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# Economic Scrutiny of bio-pesticide use in potato cultivation in Meghalaya

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ABSTRACT

In the sustainable intensification of crop production through green economy, the bio-pesticides are playing an immense role. Meghalaya being an organic state by default, farmers are adamant to non-use chemicals in the agricultural production. Therefore, the current study was conducted among the potato growers of East Khasi Hills district to identify the economic sustainability of using organic inputs such as bio-pesticides with a respondent size 100 which included equal number of both adopters and non-adopters, selected from two villages of Mawkynrew and Mawrynkneng blocks using random sampling with proportionate allocation method. Cost estimation showed that the expenditure of adopters was less than non-adopters and the cost of potato production for adopters were found to be 10.77 % less than non-adopters. On contrary gross returns marked to be high for adopters by 18.96 % which accounted for the 33.34 % increase in the benefit-cost ratio. Economic viability of organic farming practices in potato cultivation was underlined by the increased B-C ratio and higher net farm income of adopters by using bio-pesticide which is eco-friendly and sustainable.

## 1. Introduction

Green Revolution turned to be a milestone in the history of agriculture. Over the previous decades, intensive and cultivation of improved varieties of crops were introduced in India which skyrocketed the production to many folds, and crop protection also played a significant role in the success of Green Revolution and increased productivity. Even though as a result, there evolved several problems like environment pollution, collapsing the rhythm of ecological equilibrium, pesticide residues and even pest resurgence. Also, the indiscriminate use of chemical pesticides has necessitated for alternatives mainly over environmental considerations. The biological control of pests and diseases continues to be a viable alternative for sustainable agriculture due to the growing concern over the use of chemical pesticides in agriculture. It has been demonstrated that biological control has a significant impact on the management of soil-borne plant diseases, is less reliant on the use of hazardous pesticides, is environmentally benign, and is more focused and target-specific. The demand for organic food products has increased in the contemporary environment as a result of rising income levels brought on by an expanding economy as well as growing awareness of the negative effects of chemical pesticides. Given the rising demand for healthy, safe food, long-term sustainability, and anxieties about environmental pollution brought on by the indiscriminate use of agrochemicals, organic farming has become a top priority across the globe. India is one of the Emerging Organic Sectors in Asia and is ranked 10th among the top ten countries in the world in terms of cultivable land under organic certification. (Bhushan *et al.*, 2011). Meghalaya which is one among the North Eastern states in India, because of its special advantages said to be very suitable for organic farming. Government has introduced various schemes like MISSION ORGANIC to support the farmers and for revolutionizing sustainable practices in farming for a pleasant future. Since the state of Meghalaya and North-Eastern Hill region as a whole organic by default and also there is increased concerns now a days for organic food production in a health point of view as well as to

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increase the productivity sustainably, bio-pesticides can be a viable option for farmer to choose. Keeping in view of these, the current study "Economic Scrutiny of bio-pesticide use in potato cultivation in Meghalaya" was carried out with the following specific objectives i) To work out cost of cultivation of potato for adopters and non-adopters. ii) To comprehend the economic efficiency measures from potato cultivation by using bio-pesticides.

## 2. Methodology

Multi stage sampling procedure was applied for the study, in which sampling design consisted of four stages. East Khasi Hills district was chosen as the study area since it has the maximum potato production in the state. Multistage sampling procedure was used for household selection. In the second stage, blocks namely Mawkynrew and Mawrynkneng were selected purposively from the district as they had the highest number of adopter farmers cultivating potato, and in the third stage, one village from each of the blocks viz., Laitdiengsai, Pepbah were selected respectively. Potato was considered for the present study as this was found to be in highest acreage in the district in which biopesticides was also used more in the study area. Random sampling with proportionate allocation method were followed and sample comprised of a total of 100 respondents of which 50 were adopters of bio-pesticides and remaining 50 were non-adopter farmers who were following conventional practices.

Primary data was collected using pre-tested standardized personal interview schedule, which consists of both open ended and close ended questions.

### Analytical tools

In order to study the cost incurred in potato cultivation, various cost concepts recommended by Special Expert Committee (GoI, 1979) were used in the analysis which includes Cost $A_1$, Cost $A_2$, Cost $B_1$, Cost $B_2$, Cost $C_1$ and Cost $C_2$ *etc.*

**Cost $A_1$:** Value of hired human labour + Value of owned and hired machinery + Value of feed + Value of fertilizer + Value of manures + Value of pesticides + Depreciation + Irrigation charges + Land revenue + Interest on working capital + Miscellaneous expenses

