E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; 8(9): 418-422
Received: 21-06-2025
Accepted: 25-07-2025

Nongmaithem Jyotsna
Krishi Vigyan Kendra, Senapati, Manipur, India

W Dipin
Krishi Vigyan Kendra, Senapati, Manipur, India

RS Telem
Krishi Vigyan Kendra, Senapati, Manipur, India

Tabitha Donbiaksiam
FEEDS, Hengbung, Senapati, Manipur, India

Rocky Thokchom
FEEDS, Hengbung, Senapati, Manipur, India

Corresponding Author:
Tabitha Donbiaksiam
FEEDS, Hengbung, Senapati, Manipur, India

Optimizing minimum tillage technique and economic evaluation for field pea production in rice fallow lands in Manipur

Nongmaithem Jyotsna, W Dipin, RS Telem, Tabitha Donbiaksiam and Rocky Thokchom

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i9f.3792

Abstract
This study evaluates the economics of minimum tillage for cultivating field pea (*Pisum sativum* L.) in rice fallow conditions in Mayangkhang and Hengbung village in an area of 5 hectares each. Data was collected over four cropping years (2016-17, 2018-19, 2020-21, and 2022-23) and comparison of demonstration plots (Demo) against local practice plots (Local) is done. The analysis focuses on yield, gross cost, net income, Benefit-Cost Ratio (BCR), profit gap, extension gap yield and Technology Index. Field pea variety Aman (IPF 5-19) is used for this study. The result indicates that minimum tillage demonstrated higher yields, net incomes, and BCR compared to local practices in both villages. In Mayangkhang village, the BCR for Demo plots is 1.68:1 for the four years, while in Hengbung, it is 1.48:1. The findings suggest that minimum tillage significantly enhances the economic viability of field pea cultivation in rice fallow systems. The result shows better profit from Mayangkhang village with an average increase of 4% in yield and 43.1% in net income as compared to Hengbung village.

Keywords: Minimum tillage, field pea, rice fallow, Benefit-Cost Ratio (BCR), economic viability

Introduction
Field pea (*Pisum sativum* L.) is an important leguminous crop grown in the rice-fallow ecosystems of North Eastern India, where its cultivation follows rice harvest. Usually cultivated for dry pods and variety of snacks. It is an important winter crop next to chickpea and French bean. Area-wise production and productivity of Field pea in India is 417.87 million hectares with production of 3942 million tonnes (Maity *et al*, 2017) [7]. It is cultivated in Mediterranean region of Europe & West Asia before 10000 years ago (Mithen, 2006, Zohary, 2024) [8, 17]. Field pea is hypogeal can be planted deep depending on the moisture. Rice-fallow covers an area of 22.3 M ha in South Asia, having maximum acreage in India of 88.3% (Gumma *et al*, 2016) [3]. These rice fallow land typically faces issues such as soil degradation and poor moisture retention, which can affect subsequent crop yields (Verhulst *et al*, 2011., Singh *et al*, 2012., Ghosh *et al*, 2016) [16, 14, 2]. Minimum tillage, which involves less soil disturbance compared to conventional tillage, has been suggested as a sustainable agricultural practice that may improve crop productivity and economic returns by conserving soil moisture, reducing labor costs, and increasing yield potential. It has been used to alleviate the negative effects caused by intensive tillage practices and implements theat effective and sustainable agriculture requires a deeper understanding of the impacts of minimum tillage practices on soil physical properties (Rusu, 2014., Li *et al*, 2019., Li *et al*, 2020) [13, 5, 6]. This study aims to assess the economic impact of minimum tillage for field pea variety Aman (IPF 5-19) cultivation in rice fallows in two different villages Mayangkhang and Hengbung village of Manipur. By comparing demonstration plots using minimum tillage with local practices, this research provides valuable insights into the financial viability of adopting such sustainable agricultural practices in the region.

Materials and Methods
Study Area and Crop
The study was conducted where a field trial is superintended during four cropping seasons (2016-17, 2018-19, 2020-21, and 2022-23) in Mayangkhang and Hengbung villages in Manipur. The soil texture is sandy loam and clay loam respectively with optimum pH range of 5.6-6.5 and well drain. The field pea variety Aman (IPF 5-19), a legume widely grown in rice fallows for its nitrogen-fixing properties and ability to improve soil health is used for this study. In Mayangkhang and Hengbung village rice fallow land system is adopted with 20 beneficiaries in Myangkhang and 21 in Hengbung village. Each plot size is 5m x 3m (15m^2) in an area of five hectares under rice-fallow experiment in both villages. Nutrient management is done with application of 60 kg N, 80 kg P and 70 kg K/ha as basal and 60 kg N/ha on 30 days after sowing and farm yard manure (FYM) is added at 20kg/ha. Irrigation is done regularly once in a week. Weeding is done 15 days after sowing with subsequent weeding as required. Harvest was done 120 days after sowing.

