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# Yield Gaps Analysis in Groundnut Production

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**Abstract:** The study was conducted in Dharwad district of Kamataka where groundnut is a major oilseed crop. The decomposition model was used to identify the contribution of different sources to the yield gap of groundnut between demonstration plots and farmer's fields. The potential farm yield of groundnut was found to be more than the actual yield on the farms. The major contributors to this yield gap were difference in input use and techniques of production.

## Introduction

Any new technology developed at research stations is tested to amply through verification trials and demonstrations before it is released to the farmers for adoption. Even then, the crop yields realised by the farmers on their farms tend to be considerably lower than those recorded at the research stations or the demonstration plots. Wide variations are also witnessed in the yields realised under different agro-climatic conditions. This shows the existence of a considerable untapped yield potential. The factors responsible for such yield differences are many and their contributions are varied.

In the present study, an attempt was made to decompose the sources of such yield difference in groundnut crop, an important oilseed crop of the country. The study was conducted in Dharwad district of Karnataka State where groundnut is a dominant oilseed crop.

## Material and Methods

Both secondary and primary data are used in the present study. The data pertaining to performance of improved variety of groundnut at the demonstration plots were collected from the Extension Education Unit of the University of Agricultural Sciences, Dharwad Campus.

For the purpose of collection of primary data from the farmers, Multi-stage sampling design was adopted. Dharwad and Hubli taluks in Dharwad district were selected based on higher percentage of area under improved variety of groundnut (JK-24). Four villages from each of the selected taluks were chosen based on the relative proportion of area under the improved variety of groundnut. From each village 15 farmers were selected randomly. Selected farmers were post classified into small (2 ha and below) and large farmers (> 2 ha). Of the total 120 farmers selected, the number of small farmers was 59 and large farmers was 61. The data on input used in groundnut production and yield, were obtained from the sample farmers by personal interviews with the help of prestrutucred schedule.

To know whether there is any difference in the groundnut yields between demonstration plots (potential farm yield) and yield on the farmers field, the structural break in parameters of these two production functions were indentified by estimating per hectare output elasticities by OLS method by fitting log linear regression seperately for demonstration plots, small farms, large farms and overall farms.

The following equations were used for assessing structural break in production parameters between production functions of

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potential farm yield (1) and actual yield on small farms (2).

$$\text{Log } Y_1 = \text{Log}A_1 + a_1 \log S_1 + b_1 \log F_1 + C_1 \log P_1 + d_1 \log L_1 \ldots\ldots (1) + U_1$$

$$\text{Log } Y_2 = \text{Log}A_2 + a_2 \log S_2 + b_2 \log F_2 + C_2 \log P_2 + d_2 \log L_2 \ldots\ldots (2) + U_2$$

$$\text{Log } Y_3 = \text{Log}A_3 + a_3 \log S_3 + b_3 \log F_3 + C_3 \log P_3 + d_3 \log L_3 \ldots\ldots (3) + e \log D + U$$

Equation (3) is the pooled production function of potential farm yield and actual yield on small farms with "techniques of production" as dummy variable.

Y = groundnut yield in kg/ha

A = intercept term

S = Expenditure on seeds Rs/ha

F = Expenditure on plant nutrients (N+P+K+FYM) Rs/ha

P = Expenditure on plant protection chemicals Rs/ha

L = Family labour + hired labour charges Rs/ha

U = Error term

a, b, c and d = output elasticities of respective inputs.

" D " in equation ( 3 ) is dummy variable for techniques of production.

If regression coefficient of " dummy " variable and computed " F " value for pooled regression is significant, then there is structural break in production parameters between production functions of potential farm yield and actual yield on small farms. Similarly for large farms and overall farms.

For decomposing the yield gaps between the potential farm yield and actual yield on small farms, the following decomposition model was used

$$\text{Log } Y_2/Y_1 = \text{Log}A_2/A_1 + [(a_2-a_1)\log S_1 + (b_2-b_1)\log F_1 + (C_2-C_1)\log P_1 + (d_2-d_1)\log L_1 + [(a_2 \log (S_2/S_1)] + \{b \log (F_2/F_1)\} + \{C_2 \log (P_2/P_1)\} + \{d_2 \log (L_2/L_1)\} + [U_2 - U_1]$$

Similarly, the decomposition models for decomposing yield gaps between potential farm yield on large farms and potential farm yield and yield on overall farm can be used.

On the Right Hand side of the decomposition equation the first two bracketed expressions summed up, measure contribution of the difference in the techniques of production to the productivity difference between the potential farm yield and actual yield on small farms. The third bracketed expression measures the contribution of difference in the use of seed, plant nutrients, plant protection chemicals and labour input to the yield gap.