**Cost $A_2$:** Cost $A_1$ + Rent paid for leased in land

**Cost $B_1$:** Cost $A_1$ + Interest on value of owned fixed capital asset (excluding land)

**Cost $B_2$:** Cost $B_1$ + Rental value of owned land less land revenue + Rent paid for leased in land

**Cost $C_1$:** Cost $B_1$ + Imputed value of family labour

**Cost $C_2$:** Cost $B_2$ + Imputed value of family labour

**Economic Efficiency measures:** To work out the economic efficiency measures the following formulae were used

**Gross farm income** (GFI) = Value of main product + Value of bye-product

**Farm business income** = GFI – Cost $A_2$

**Family labour income** = GFI − Cost $B_2$

**Net farm income** = GFI – Cost $C_2$

**Farm investment income** = Farm business income – Imputed value of family labor.

**Benefit cost ratio (BCR)**

$$BCR = GFI \div Cost\ C_2$$

The percentage difference was also be calculated by considering non-adopters as control, to know how much accrual of benefits adopters are acquiring.

$$\text{Percentage difference} = \left\{\frac{(\text{non-adopters spending} - \text{adopters spending})}{\text{non-adopters spending}}\right\} * 100$$

## 3. Results and Discussion

### Costs incurred in Potato cultivation

Table 1 represents the share of various factors in the cultivation cost of potato according to cost concepts for both adopters and non-adopters. Cost $C_2$ was found to be ₹ 1,61,493.77 for adopters and ₹1,80,992.91for non-adopters. Cost $A_1$ accounted for 70.24 % (₹1,13,435.18) of total cost Cost $C_2$ for adopters, while it was 76.61 % (₹1,38,662.09) for non-adopters. There we can see an apparent advantage of 18.19 % in the Cost $A_1$ when compared to non-adopters, and this increment was due to the fertilizer cost which caused an additional expenditure for non-adopters. Out of the total cost, cost $B_2$ accounted for 75.74 % (₹1,22,323.59) for adopters, while it was around 81.26 % (₹1,47,074.67) for non-adopters. Adopters advantage in the case of Cost $B_2$ was 16.82 % when compared to non-adopters, however in the final cost $C_2$ their advantage over non-adopters were 10.77% *i.e.,* they saved 10.77 % of comprehensive cost of cultivation $C_2$ when compared to non-adopters.

The result representing share of various factors to the cost of cultivation of potato showed that, hired labour contributed the more in the case of both adopters (29.11%) and non-adopters (28.85%). For adopters the next greater contributing factors was cost of organic manures (15.16%), family labour (24.25%) and planting material cost (23.06%). Whereas, for non-adopter's, fertilizer cost (14.16%), family labour (18.74%), planting material cost (22.71%) *etc.* were among the factors which were prominent in cost of cultivation. For plant protection adopters had to spend a nominal share (0.70%), since they used bio-pesticides and it effectively controlled pest and diseases and ensured plant

health so that need for multiple time application did not arise. Whereas, non-adopters were spending a larger amount of ₹2,450.09 (1.35%) for purchasing different chemical pesticides for the control. Adopter farmers used organic manures such as FYM, poultry manure and pig manure on which they spend 15.16 % and no expenditure on chemical fertilizers. Even though non-adopter farmers were using chemical fertilizer which accounted of 14.10 % of cost they were applying farm yard manure also which corresponds to 7.54 % of their cost of cultivation.

By analysing the results, it was understood that, adopters are saving cost for almost all of the factors involved in cultivation than non-adopters. In the case of hiring labour adopters saved 9.97 % than non-adopters by utilizing the available family labour in cultural operations where non-adopters need to hire labourers. Adopters reduced 100 % of the spending on chemical fertilizers since they were following organic methods. At the same time, for organic manures adopters had to spend 79.43 % more than non-adopters which showed that they are very adamant in using eco-friendly and naturally available inputs for cultivation. For bio-pesticides adopters spend an amount of ₹1,128.62 which was 79.43 % lesser than non-adopters who were using chemical measures for the same which incurred a higher cost of ₹2,450.09 to them. Since adopters were utilizing family labour mostly for cultural operations, it added to their cost by 15.48 % more than non-adopters. For storing potatoes adopters had a well-maintained shed facility, which might be the reason for their increased value of interest on fixed capital which was 19.73 % more than non-adopters. Interestingly, it was found that all the costs like hired labour was more for non-adopters which shows that spending in terms of cash were very high for non-adopters since they had to pay the labourers in cash whereas adopters minimized this spending by using family labour. In fact non-adopters were spending 21.70 % in total for fertilizer. This indiscriminate use of fertilizers may be because of their lack of awareness about scientific method of cultivation which resulted not only in deterioration of soil quality but also a burden of additional cost which was exhausting their resources.

It was apparent from the above discussion that bio-pesticides adopting farmers have saved the cost on different aspects *viz.,* better germination of crop, less hired labour usage, cent per cent savings in usage of chemical fertilizers and also the cost savings on plant protection measures. Similar findings were also reported by Singh *et al.* (2011) in their study in Patiala and Faridhkot district, Punjab. Hence, this cost saving will helpful to enhance the income of the farmers with concerns of environment friendly cultivation of potato using bio-pesticides from the beginning of crop cultivation.