Experimental Design
The experiment compared two types of agricultural practices for field pea cultivation.

a. Demo plots: Plots where minimum tillage was applied (Figure 1 and 2).
b. Local plots: Plots where traditional tillage methods were used (Figure 1 and 2)

Each village had both Demo and Local plots, and the data for yield, gross cost, net income, and Benefit Cost Ratio (BCR) were collected and analyzed annually.

Fig 1: Demo and local plot of Mayangkhang village field pea cultivation of variety Aman (IPF 5-19), 2022-23.

Fig 2: Demo and local plot of Hengbung village field pea cultivation of variety Aman (IPF 5-19), 2022-23.

Parameters Recorded
The yield of field pea in quintals per hectare is recorded for both Demo and Local plots at the time of harvest around 120 days after sowing. The total expenses incurred in the cultivation process were calculated as gross cost (Rs.). It includes all direct and indirect costs such as labor, seeds, fertilizers, irrigation, and equipment usage.

Gross Cost = Total expenditure on cultivation (seeds, labor, fertilizers, etc.)

Net income was calculated subtracting the gross cost from the gross revenue. The net income from field pea cultivation, calculated by following formula:

Net Income = Gross Revenue - Gross Cost

Where,
Gross Revenue=Yield (q/ha) × Market Price per quintal (Rs/q)

Benefit Cost Ratio (BCR) is calculated as the ratio of net income to gross cost. It indicates the economic profitability of the cultivation system. The benefit cost ratio (BCR) was calculated using the following formula by Reddy *et al*., (2004) [12].

BCR = Net Income/Gross Cost

Benefit cost ratio (BCR) is an indicator of the relative economic performance of the treatments and a ratio of more than one indicates the economic viability of the treatment compared with the control treatment (Aziz *et al*., 2012) [1]. A BCR greater than 1 indicates a profitable venture, while a BCR less than 1 suggests the system is not profitable.
The profit gap, extension yield gap and Technology Index is also recorded where,

Profit gap = Demo plot profit – Local plot profit

Extension yield gap=Demo plot yield - Local plot yield

Technology index= (extension gap yield yield/ Demo plot yield) x 100

Data Analysis
For each year, yield data for both Demo and Local plots were compared to assess the effect of minimum tillage on field pea productivity. For gross cost (Rs), the cost of cultivating field pea in both types of plots was recorded to assess the financial investment. Net Income (Rs) was calculated from the difference between gross revenue and gross cost for both Demo and Local plots. The BCR was calculated to compare the profitability of both farming methods. The BCR was used to assess the economic feasibility of adopting minimum tillage for field pea cultivation in rice-fallow systems. The results were summarized for each year and compared to determine trends and differences in economic performance between the Demo and Local plots over the four years.

Statistical Analysis
The data was analyzed using descriptive statistics to assess trends in yield, gross cost, net income, and BCR over the study period. The economic performance of both practices was compared using the calculated BCR to determine which method provided better economic returns.

Results and Discussion
Mayangkhang Village
As per the data in Table 1and Figure 3, the average yield in the Demo plots increased from 13.62 q/ha in 2016-17 to 14.00 q/ha in 2022-23, showing a consistent increase over the years. In

contrast, the Local plots had a lower yield, ranging from 11.02 q/ha in 2016-17 to 11.93 q/ha in 2022-23. The gross cost in the Demo plots ranged from Rs 47,500 in 2016-17 to Rs 48,819.43 in 2022-23, with a slight increase in each season (Table 1). The Local plots had a lower cost, with values ranging from Rs 43,256 in 2016-17 to Rs 46,823.95 in 2022-23. The net income for the Demo plots increased from Rs 32,060 in 2016-17 to Rs 32,953.24 in 2022-23. The Local plots (Table 1, Figure 4) had a net income of Rs 15,321 in 2016-17, increasing to Rs 16,600.57 in 2022-23.

