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# Economics of Underutilized Crop Production in Mizoram

Lalrinsangpuii* . R. Malhotra . Laishram Priscilla

Division of Dairy Economics, Statistics & Management, National Dairy Research Institute, Karnal 132001

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ABSTRACT

The study was carried out on 120 farmers in Mizoram during the year 2014-15 to analyse the cost and returns, resource use efficiency and constraints faced by the farmers in the cultivation of underutilized crops. The farms were classified into small, medium and large categories using cumulative square root frequency method of stratification. The total cost of cultivation was estimated to be ` 24010/ha for overall farm. Among the different categories of farms the total cost of cultivation was highest on medium farms followed by large farms and small farms, respectively. The overall farms had realized gross income of ` 31657 from the underutilized crops. Among the various categories of farms, the gross income was highest on large farms ` 32850 followed by medium (` 32081) and small farms (` 30039). The Cobb-Douglas production function indicated that response to land holding and human labour was found to be positive and significant. High cost of inputs was the most serious problem stated by the farmers in crop production followed by unavailability of financial support.

## 1. Introduction

North-Eastern Region (NER) of India is one of the hot spots of plant biodiversity and therefore, considered as one of the richest reservoirs of genetic variability and diversity of various vegetable crops, herbs and spices (Yadav *et al*., 2009; Singh *et al*., 2013). Horticulture provides a cropping system which ensures livelihood, economic and nutritional security and holds the key for socio-economic development of the region. The diverse topography, altitude and climatic conditions offer ample scope for cultivation of multiple horticultural produce in the region. The scenario hence reflects that horticulture can be made watch word for progress of the region. NER is one of the richest reservoirs of different underutilized vegetable crop species and is well known for its rich genetic resources and variabilities for edible and non-edible types of Cucurbits. Apart from the nutritional value, many regional underutilized vegetable crops are used for medicinal purposes, for income generation and poverty alleviation. A large number of indigenous vegetables crop species are used, particularly, by the tribal population. Wide range of *Solanum* species is also found in various parts of the region.

The crops which are neither grown commercially on large scale nor traded widely are generally termed as underutilized. Most of them have remained either wild or semi-domesticated, and are traded and consumed locally. They are rich source of vitamins, minerals, carbohydrates, proteins, phyto-chemicals and fats. Mizoram, the north-eastern state of India, is rich repository of various underutilized vegetables and spices. Considerable genetic diversity also exists among edible horticultural crops due to topographical variations and diverse climatic conditions in the state. Besides, they are also used for various medicinal purposes and are the source of livelihood of many people living in remote rural areas of the state. Keeping the above prospects of underutilized crops in Mizoram, a study was conducted to estimate the economics of these crops in the state.

## 2. Materials and Methods

***Study area***

Out of the eight districts in Mizoram the three districts namely, Aizawl, Kolasib and Champhai districts were purposively selected as the production of vegetables is

*Corresponding author: mapuii_bh@yahoo.com

relative higher in these districts comparing to the other districts of the state.

***Data***

The primary data was collected by conventional survey method on a well-structured schedule through personal interview on various aspects of crop enterprises from 120 selected households for the year 2014-15. The data was collected for three major underutilized crops in the state *viz*., chow-chow (*Sechium edule*), samtawk (*Solanum ferox)* and colocasia (*Colocasia* spp.).

***Costs and Returns Concepts***

The farms based on land holding size were categorized into three classes namely small, medium and large using cumulative square root frequency method of stratification (Singh and Mangat, 1996). To estimate the cost of cultivation following cost concepts were used (CACP):

**Cost $A_1$ =** Value of purchased material inputs (seed, insecticides and pesticides, manure, fertilizer) + hired human labour + animal labour (hired and owned) + hired farm machinery + depreciation on farm implements and farm buildings + irrigation charges + land revenue cesses and other taxes + interest on working capital.

**Cost $A_2$ =** Cost $A_1$ + rent paid for leased-in land.

**Cost $B_1$ =** Cost $A_2$ + interest on value of owned capital assets (excluding land).

**Cost $B_2$ =** Cost $B_1$+ rental value of owned land (minus land revenue).

**Cost $C_1$ =** Cost $B_1$ + imputed value of family labour.

**Cost $C_2$ =** Cost $B_2$ + imputed value of family labour.

For returns analyses following measures were used.

