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Contribution of Shelterbelts in Employment Generation in Arid Zone of Western Rajasthan

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Abstract: An attempt has been made in this paper to document the impact of shelterbelt on net profit. The land allotment in IGNP was made on the basis of 'murba' (which is equivalent to 5 ha). The primary data were collected from 40 farmers with shelterbelt and 40 from non-shelterbelt farms selected randomly in each area of tube well and canal command area of IGNP Phase-II in Mohangarh. The labor decomposition model was used to define the contribution of shelterbelt in employment generation and also increase in complementary inputs. The new technology (shelterbelt) is supposed to increase economic activities by increasing productivity, efficiency and profitability. The results indicated that total additional employment generated by shelterbelt technology was 106.4%, of this 76.5% employment was generated by shelterbelt alone and remaining 29.9% by complementary inputs. Therefore, it is concluded that by adoption of shelterbelt technology employment opportunity can be increased.

Key words: Adoption, complementary inputs, employments, shelterbelt.

Millions of people in India are estimated to be unemployed and/or under-employed, more so in the agricultural sector. Efforts have been made to promote development activities. One of the important considerations for development activities in rural sector was introduction of modern technologies in agricultural sector, which promote agricultural production and open more employment opportunities. The agricultural developments were associated with rapid mechanization, increased use of fertilizers and pesticides, assured irrigation facilities, infrastructures and post harvest technologies. The introduction of labor-saving technologies enhanced the farmers income (Bhalla, 1987), but total labor absorption has been either stagnant or might have fallen in absolute terms for individual crops in most of the advanced states. Vaidyanathan (1978) explained inter-regional variation by arguing that (1) biochemical technology and soil moisture were the intrinsic to raise land yields, (2) physical, including human energy, inputs contributed to yields, not directly, but through bio-technology application, and (3) human labor was governed by land productivity and relative prices of different inputs. Billings and Singh (1971), Bisaliah (1978), Raj Krishna (1976) and Singh (1976) have argued that the process of modernization if associated with increase in assured irrigated area along with increase in cropping intensity, would increase employment opportunity in agricultural sector. On the contrary, Raj Krishna's (1978) study carried out in Punjab state showed that the direct effect of modern technology on employment was negative due to mechanization.

The arid zone of Rajasthan is characterized by low temperature during rabi season, and high wind velocity and temperature, poor soil fertility with moisture stress due to erratic rainfall during kharif season. These factors lead to low unstable crop yields.

The shelterbelt is considered to be the most important technology to minimize erosion hazards and optimize agricultural production. The introduction of Indira Gandhi Nahar Pariyojana (IGNP) and development of the tube well covering 50,000 ha in Lathi series prospected to provide assured irrigation facilities, the activities have increased manifold. The higher agricultural production can be obtained only through shelterbelt technology. The shelterbelt technology increased the use of

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inputs, increase crop productivity and generate employment. The question arises, what is the source of employment change? How much of additional employment is generated due to shelterbelt technology? What proportion of change in employment can be attributed to the other complementary inputs? An attempt has been made in this paper to analyze these objectives through labor decomposion.

Materials and Methods

To assess socio-economic impacts of shelterbelt plantations, 40 farmers with shelterbelt and 40 farmers without shelterbelt (control) were selected randomly in each area of tube well command Lathi series and canal command area in Mohangarh. All these farmers were surveyed and primary information collected as per pre-designed schedule. During survey, issues were discussed with farmers in participatory mode and efforts made to involve more members of farm family including farm women and children in extracting information on various socio-economic aspects. The data on various aspects such as cost of inputs used for crop production, returns from crops, and production from shelterbelt and from non-shelterbelt farm were also recorded. To know the contribution of shelterbelt in net farm returns and additional employment generation, Bisaliah (1978) decomposition models were used.

Labors decomposition

The Cobb-Douglas production function of the following form was used:

$$\text{Ln } Y = \text{Ln } A + a_l \text{ Ln } X_1 + a_2 \text{ Ln } X_2 + a_3 \text{ Ln } X_3 + Ui \quad ..... \; ..... \; ..... \; (1)$$

where, Y = Net returns (Rs./farm).

X_1 = Value of fertilizer and farmyard manure per farm (Rs./farm) (FERT)

X_2 = Human labor employed per farm (in man days) (HL)

X_3 = Value of other expenditures i.e., expenditure on seeds, ploughing unit, irrigation charges, etc. per farm (in Rs.) (OWN)

A = Constant term of scale parameter.

a's = Partial output elasticities of hired and family labor, fertilizer and other expenses.