## Results and Discussion

The production function estimates of small, medium and large farms indicated that on all the farms the output elasticities of seeds, plant nutrients and labour were significant but that of plant protection chemicals was not significant. The estimates of production functions of demonstration plots and pooled production functions of demonstration plots and small farms, demonstration plots and large farms and demonstration plots and overall farms indicated that in the case of all the three sets of pooled production functions the coefficients of dummy variable for techniques of production were significant. So, there was structural break in the parameters of groundnut production functions between demonstration plots and farmers field, as the significant contribution of techniques of production (dummy) variable was noticed. That is to say, there existed a gap between the yield of demonstration plots and the actual yield on farmers fields.

Geometric mean levels of inputs used and outputs realised under different situations are presented in table 3. The results revealed that the mean levels of all the important inputs used on demonstration farms was high, compared to that used on the farms of respective farm groups. A large difference in input use between demonstration plots and farmers field was seen in the case of plant protection chemical input while very narrow difference was seen in the case of plant nutrients. The difference was also observed in the per hectare output realised between the demonstration plots and the respective farm groups.

The decomposition of productivity difference in groundnut between potential farm yield and actual yield was carried out with the help of decomposition equation presented in the methodology part using the values of respective production function parameters from table 1 and 2, the geometric mean levels of inputs and outputs from table 3.

The left hand side of the decomposition equation presents the yield gap between potential farm yield and actual yield. The decomposition analysis revealed that the actual yield of groundnut on overall farms were less than the potential farm yield by 29.24 per cent (table 4). The potential farm yield of groundnut was found to be more than the actual yield by 31.86 per cent in the case of small farms. The actual yield on large farms was found to be lower than the potential farm yield by 27.11 per cent. Thus, the present study showed that there was well over 25 per cent difference between the potential farm yield and the actual yield. This implied that more than one-fourth of the potential farm yield had been left untapped by the farmers. In other words, the groundnut output could be increased by more than 25 per cent of the present production on farmers field if the untapped potential farm yield could be fully exploited.

The contribution of techniques of production to the productivity difference between the potential farm yield and the actual yield was arrived at by summing up the first and second terms on the right hand side of the decomposition equation. The contribution of techniques of production to the productivity difference was estimated to be 6.99 per cent in the case of small farms and 5.27 per cent in the case of large farms. The percentage of

Table 4. Decomposition of productivity difference between potential farm yield and actual yield of groundnut

| Source of difference | Percentage attributed | | |
|---|---|---|---|
| | Small farms | Large farms | Overall farms |
| I. Total change measured in output | 30.49 | 26.99 | 28.69 |
| II. Due to techniques of production | 6.99 | 5.27 | 3.42 |
| III. Due to difference in inputs used | | | |
| a. Expenditure on seeds | 7.62 | 7.43 | 7.52 |
| b. Expenditure on plant nutrients | 0.25 | 8.01 | 6.75 |
| c. Expenditure on plant protection chemicals | -2.85 | -2.77 | -2.81 |
| d. Expenditure on labour | 19.85 | 9.17 | 14.36 |
| Total due to inputs | 24.87 | 21.84 | 25.82 |
| IV. Total difference in output due to all sources | 31.86 | 27.11 | 29.24 |

Table 3. Geometric mean levels of inputs and yield per hectare

| Sl. No. | Particulars on seeds (Rs.) | Expenditure on plant nutrients (Rs.) | Expenditure on plant protection chemicals (Rs.) | Expenditure on labour (Rs.) | Yield (kg/ha) |
|---|---|---|---|---|---|
| 1. Demonstration plots | 1674.47 | 2380.21 | 1259.52 | 4499.21 | 1712.00 |
| 2. Small farms | 1286.92 | 2361.74 | 6.46 | 3606.51 | 1262.00 |
| 3. Large farms | 1295.03 | 1852.97 | 7.51 | 4062.09 | 1307.00 |
| 4. Overall farms | 291.15 | 1927.44 | 6.92 | 333.98 | 1285.00 |

contribution of techniques of production to the productivity difference for overall farms was, however, found to be 3.42 per cent.

The analysis revealed that a small portion of untapped potential farm yield was accounted for by the difference in techniques of production. The techniques of production affected productivity by shifting the values of scale and slope parameters. This was meant that with no extra units of inputs, the actual yield of groundnut could be increased by adopting better techniques of production. The term techniques of production referred to superior management practices (recommended cultural practices).

It was quite natural to accept that techniques of production used on the demonstration plots were superior to those used on the farmers" fields as these were supervised by the extension workers. In this context, better guidance from the extension agencies would be of immense help to the cultivators. This called for steps to strengthen the existing extension net work to persuade the farmers to accept the recommended practices and to adopt it properly and assimilate.

The difference between the potential farm yield and the actual yield on farms was mainly from the difference in input use than from the techniques of production. The contribution of techniques of production to the productivity difference was comparatively less. This meant that there was limited scope for exploiting the untapped potential farm yield through better techniques of production.

