity of production along with test of significance and standard errors for farm business as a whole (crop + milk production combined). The elasticities of production for all the input factors appearing in the production function equation are positive and significant. The highest significant coefficients are found to be manures and fertilizers, irrigation, fodder and concentrates.

Table IX-4: Elasticity of production, coefficient of multiple determination and return to scale on farm business as a whole (crop + milk combined).

<table>
<thead>
<tr>
<th>Particulars</th>
<th>'Human labour'</th>
<th>'Bullock labour'</th>
<th>'Seed'</th>
<th>'Manure' &amp; 'Irrigation'</th>
<th>'Labour' &amp; 'Irrigation'</th>
<th>'Fodder' &amp; 'Concen.'</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression coefficients</td>
<td>0.1226</td>
<td>0.1056</td>
<td>0.1088</td>
<td>0.2907</td>
<td>0.2144</td>
<td>0.0507</td>
<td>0.1093</td>
</tr>
<tr>
<td>S.E.</td>
<td>0.0622</td>
<td>0.0496</td>
<td>0.0534</td>
<td>0.1551</td>
<td>0.1077</td>
<td>0.0234</td>
<td>0.0577</td>
</tr>
</tbody>
</table>

* Significant at 5% level of significance

Scale Relationship

By scale of return, here, we imply, the behaviour of the change of total returns of the farm or crop, when all the inputs are changed simultaneously in the same proportion. A sum of elasticities equal to one indicates constant return to scale, less than one decreasing and more than one increasing returns to scale.
The sum of elasticities for crop production, important individual crops, milk production and farm business as a whole as shown in Table IX-1 to IX-4 indicate the percentage change in gross income as the quantities of all resources are increased by 1 per cent each. It may be noticed that on crop production and farm business as whole (crop + milk), constant return are indicated for all size groups of farm. In case of individual crops sugarcane planted indicates an increasing return to scale, wheat and sugarcane ratoon constant return to scale and maize decreasing return to scale. In case of milk enterprise alone, decreasing returns to scale are found.

Marginal Value Product of Inputs

The marginal Value Products (M.V.P.) of various inputs namely human labour, bullock labour, seed, manure & fertilizer and irrigation were worked out at their geometric mean level to compare their productivity within different size of holdings and crops. The steps involved for the estimation of M.V.P. of various inputs are as follows:

\[ y = ax_1^{b_1} x_2^{b_2} \ldots x_n^{b_n} \]

Where, \( y \) = Output values in Rs. per hectare
\( x_1 \) to \( x_n \) = Input variables.

The partial derivatives of the output value \( y \) with respect to the input \( x_1 \) is

\[ \frac{dy}{dx_1} = ab_1x_1^{b_1-1} x_2^{b_2} \ldots x_n^{b_n} \]
The marginal value product of $x_1$ was then obtained by substituting the corresponding geometric mean value of $x_1, x_2, \ldots, x_n$.

1) M.V.P. of different inputs for crop production as a whole

The M.V.P. of the different inputs for various size groups of holdings have been presented in Table IX-6.

Table IX-6: Marginal value products of various inputs on different size groups of holding for farm crop production as a whole.

<table>
<thead>
<tr>
<th>Size group (in hectares)</th>
<th>Human labour</th>
<th>'Bullock labour</th>
<th>Seed</th>
<th>'Manures &amp; fertilizer</th>
<th>Irrigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1</td>
<td>1.5348</td>
<td>1.2760</td>
<td>2.5318</td>
<td>4.2299</td>
<td>3.2704</td>
</tr>
<tr>
<td>1 - 2</td>
<td>1.3654</td>
<td>1.3576</td>
<td>2.2297</td>
<td>4.7997</td>
<td>3.5266</td>
</tr>
<tr>
<td>2 - 3</td>
<td>1.4909</td>
<td>1.7872</td>
<td>2.0882</td>
<td>5.1074</td>
<td>4.3732</td>
</tr>
<tr>
<td>3 - 4</td>
<td>1.0788</td>
<td>1.5293</td>
<td>2.7541</td>
<td>5.1655</td>
<td>5.3124</td>
</tr>
<tr>
<td>4 &amp; above</td>
<td>1.1620</td>
<td>2.2848</td>
<td>2.4463</td>
<td>3.2788</td>
<td>4.7149</td>
</tr>
<tr>
<td>Overall</td>
<td>1.1792</td>
<td>1.3954</td>
<td>2.6634</td>
<td>4.2629</td>
<td>3.0029</td>
</tr>
</tbody>
</table>

Table IX-6 indicates the additional returns which are expected from the addition of one unit (rupee) of the various input factors. On an overall basis an additional rupee spent on human labour, bullock labour, seed, manure and fertilizer and irrigation would return Rs. 1.17, Rs. 1.39, Rs. 2.66, Rs. 4.26 and Rs. 3.00 as additional output.
An examination of the marginal value product of different resources indicates that marginal value products of human labour and bullock labour were lowest in comparison to other resources. From this it may be concluded that farmers of the study area use much of human labour and bullock labour in relation to other inputs. The marginal value products of human labour varied from 1.0788 in 3-4 hectares size group to 1.5348 in 0 - 1 hectare size group while of bullock labour it varied from 1.2760 on 0 - 1 hectare to 2.2848 on 4 & above hectares size group of farms.