Gross returns = Value of the main product + by product

Farm business income = Gross income – Cost $A_2$

Family labour income = Gross income – Cost $B_2$

Net income = Gross income – Cost $C_2$

Farm investment income = Farm business income – Wages of family labour

$$\text{Return per rupee (RPR)} = \frac{\text{Gross income}}{\text{Total Cost}}$$

Fixed Costs (FC): FC includes interest on fixed capital and depreciation. The interest on fixed capital was worked out at the prevailing interest rate given by the commercial bank in the study area *i.e.,* 13 per cent and depreciation on farm house and other equipments were calculated using straight line method. The annual depreciation on farm house was calculated at the rate of 2 per cent for *pucca* shed and 5 per cent for *kachha* house assuming the useful life of 50 and 20 years, respectively (Rao, 1991). The depreciation of other equipments was also calculated as per the productive life of the individual equipment. Variable Costs (VC): VC are those costs which are incurred on the variable factors of production and can be altered in the short run. It included seed cost, labour cost, manures and fertilizers cost and cost of plant protection chemicals.

Gross Cost: It was obtained by adding all the cost components including fixed and variable costs.

Gross Cost = Total Variable Cost + Total Fixed Cost

***Resource Use Efficiency***

The most widely used form of the production function in agriculture has been the Cobb-Douglas form and the details are furnished as follows:

$Y = a .x_1^{b1} .x_2^{b2} .x_3^{b3} .x_4^{b4} .x_5^{b5}.e$

Where,

| | | |
|---|---|---|
| Y | = | Gross return (`/ha) |
| $X_1$ | = | Land (`/ha) |
| $X_2$ | = | Seed cost (`/ha) |
| $X_3$ | = | Human labour (`/ha) |
| $X_4$ | = | Manures and fertilizers (`/ha) |
| $X_5$ | = | Plant protection chemicals (`/ha) |
| $b_i$ | = | Elasticities of production |
| e | = | Error term |
| a | = | Constant |

***Returns to scale***

The returns to scale was estimated directly by getting the sum of $b_i$'s coefficients. To arrive at meaningful conclusion on the returns to scale *viz.*, increasing, constant or decreasing the summation value of $b_i$'s was considered.

***Marginal Value Product (MVP)***

The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) of the resources was used to judge the resource use efficiency. The imputed MVP was compared with the MFC or opportunity cost of the resource to draw the inferences. A resource is said to be optimally allocated when its MVP = MFC. The MVP was calculated at the geometric mean levels of the variables using the following formula:

$$\text{MVP} = b_1 \frac{\overline{Y}}{\overline{X}}$$

Where,

$\bar{Y}$ = Geometric mean of output

$\bar{X}$ = Geometric mean of $i^{th}$ input

$b_1$ = Regression co-efficient of $i^{th}$ input ($X_i$)

The MFC was taken as unity, since the X and Y variables were defined in monetary terms.

***Constraints in Crop Farming***

The Garrett ranking technique was used to study the opinions of the farmers regarding the constraints in crop farming. The per cent position of each rank was found out by the following equation.

$$\text{Per cent position} = \frac{100\ (R_{ij} - 0.5)}{N_j}$$

Where,

$R_{ij}$ = Rank given for the $i^{th}$ items by the $j^{th}$ individual, and

$N_j$ = Number of items ranked by the $j^{th}$ individual.

## 3. Results and Discussions

The findings of the study regarding economics of underutilized crop cultivation are discussed under the following sections:

***Cost Structure in Crop Cultivation***

The perusal of Table 1 indicated that the overall cost of cultivation was ` 24010/ha. Among the different categories of farms the total cost of cultivation was highest on medium farms (` 25005/ha) followed by large farms (` 23968/ha) and small farms (` 23056/ha), respectively. This is in contrast with the findings of Pagire and Dangare (2008) who worked on the per hectare cost of cultivation of *kharif* potato in Satara District of Western Maharashtra. Their result showed that the cost of potato cultivation was the lowest in the medium size group followed by small and large size groups of potato growers. Human labour was the most important item of variable expenditure for all farms and it shared 28.59% in total cost for overall farm. Among the three groups of farms, the cost of seed, FYM and plant protection chemicals were highest on large farms. The expenses on chemical fertilizers contributed highest on small farms followed by large and medium farms. Among the fixed item of expenditure, rental value of land was the most important item for all the groups of farms.

The finding of Kumar *et al*., (2008) in Banaskantha District of Gujarat showed that cost of seed tuber accounted a major share (about 34%) of total variable cost in potato cultivation while in Kanke block of Ranchi District, family labour cost was the most important item of variable expenditure (28%) on the sample farms in tomato cultivation (Singh and Anupama 2010).