**Table 1.** Cost of potato cultivation using cost concepts (₹/ha)

| | Particulars | Amount (₹) | | Difference in spending (%) |
|---|---|---|---|---|
| | | Adopters | Non-adopters | |
| i) | Hired labour | 47018.50 (29.11) | 52225.10 (28.85) | -9.97 |
| ii) | Cost of the seeds | 37240.02 (23.06) | 41100.25 (22.71) | -9.39 |
| iii) | Cost of Fertilizers | 0 (0) | 25630.09 (14.16) | -100 |
| iv) | Organic fertilizers(FYM,Poultry manure,Pig manure) | 24484.10 (15.16) | 13645.30 (7.54) | 79.43 |
| v) | Plant protection | 1128.62 (0.70) | 2450.09 (1.35 | -53.94 |
| vi) | Interest on working capital @ 4.50 | 2245.94 (1.39) | 1971.20 (1.09) | 13.93 |
| vii) | Depreciation | 1317.82 (0.82) | 1640.06 (0.91) | -19.65 |
| viii) | Cost $A_1$(i+ii+iii+iv+v+vi+vii) | 113435.18 (70.24) | 138662.09 (76.61) | -18.19 |
| ix) | Rent payed for the leased in land | 0.00 (0.00) | 0 (0) | ---- |
| x) | Cost $A_2$(viii+ix) | 113435.18 | 138662.09 | |

| | | | | |
|---|---|---|---|---|
| | | (70.24) | (76.61) | -18.19 |
| xi) | Interest on the owned fixed capital assets excluding land @ 8.45% | 2888.41 | 2412.58 | |
| | | (1.79) | (1.34) | 19.72 |
| xii) | Cost $B_1$(x+xi) | 116323.59 | 141074.67 | |
| | | (72.03) | (77.94) | -17.54 |
| xiii) | Rental value of owned land | 6000 | 6000 | |
| | | (3.72) | (3.32) | 0 |
| xiv) | cost $B_2$(xii+xiii) | 122323.59 | 147074.67 | |
| | | (75.74) | (81.26) | -16.82 |
| xv) | Imputed value of Family labour | 39170.18 | 33918.24 | |
| | | (24.25) | (18.74) | 15.48 |
| xvi) | Cost $C_1$(xii+ xv) | 155493.77 | 174992.91 | |
| | | (96.28) | (96.68) | -11.14 |
| xvii) | Cost $C_2$(xiv+ xv) | 161493.77 | 180992.91 | |
| | | (100) | (100) | -10.77 |

*Note: Figures shown in the parentheses indicate percentages to the total cost $C_2$*

**Returns from potato cultivation**

The returns received from cultivation of potato were presented in the Table 2. Adopters obtained a higher gross return ₹2,76,000 which was 18.96% more than non-adopters due to the increased productivity in adopter's farm. This clearly indicated the yield advantage which adopters derived by using of bio-pesticides. Even though the yield was more on farm of adopters, both of them received a similar price per kg of produce. This shows the need for organic certification for ensuring a premium price for organic. produce. Family labour income, farm business income, farm investment income were higher for adopters than non-adopters by 80.95%, 74.17%, 107.66% respectively. A significant difference was observed in the case of net farm income where adopters got a benefit of 124.49% than non-adopters. B C ratio was found to be 1.96 for adopters against 1.47 of non-adopters which recorded an increment of 33.34 % for adopters. the increased B-C ratio in adopter farms announces the profitability of them in potato cultivation by using bio-pesticides

**Table 2.** Returns from potato cultivation

(₹/ha)

| Particulars | Amount (₹) | | Difference (%) |
|---|---|---|---|
| | Adopters | Non-adopters | |
| Productivity (q /ha) | 138 | 116 | 18.96 |
| Gross returns | 276000 | 232000 | 18.96 |
| Family labour income | 153676.41 | 84925.33 | 80.95 |
| Farm business income | 162564.82 | 93337.91 | 74.17 |
| Net farm income | 114506.23 | 51007.09 | 124.49 |
| Farm investment Income | 123394.64 | 59419.67 | 107.66 |
| B-C Ratio | 1.96 | 1.47 | 33.34 |

## 4. Conclusion

The bio-pesticide use in potato assessed in terms of productivity, cost and returns revealed a proper positive economic impact among the potato growers who adopted bio-pesticide in their farms. The yield of potato was found to be higher for adopters than non-adopters. The cost of cultivation was also less for adopters and hence, they derived an increased returns from potato cultivation than non-adopters. Hence it was confirmed that adopters were obtaining higher yield due to better plant health even in adverse environmental conditions which resulted in the increment in their benefit-cost ratio. Farmers' perception on the intervention, in addition to their socioeconomic traits and institutional considerations, play a critical role in deciding whether to embrace the intervention. Increased adoption of bio-pesticides by farmers in potato cultivation would be positively impacted by better education, regular interaction with specialists, prompt supply of agri-inputs in accessible locations, and expanding knowledge of the benefits of bio-pesticides.

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