The Marginal Value Products of seed was more or less equal on all size groups of farms. The marginal value product of manure and fertilizers came to highest followed by irrigation amongst all inputs. M.V.P. of manures and fertilizers was lowest on 4 & above hectares size groups (3.2788) as compared to other size groups of farms where it came around 5.1 on 2-3 and 3-4 hectares size group and around 4.5 on 0 - 1 and 1 - 2 hectare size groups. The M.V.P. of irrigation varied from 3.2704 on 0-1 hectare to 5.3124 on 3-4 hectares size group.

Thus, it may be concluded that the lowest marginal value productivities were noticed for human and bullock labour and highest for manure and fertilizers followed by irrigation and seed on various size groups of holdings. Further, it may be observed that the marginal value productivities for manure and fertilizers and irrigation were higher on large size group of holdings, in comparison to smaller ones.
(ii) M.V.P. of different inputs for individual crops

The marginal value products of various inputs were worked out at their geometric mean levels to compare their productivity between crops. These values are presented in Table IX-7.

Table IX-7: M.V.P. of different inputs for individual crops.

<table>
<thead>
<tr>
<th>Crops</th>
<th>'Human' labour</th>
<th>'Bullock' labour</th>
<th>'Manure &amp; Fertilizer'</th>
<th>'Seed'</th>
<th>'Irrigation'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>1.5914</td>
<td>1.9785</td>
<td>2.7640</td>
<td>4.5540</td>
<td>-</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>1.1545</td>
<td>1.2864</td>
<td>3.0078</td>
<td>5.5109</td>
<td>4.7007</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>1.1047</td>
<td>1.7960</td>
<td>-</td>
<td>4.2188</td>
<td>4.5303</td>
</tr>
<tr>
<td>Wheat</td>
<td>1.4878</td>
<td>1.8760</td>
<td>3.8462</td>
<td>4.8921</td>
<td>3.8901</td>
</tr>
</tbody>
</table>

Table IX-7 shows that in different crops, the marginal value productivity of manure and fertilizers was highest followed by irrigation and seed while it was lowest for human and bullock labour as compared to other inputs. It indicates that an additional rupee spent on manure and fertilizer and irrigation give much higher returns in its additional output as compared to human and bullock labour.

So far as individual crops are concerned the M.V.P. of human labour and bullock labour were almost equal and did not show much variation. The M.V.P. of seed came to 2.7640 for maize,
3.0078 for sugarcane planted and 3.8462 for wheat. The M.V.P. of irrigation varied from 4.2188 for sugarcane ratoon to 5.5109 for sugarcane planted. In case of irrigation M.V.P. varied from 3.8901 for wheat to 4.5303 for sugarcane ratoon.

(iii) Marginal value products of inputs for milk production

The marginal value products of various inputs namely fodder, human labour and concentrates were worked out at their geometric mean level to compare their productivity. The steps involved for the estimation of milk production were the same to that of crop production. Table IX-8 shows the M.V.P. for different inputs used in milk production.

Table IX-8: Marginal Value Products of various inputs for milk production.

<table>
<thead>
<tr>
<th>Fodder</th>
<th>Human labour</th>
<th>Concentrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1768</td>
<td>1.5461</td>
<td>3.0774</td>
</tr>
</tbody>
</table>

Table IX-8 indicates that additional returns which are expected from the addition of one unit (rupee) of the various inputs factors. An additional rupee spent on fodder, human labour and concentrates would return Rs. 2.17, Rs. 1.54 and Rs. 3.07 respectively in additional output.
(iv) **M.V.P. of different inputs for Farm Business as a whole**
(Crop + milk production combined)

The M.V.P. of different inputs for Farm Business as a whole, on an overall basis, have been presented in Table IX-9.

Table IX-9: M.V.P. of various inputs for Farm Business as a whole.

<table>
<thead>
<tr>
<th>Human &amp; Bullock labour</th>
<th>Seed (crop production)</th>
<th>Manure &amp; Irrigation</th>
<th>Concentrates (milk production)</th>
<th>Fodder (crop production)</th>
<th>Labour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.050</td>
<td>1.078</td>
<td>2.060</td>
<td>3.371</td>
<td>2.554</td>
<td>1.025</td>
</tr>
<tr>
<td>2.085</td>
<td>2.771</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table IX-9 shows that marginal value products of manures and fertilizers and irrigation were substantially high followed by seed in case of crop production, indicating the possibility of raising income by more intensive use of these inputs. In case of milk production side, the marginal value productivities of concentrates and fodder were sufficiently high, indicating the desirability of more intensive feeding of concentrates and fodder to milch animals to have higher returns. The marginal value productivities of human labour and bullock labour were found lowest indicating their higher utilization on sample farms.