***Costs and Returns in Crop Cultivation Based on Cost Concept***

The category-wise analysis showed that the Cost $A_1$ which includes the direct expenses incurred on crop production in cash and kind on was found to be highest on large farm *i.e.,* ` 15709/ha which was followed by medium and small farms (Table 3). Cost $A_2$ which includes Cost $A_1$ and rent paid for leased-in land and was highest on medium farm which was worked out to be `15867/ha. It was also found that Cost $B_1$, Cost $B_2$, Cost $C_1$ and Cost $C_2$ were highest on medium farms followed by large and small farms; this was mainly due to higher application of inputs by the medium farms. The total cost of cultivation (Cost $C_2$) on medium, large and small farms were ` 31168, ` 30141 and ` 28460,respectively.

Gross returns, farm business income, family labour income, net income and farm investment income per hectare of crop cultivation were also presented in Table 3. The overall farms had realized gross income of ` 31657 from the underutilized crops. Among the various categories of farms, the gross income was highest on large farms ` 32850 followed by medium (` 32081) and small farms (` 30039). On the other hand, the farm business income was lowered due to the deductions made towards interest on fixed capital, land rent and imputed family labour charges. However, the net income of the farmers was observed to be ` 1664.

***Resource Productivities***

The significant regression coefficients for land holding, human labour, manures and fertilizers indicate increase in the use of these inputs would result in improving the production of crops which was contributed significantly towards gross returns (Table 3). The regression coefficient of plant protection chemicals was non-significant and negative while the regression coefficient of seed was non-significant but positive. Hence, it may be concluded that reduction in the expenditure on the plant protection chemicals and further increase in the expenses on seed would help in improving the share of net income in the gross returns. The value of $R^2$ was found to be 0.79 indicating that 79 % of variation in the dependent variable was explained by the independent variables chosen in the function.

**Table 1.** Category wise cost of cultivation of underutilized crops in Mizoram (`/ha)

| Particulars | Small | Medium | Large | Overall |
|---|---|---|---|---|
| Total human labour | 6543.87 | 6867.27 | 7179.34 | 6863.50 |
| | (23.38) | (27.46) | (29.95) | (28.59) |
| Seed | 2544.11 | 2606.18 | 2895.51 | 2681.93 |
| | (11.03) | (10.42) | (12.08) | (11.17) |
| FYM | 1022.63 | 2001.09 | 2117.85 | 1713.86 |
| | (4.44) | (8.00) | (8.84) | (7.14) |
| Chemical fertilizers | 901.35 | 871. 25 | 872.10 | 881.56 |
| | (3.91) | (3.48) | (3.64) | (3.67) |
| Insecticides & pesticides | 500.14 | 670.12 | 670.32 | 613.53 |
| | (2.17) | (2.68) | (2.80) | (2.56) |
| Interest on working capital | 1052.08 | 1132.16 | 1202.21 | 1128.81 |
| | (4.56) | (4.53) | (5.02) | (4.70) |
| **Total Variable Costs (TVC)** | 12564.18 | 14148.07 | 14937.34 | 13883.19 |
| | (54.50) | (56.58) | (62.32) | (57.82) |
| Rental value of own land | 8739.27 | 8937.99 | 8039.85 | 8572.37 |
| | (37.91) | (35.75) | (33.54) | (35.70) |
| Rent paid for leased in land | 1046.36 | 1226.30 | 0 | 757.56 |
| | (4.54) | (4.90) | | (3.16) |
| Depreciation | 345.38 | 358.11 | 559.47 | 420.99 |
| | (1.50) | (1.43) | (2.33) | (1.75) |
| Land revenue and other taxes | 151.64 | 134.87 | 212.32 | 166.27 |
| | (0.66) | (0.54) | (0.89) | (0.69) |
| Interest on fixed capital | 208.77 | 199.33 | 219.39 | 209.16 |
| | (0.91) | (0.80) | (0.92) | (30.10) |
| **Total Fixed Costs (TFC)** | 10491.42 | 10856.61 | 9031.03 | 10126.35 |
| | (45.50) | (43.42) | (37.68) | (42.18) |
| **Gross Cost (TVC+TFC)** | 23055.60 | 25004.67 | 23968.36 | 24009.55 |
| | (100) | (100) | (100) | (100) |