Table 1: Economics of demonstration from minimum tillage of field pea *var.* Aman in rice fallow of Mayangkhang village

Economics of demonstration	2016-17		2018-19		2020-21		2022-23	
	Demo	**Local**	**Demo**	**Local**	**Demo**	**Local**	**Demo**	**Local**
Yield (q/ha)	13.62	11.02	13.74	11.29	13.86	11.40	14.00	11.93
Gross cost (Rs)	47500	43256	47913.91	44301.26	48302.62	44741.86	48819.43	46823.95
Net income (Rs)	32060	15321	32347.23	15692.44	32627.73	15851.02	32953.24	16600.57
BCR	1.68:1	1.35:1	1.68:1	1.35:1	1:68:1	1.35:1	1.68:1	1.35:1

*Area = 5 ha; Beneficiaries = 20

The BCR for the Demo plots remained constant at 1.68:1 throughout the study period, indicating consistent profitability. The Local plots had a BCR of 1.35:1, showing lower returns compared to the Demo plots.

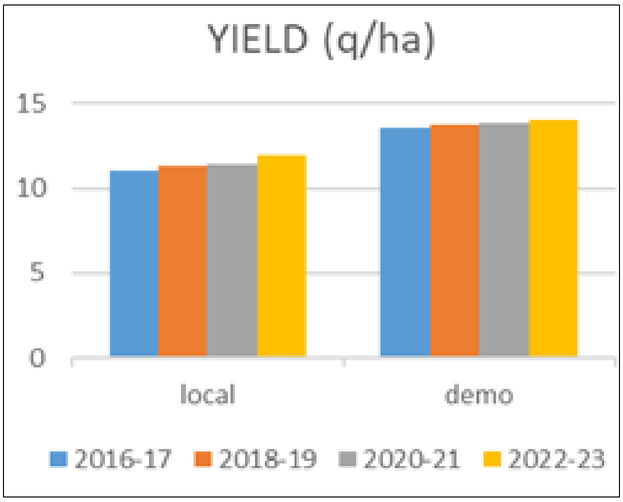

Fig 3: Yield pattern in Mayangkhang

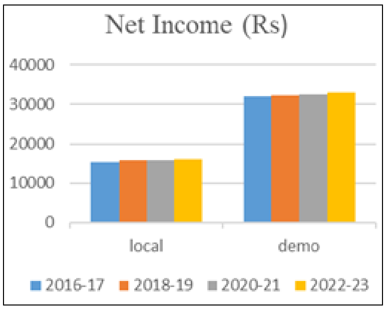

Fig 4: Net income in Mayangkhang

Hengbung Village: A careful scrutiny of the data in Table 2 and Figure 5 show that in Hengbung village, the Demo plots recorded an increase in yield from 13.26 q/ha in 2016-17 to 13.82 q/ha in 2022-23. The Local plots showed a steady yield increase, from 10.90 q/ha to 11.60 q/ha over the same period. The gross cost in the Demo plots ranged from Rs 46,000 in 2016-17 to Rs 47,995.85 in 2022-23. The Local plots had a lower cost, with values ranging from Rs 42,652 in 2016-17 to Rs 45,488.77 in 2022-23. The net income for the Demo plots increased from Rs 22,100 in 2016-17 to Rs 22,937.66 in 2022-23 (Table 2, Figure 6).

Table 2: Economics of demonstration from minimum tillage of field pea *var.* Aman in rice fallow of Hengbung village

Economics of demonstration	2016-17		2018-19		2020-21		2022-23	
	Demo	**Local**	**Demo**	**Local**	**Demo**	**Local**	**Demo**	**Local**
Yield (q/ha)	13.26	10.90	13.44	11.12	13.65	11.36	13.82	11.60
Gross cost (Rs)	46000	42652	46484.38	43539.17	47243.87	44519.31	47995.85	45488.77
Net income (Rs)	22100	12448	22324.56	12772.47	22669.99	13015.56	22937.66	13223.47
BCR	1.48:1	1.29:1	1.48:1	1.29:1	1.48:1	1.29:1	1.48:1	1.29:1

*Area = 5 ha; Beneficiaries = 21

The Local plots showed a smaller increase in net income, from Rs 12,448 to Rs 13,223.47. The BCR for the Demo plots was consistent at 1:48:1, indicating higher profitability compared to the Local plots, which had a BCR of 1:29:1 (Table 2).