Following Lau and Yotopoulos (1971), a UOP profit function in logarithmic form is specified as:

$$\text{Ln } \pi = \text{Ln } A + b_l \text{ Ln } W + b_2 \text{ Ln } X_1 + b_3 \text{ Ln } X_2 + b_4 \text{ Ln } X_3 \quad ..... \; ..... \; ..... \; (2)$$

where, $A^* = A^{\theta} (1\text{-}a_1)^{\;a1\,\theta}$

$b_1 = -a_1{}^{\theta} < 0$; $b_2 = a_2{}^{\theta} > 0$; $b_3 = a3^{\;\theta} > 0$ and

$b_4 = a_4{}^{\theta} > 0$ Let $1/1\text{-}a_1 = \theta$

Definitions of FERT, HL, OWN are the same as in equation 1 and defined as per hectare profit.

If one compares the parameters of UOP profit function, and Cobb-Douglas function, it is evident that both are closely related. The crucial feature in function (2) is that it assumes firm to behave according to same decisions like profit maximization given the price for output, and labor and given the quantities of other inputs. The employment decomposition model is formulated with the help of labor demand function and it was worked out as follows:

$$WN/\pi = (-b_l)$$

$$\text{Ln } N = \text{Ln } (-b_l) - \text{Ln } W + \text{Ln } \pi$$

Substituting the value of (Log π - Log W) from equation (2):

$$\text{Ln } N = \text{Ln}(-b_l) + \text{Ln } A + (b_l\text{-}1) \text{ Ln } W + b_2 \text{ Ln } X_1 + b_3 \text{ Ln } X_2 + b_4 \text{ Ln } X_3 \quad ..... \; ..... \; ..... \; (3)$$

An employment decomposition model is formulated by using labor demand function and the final equation is of the following form:

$$dN/N = [\theta \; dA/A] + [\; \theta \; da_l / a_l + \theta^2 (\text{Ln } A + \text{Ln } a_l) \; da_l - \theta^{\;2} (\text{Ln } W) \; da_l + \theta^{\;2} \{ (1\text{-}a_l) \; da_2 + a_2 \; da_l \} \text{ Ln } X_1 + \theta^{\;2} \{ (1\text{-}a_l) da_3 + a_3 \; da_l \} \text{ Ln } X_2 + \theta^{\;2} \{ (1\text{-}a_l) \; da_4 + a_4 \; da_l \} \text{ Ln } X_3 \;] + [\theta \; a_1 \; d \; X_1 \; / \; X_1 + \theta \; a_3 \; d \; X_3 \; / \; X_3] \quad ..... \; ..... \; ..... \; (4)$$

Equation (4) permits to decompose per hectare change in employment (dN/N) into three components.

i. Technology effects: This includes the effects of shifts in scale parameters (A) and slope parameters in function used. (1), given W, FERT, HL, OWN as under old technology and is captured by adding the values of first two bracketed expressions of employment decomposition equation (4).

i. Normalized wage rate effect: This is measured by third bracketed expression in employment decomposition model (4).

i. Complementary inputs effect: This effect (further bracketed expression) includes the employment effects of differences in quantities of inputs given the new technology elasticities.

The employment decomposition mode1 (4) measured the sources of change in employment between shelterbelt and non-shelterbelt. The output elasticities with respect to various inputs are the same in separate regression models for shelterbelts, indicating existence of Hicks - neutral type of technical change. This was further indicated by da_1, = da_2 = da_3 = da_4. = 0 in the employment decomposition equation in equation (4).

$dN/N = [\theta\ dA/A]-[(\theta a_1 +1)dW/W]+[\theta a_2 d\ X_1/X_1+\theta a_3(d\ X_3/X_3)$ .... (5)

For simplicity in calculation, equation (5) can be written as:

$\Delta N/N=[\theta\Delta A/A)-[(\theta a_1+1)\Delta W/W]+[\theta a_2\Delta\ X_1/X_1 + \theta a_3\Delta\ X_3/X_3]$ .... (6)

Normal wage rate W = Pn/Py

where, Pn =Money wage rate

Py = Price of output per unit

Since the price of Pn and Py is same in the command area under all the irrigation classes and soil degradation levels the change in normal wage rate was assumed as zero. The final decomposition equation becomes:

$\Delta AN/N = \theta\ \Delta A/A + \theta\ a_2\,\Delta\ X_1/X_1 + \theta\ a_3\Delta\ X_3/X_3)$ .... (7)

Equation (7) was the last decomposition equation for working out employment change. For estimating employment change the parameters of function and per farm input levels were worked out. Similarly to maintain constant returns to scale and Hicks-neutral technical change, a pooled least square regression model was estimated. It has been argued that ordinary least square applied to the UoP profit function (2) and the labor demand function separately are consistent. However, these estimates are argued to be inefficient because it appears in both the equations. So a more efficient approach to estimate (2) and (3) jointly, imposing the conditions that bias are equal, is of Ze11ners' method which reduces the standard errors in comparison to a sing1e equation of least squares. Therefore, the estimation procedures in the present study are likely to produce some bias in the values of coefficients.