The other factor explaining the difference between the potential farm yield and actual yield was the difference in the per hectare input use. The difference in input use was found to contribute much more to the productivity difference in all categories of farms. In the case of small farms it was 24.87 percent, in overall farms 23.24 per cent and in large farms 21.84 per cent. There is vast scope for exploiting the untapped potential farm yield by increasing the level of input use on the farmers fields.

The productivity difference between the potential farm yield and the actual yield attributable to the difference in the use of plant protection chemicals was negative. This implied that the farmers would obtain higher output per hectare than that obtained on the demonstration plots by spending less on plant protection chemicals. As discussed earlier the parameters of plant protection chemicals in respect of production function for demonstration plot was negative (table 4). This implied that the plant protection chemicals were over utilized on demonstration plots. The units of application of plant protection chemicals were largely determined by the nature and severity of the pests and disease attack to the crops on demonstration plots. Perhaps, there was too much anxiety to protect the crops from pests and diseases to avoid the farmers impression that the crop/variety demonstrated was succeptible to pests and diseases.

The foregoing discussions revealed that the possibility of exploiting the untapped potential farm yield by using more units of plant protection chemicals was rather limited.

The use of less labour, seeds and plant nutrients on the farmers' fields compared to demonstration plots was found to be mainly responsible for lower productivity. This suggested that a large portion of the untapped potential farm yield could be exploited by using larger quantities of labour with marginal increase in seeds and plant nutrients.

The contribution of input gap to the total productivity difference was found to be much greater than the contribution due to the difference in the techniques of production. This indicated that the scope to increase productivity by adopting better techniques of production is less.

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Table 1. Production function estimates in groundnut at farmers level

| Sl. No. | Explanatory variables | Output elasticities | | |
|---|---|---|---|---|
| | | Small farmers | Large farmers | Overall farmer |
| 1. | Intercept (a) | -3.0618 | -4.0129 | -3.9892 |
| 2. | Expenditure on seeds (Rs) ($X_1$) | 0.4535** | 0.4436** | 0.4467** |
| | | (0.1679) | (0.1523) | (0.1723) |
| 3. | Expenditure on plant nutrients (Rs) ($X_2$) | 0.3194** | 0.2882 | 0.3121** |
| | | (0.0943) | (0.2012) | (0.0902) |
| 4. | Expenditure on plant protection | 0.1823 | 0.1836 | 0.1948 |
| | chemicals (Rs) ($X_3$) | (0.1328) | (0.0906) | (0.1009) |
| 5. | Expenditure on labour (Rs) ($X_4$) | 0.7652* | 0.7627 | 0.7396** |
| | | (0.3623) | (0.5197) | (0.2293) |
| 6. | $R^2$ | 0.9385 | 0.5923 | 0.6787 |

Note: Figures in the parentheses indicate standard error of estimates

** Significant at one per cent level

* Significant at five per cent level

Table 2. Structural break in parameters of production functions

| Sl. No. | Explanatory variable | Demonstration Plots | Pooled functions | | |
|---|---|---|---|---|---|
| | | | *Demonstration* and small farms | *Demonstration* and large farms | *Demonstration* and overall farms |
| 1. | Intercept (a) | -4.7981 | -3.6293 | 0.3926 | 3.7321 |
| 2. | *Expenditure on seeds* (Rs) ($X_1$) | *0.2893** | 0.3923* | 0.4029* | 0.3829* |
| | | (0.1432) | (0.1893) | (0.1529) | (0.1926) |
| 3. | Expenditure on plant nutrients (Rs) ($X_2$) | 0.3201** | *0.1994*** | 0.3083* | *0.2123*** |
| | | (0.1134) | (0.0732) | (0.1258) | (0.0706) |
| 4. | Expenditure on plant Protection chemicals (Rs) ($X_3$) | -0.0054* | 0.1239** | 0.0736 | 0.1295 |
| | | (0.0020) | 0.0496) | (0.0653) | (0.0509) |
| 5. | Expenditure on labour (Rs) ($X_4$) | 0.8976* | 0.7026** | 0.7356** | 0.6923** |
| | | (0.4230) | (0.2351) | (0.2128) | (0.1952) |
| 6. | Dummy (techniques of production) | — | 0.1392* | 0.2513** | 0.1320* |
| | | — | (0.0738) | (0.0635) | (0.0653) |
| 7. | $R^2$ | 0.9523 | 0.8923 | 0.6357 | 0.7826 |
| 8. | 'F' value | 474.2033 | 55.7939 | 32.8213 | 67.6679 |

Note : Figures in parentheses indicate standard errors of repective coefficients
** Highly significant at one per cent level
* Significant at five per cent level