Note: Figures in parentheses indicate percentages to gross cost

**Table 2.** Category wise different costs and returns (`/ha)

| Particulars | Marginal | Small | Medium | Overall |
|---|---|---|---|---|
| Gross income | 30039 | 32081 | 32850 | 31657 |
| Cost $A_1$ | 13061 | 14641 | 15709 | 14470 |
| | (45.89) | (46.97) | (52.12) | (48.25) |
| Cost $A_2$ | 14108 | 15867 | 15709 | 15298 |
| | (49.57) | (50.91) | (52.12) | (51.00) |
| Cost $B_1$ | 14316 | 16067 | 15929 | 15507 |
| | (50.30) | (51.55) | (52.85) | (51.70) |
| Cost $B_2$ | 23056 | 25005 | 23968 | 24079 |
| | (81.01) | (80.23) | (79.52) | (80.28) |
| Cost $C_1$ | 19721 | 22230 | 22101 | 21420 |
| | (69.29) | (71.32) | (73.33) | (71.42) |
| Cost $C_2$ | 28460 | 31168 | 30141 | 29992 |
| | (100) | (100) | (100) | (100) |
| Farm business income | 15931 | 16214 | 17141 | 16359 |
| Family labour income | 6983 | 7076 | 8882 | 7577 |
| Net income | 1578 | 913 | 2709 | 1664 |
| Farm investment income | 10527 | 10051 | 10968 | 10446 |
| Return per rupee (RPR) | 1.06 | 1.03 | 1.09 | 1.06 |

Note: Figures in parentheses are percentage to total cost

The remaining 21 % of variation might be due to some other factors which have not been captured in the function such as rainfall, temperature, humidity *etc.* The sum of the production elasticities were observed to be positive and less than unity (0.69), which shows decreasing returns to scale. The ratios of Marginal Value Product and Marginal Factor Cost was observed to be negative in case of manures and fertilizers (-0.03). On the contrary, the MVP to MFC ratio for land (3.58) was observed to be positive and more than unity. Similarly, for the resource like human labour it was positive and less than unity (0.04).

**Table 3.** Estimated Cobb-Douglas production coefficients and MVP to MFC ratios

| Particulars | Parameters | Production elasticities | MVP: MFC |
|---|---|---|---|
| Intercept | a | 0.91 (0.57) | |
| Land holding | $b_1$ | 0.27* (0.07) | 3.58 |
| Seed | $b_2$ | 0.15 (0.08) | - |
| Human labour | $b_3$ | 0.37* (0.14) | 0.04 |
| Manures and fertilizers | $b_4$ | -0.09** (0.05) | -0.03 |
| Plant protection chemicals | $b_5$ | -0.007 (0.03) | - |
| Coefficient of determination | $R^2$ | 0.79 | |
| Returns to scale | $\sum$ bi | 0.69 | |

Note: Figures in parentheses are standard errors
** indicates significant @ 5% level of probability and
* indicates significant @ 1% level of probability

The less than unity MVP to MFC ratios of human labour implies its uneconomic use. The ratio was negative for manures and fertilizers indicated that expenditure on this input was more than the optimum level. By reducing the expenditure on these inputs would help in increasing the net income of the sample farmers. The MVP to MFC ratio for land was greater than one showing significant underutilization of this resource and possibility of additional use to achieve the optimal level. So, there is a scope to use this input and increase the gross returns.

***Constraints to Higher Returns in Crop Production***

Out of the various problems stated by the farmers, high cost of inputs was the most serious problem followed by unavailability of financial support (Table 4). Unavailability of irrigation facilities, lack of knowledge about application of chemical fertilizers, adverse effect of natural calamities *etc*. were other problems faced by the farmers in Mizoram.

**Table 4.** Constraints in crop production

| Items | Per cent position | Rank |
|---|---|---|
| High cost of inputs | 37.21 | I |
| Unavailability of financial support | 33.69 | II |
| Unavailability of irrigation facilities | 26.46 | III |
| Lack of knowledge about the application of chemical fertilizers | 22.17 | IV |
| Adverse effect of natural calamities | 19.34 | V |
| Pests attack | 18.46 | VI |
| Timely non-availability of inputs | 17.48 | VII |
| High cost of labour | 15.31 | VIII |

## Conclusion

Underutilized vegetable crops and spices of Mizoram have outstanding potential to meet nutritional and livelihood security to the local people and intrinsically linked to their cultural and traditional systems, rich source of nutrients and bioactive medicinal substances. It is, therefore, urgent need to take up programme on management, utilization and improvement of underutilized crops to ensure food and nutritional security for future. Besides, it seems imperative to evaluate nutritive and medicinal values including antioxidant properties.

Exploration and documentation of all possible natural populations, regeneration status in nature, selection and utilization of elite strains, and standardization of cultivation practices for popularization of these underutilized crops are required for betterment of local people and rural development.

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