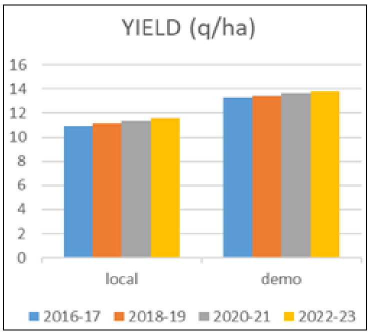

Fig 5: Yield pattern in Hengbung

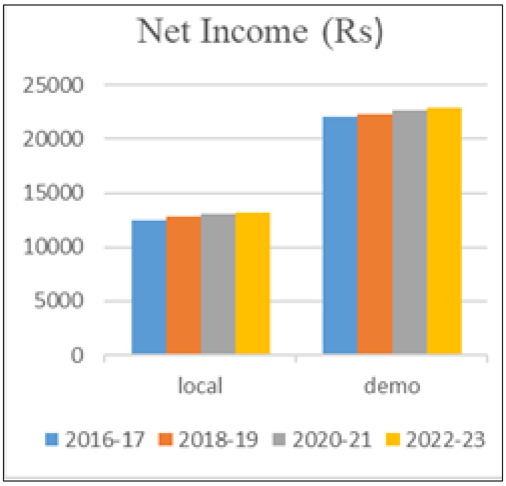

Fig 6: Net income in Hengbung

The results from both villages clearly indicate that minimum tillage practices for field pea cultivation in both Mayangkhang and Hengbung villages consistently outperformed local traditional tillage practices in terms of yield (Figure 3,5), net income (Figure 4,6) and BCR. The increase in yield in Demo plots (Figure 3,5) can be attributed to better moisture conservation and improved soil structure due to reduced tillage. This enhanced yield directly contributed to higher net income despite the slight increase in gross cost over the years. The higher BCR in the Demo plots (Table 1,2) indicates that minimum tillage is more economically viable compared to the Local plots. While both villages showed similar trends, Mayangkhang demonstrated slightly higher yields and net incomes compared to Hengbung (Table 1,2,3), possibly due to variations in soil quality, climate, and local farming practices even with the same agronomic parameters adopted. However, the overall findings suggest that minimum tillage is a beneficial practice for enhancing the profitability of field pea cultivation in rice-fallow systems.

Table 3: Year wise profit gap data

Year	Profit gap (Rs)	
	Mayangkhang	Hengbung
2016-17	16,739	9652
2018-19	16.654.79	9552.07
2020-21	16,776.71	9654.43
2022-23	16,352.67	9714.19
Mean	16,630.80	9643.17

*Profit gap = Demo plot profit – Local plot profit

Table 4: Year wise extension gap yield

Year	Extension gap yield (q/ha)	
	Mayangkhang	Hengbung
2016-17	2.6	2.36
2018-19	2.45	2.32
2020-21	2.46	2.29
2022-23	2.07	2.22
Mean	2.395	2.298

*Extension gap yield = Demo plot yield – Local plot yield

Table 5: Year wise Technology Index (%) of Mayangkhang and Hengbung village.

Year	Technology Index (%)	
	Mayangkhang	Hengbung
2016-17	19.09	17.80
2018-19	17.83	17.26
2020-21	17.75	16.78
2022-23	14.79	16.06
Mean	17.365	16.975

*Technology Index = (Extension gap/ demo plot yield) x100

A Comparison of Profitability between the Demo Plots and the Local Plots in field pea cultivation in Mayangkhang and Hengbung.

In Table 1 and 2, comparison was made to record the profitability of the demo plots relative to the local plots in field pea cultivation in Mayangkhang and Hengbung village. The financial analysis reveals that, by adopting improved technology appropriate to local conditions, the cost of field pea production could be reduced while mean net profit recorded is Rs.16,630.80/- in Mayangkhang village and Rs.9643.17/- in Hengbung (Table 3). Mayangkhang village shows higher profitability which is 43.1% higher than Hengbung village in average (Table 3). The increment in yield of demo plot from local plot or the extension gap yield (demo plot yield-local plot yield) in Mayangkhang is 2.395 q/ha in average for the four years and in Hengbung village, the extension gap is 2.298 q/ha (Table 4). Mayangkhang village recorded better yield with an increase of 4% yield in average as compared to Hengbung village (Table 4). Technology Index is given in Table 5. The range of the technology index was 14.79 to 19.09% in Mayangkhang and 16.06 and 17.80 in Hengbung (Table 5). The year 2022–23 had the lowest technology index, while the year 2016–17 had the highest (Table 5). Higher technology index reflected the insufficient extension services for the transfer of technology (Singha *et al*., 2020., Ojha & Bisht, 2020., Raghav *et al*., 2020) [15, 9, 11]. Similar findings are observed by Yogesh *et al*, 2020 and Telem *et al*, 2024 [10].

Conclusion

This study highlights the significant economic benefits of adopting minimum tillage practices for field pea cultivation in rice fallows in the Mayangkhang and Hengbung villages. The demonstration plots consistently showed higher yields, net incomes, and BCR compared to local practices, making minimum tillage a promising sustainable agricultural practice. The higher profitability and productivity of Mayangkhang village (sandy loam) over Hengbung village (clay loam) with the same agronomic parameters will be the soil properties and environment therefore further studies could be done to study the relation of soil physical, chemical and biological properties with field pea cultivation in rice fallow system. Encouraging farmers in rice-fallow regions to adopt minimum tillage could lead to enhanced productivity and economic stability, contributing to the overall sustainability of agricultural systems in the region.