Results and Discussion

Employment decomposition model

Separate production function for shelterbelt and non-shelterbelt technologies on the area basis were estimated to assess impact on opportunity generated for employment. The estimated production functions using the Ordinary Least Square Method (OLS) is presented in Table 1. The explanatory variables included in the regression model explained adequate variations in both production functions. The F-test indicated that value of coefficient of determinant (R^2) was significant at 1% level of significance. The perusal of the production function estimated for shelterbelt and non-shelterbelt revealed that coefficient of all the explanatory variables i.e., farmyard manure and fertilizers (X_1), human labor (X_2) and other expenses (X_3) were significant at varying level of significance. The production elasticities of all the explanatory variables were relatively high in case of shelterbelt farms when compared to non-shelterbelt farms.

The existence of structural break was examined with the help of Chow's test (1996), for equality of regression coefficients, and was found significant at 5% level of significance. This indicated that shift in net return was due to shelterbelt technology. Further, nature of technologies was examined by testing the homogeneity of regression coefficients while allowing to differ in constant terms (intercept coefficient) in two production function (Kiresure, 1995). The significance of dummy variable indicated that the shift in net return was due to shelterbelt technology.

To know the additional employment generated by shelterbelt plantation, the data of farmers having shelterbelt and without shelterbelt were pooled with using dummy variable. The results of estimated regression model by using OLS method are presented in Table 1. It is revealed that dummy variable is significant at 1% level indicating structural break in net profit of the farm. The value of

Table 1. Estimated net profit function parameters, standard error and coefficient of determination per ha

Variables	Shelterbelt	Non-shelterbelt	Pooled with dummy variable
Intercept	6.2517	3.1994	2.0715
Dummy (shelterbelt)			0.9579^{xx} (0.1759)
FYM and Fertilizers (X_1)	0.2103** (0.0817)	0.1691** (0.0611)	0.30561** (0.0994)
Human labor (X_2)	0.2859** (0.1013)	0.1989** (0.0817)	0.3957** (0.1083)
OWN (X_3)	0.0719** (0.0302)	0.0483* (0.0231)	0.1579^{x} (0.0759)
R^2	0.8856	0.7719	0.9561
No. of Observations	80.00	80.00	160.00
"F" value	23.15**	19.03**	21.81**

^{x} significant at 5% level of significance,
^{xx} significant at 1% level of significance.
Figures in parenthesis indicate standard errors.

coefficient of determination of the regression model was 92.17%, which indicated that explanatory variables included in the model are sufficient for forecasting. The 'F' value of R^2 was found to be significant.

The estimated contribution of technological change and other complementary inputs in generation of additional employment were worked out with the help of regression coefficients and geometrical mean inputs used. The geometrical means of inputs are shown in Table 2. Farmers who had shelterbelt plantation used higher level of inputs in comparison to farmers who had no shelterbelts. The observed change in labor due to shelterbelt plantation was 116.50% more (Table 3). The decomposition model revealed that technological changes (due to adoption of shelterbelt) contributed nearly 76.52%.

The contribution of complementary inputs due to FYM and fertilizers (X_1) and other expenses were 21.46 and 8.41%, respectively.

Table 2. Geometrical means of inputs used per farm with shelterbelts and without shelterbelts

Particulars	Per cent attributes
Observed change	116.5
Shelterbelt changes	76.5
Complementary inputs changes	
FYM + fertilizers (X_1)	21.5
OWN	8.4
Total estimated change due to shelterbelt	106.4

The total estimated additional employment generated due to shelterbelt was 106.39. It is clear that 75% additional employment generated was due to shelterbelt only and remaining 25% was contributed by FYM and fertilizers (FERT) and other expenditure (OWN). The difference in observed change (absolute increase) and estimated changes might be due to round off and also due to estimation procedure.

Table 3. Decomposition analysis of labor

Particulars	Shelterbelt	Non-shelterbelt
FYM and fertilizers (in Rs.) (X_1)	15057.56	10571.33
Labor (Mandays) (X_2)	386.61	181.87
OWN (in Rs.) (X_3)	22581.97	17083.11

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