Acknowledgement

The authors are grateful to director of ICAR-CRIDA, Hyderabad and ICAR-ATARII VII, UMIAM for funding the project and appreciate the faculty of FGI-CAS, Hengbung for intellectual contribution and the farmers for their support and cooperation.

Competing Interest

Authors have declared that no competing interest exist.

References

1. Aziz MA, UI Hasan M, Ali A, Iqbal J. Comparative efficacy of different strategies for management of spotted bollworms, *Earias* spp. on Okra, *Abelmoschus esculentus* (L). Moench. Pak J Zool. 2012;44:1203-8.
2. Ghosh PK, Hazra KK, Nath CP, Das A, Acharya CL. Scope, constraints and challenges of intensifying rice (*Oryza sativa*) fallows through pulses. Indian J Agron. 2016;61(4):122-8.
3. Gumma MK, Thenkabail PS, Teluguntla P, Rao MN, Mohammed IA, Whitbread AM. Mapping rice-fallow cropland areas for short-season grain legumes intensification in South Asia using MODIS 250 m time-series data. Int J Digit Earth. 2016;9(10):981-1003. https://doi.org/10.1080/17538947.2016.1168489
4. Kanojia Y, Panwar P, Damor RK. Yield and Gap Analysis of Wheat Productivity through Frontline Demonstration in Tribal District Pratapgarh of Rajasthan. Int J Curr Microbiol App Sci. 2020;9(02):1156-61. https://doi.org/10.20546/ijcmas.2020.902.136
5. Li Y, Li Z, Cui S, Jagadamma S, Zhang Q. Residue retention and minimum tillage improve physical environment of the soil in croplands: A global meta-

analysis. Soil Tillage Res. 2019;194:104292.
6. Li Y, Zhang Q, Cai Y, Yang Q, Chang SX. Minimum tillage and residue retention increase soil microbial population size and diversity: Implications for conservation tillage. Sci Total Environ. 2020;716:137164. https://doi.org/10.1016/j.scitotenv.2020.137164
7. Maity T, Saxena A. Recent Advances in Processing of Peas. Veg Process Bioact Compd. 2017:396–424.
8. Mithen SJ. After the ice: a global human history, 20,000-5000 BC. Harvard University Press; 2006.
9. Ojha RK, Bisht H. Yield potential of chickpea through cluster frontline demonstrations in Deoghar district of Jharkhand. Int J Sci Environ Technol. 2020;9(6):947-55.
10. Telem RS, Jyotsna N, Kumar D, Kennedy Y, Dipin W, Akoijam R, *et al*. Evaluating Yield Gap of Field Pea in Senapati District, Manipur, India. J Exp Agric Int. 2024;46(12):679–84. https://doi.org/10.9734/jeai/2024/v46i123176
11. Raghav DK, Kumar U, Kumar A, Singh AK. Impact of cluster frontline demonstration on pigeon pea for increasing production in rainfed areas of district Ramgarh (Jharkhand) towards self-sufficiency of pulses. Indian Res J Ext Edu. 2020;20(4):34-9.
12. Reddy VR, Reddy PP, Kumar UH. Ecological and economic aspects of shrimp farming in Andhra Pradesh. Indian J Agric Econ. 2004;20(1):435.
13. Rusu T. Energy efficiency and soil conservation in conventional, minimum tillage and no-tillage. ISWCR. 2014;2(4):42-9. https://doi.org/10.1016/S2095-6339(15)30057-5
14. Singh RG, Mishra SK, Singh PK, Jat RK, Dey S, Shahi VB, *et al*. Opportunities for managing rice-fallow systems. Indian Farm. 2012;62:31-4.
15. Singha AK, Deka BC, Parisa D, Nongrum C, Singha A. Yield gap and economic analysis of cluster frontline demonstrations (CFLDs) on pulses in Eastern Himalayan Region of India. J Pharmacogn Phytochem. 2020;9(3):606-10.
16. Verhulst N, Sayre KD, Vargas M, Crossa J, Deckers J, Raes D, *et al*. Wheat yield and tillage–straw management system× year interaction explained by climatic co-variables for an irrigated bed planting system in northwestern Mexico. Field Crops Res. 2011;124(3):347-56.
17. Zohary D. The mode of domestication of the founder crops of Southwest Asian agriculture. In: The origins and spread of agriculture and pastoralism in Eurasia. Routledge; 2024. p. 142-58.