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

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; SP-8(12): 206-209
Received: 26-09-2025
Accepted: 29-10-2025

RK Roshan
SMS (Horticulture), ICAR - KVK Tamenglong, ICAR RC Manipur Centre, Manipur, India

Nongallei Pebam
FSO, Bishnupur, Medical Directorate, Govt. of Manipur. Manipur, India

Corresponding Author:
RK Roshan
SMS(Horticulture), ICAR - KVK Tamenglong, ICAR RC Manipur Centre. Manipur, India

Impact of frontline demonstrations on yield enhancement and technology dissemination in cabbage (*Brassica oleracea* var. *capitata* L.) under farmer field conditions in Churachandpur district, Manipur

RK Roshan and Nongallei Pebam

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i12Sc.4375

Abstract

Cabbage (*Brassica oleracea* var. *capitata* L.), one of the world's most widely cultivated cole crops, plays a critical role in food and nutritional security due to its high content of vitamins, minerals, fibre, and bioactive compounds. Despite its importance, productivity in the Churachandpur district of Manipur remains significantly lower than the national average, primarily due to the non-adoption of improved varieties and scientific cultivation practices. To address this gap, ICAR - Krishi Vigyan Kendra (KVK), Churachandpur under ICAR-NEH Region conducted 20 Frontline Demonstrations (FLDs) during four consecutive rabi seasons (2012-13 to 2015-16) using the improved variety 'Green Hero' along with recommended production technologies. The objective was to assess performance, quantify yield gaps, evaluate technology index, and analyse farmer adoption under real field conditions.

Results revealed that demonstration yields ranged from 320-335 q/ha, significantly surpassing existing farmers' practice yields of only 140 q/ha. The percent increase in yield due to adoption of improved practices varied from 128.57% to 139.29%. Extension gaps were found between 180-195 q/ha, while technology gaps decreased from 80 q/ha in the first year to 65 q/ha in the final year. The technology index also showed a declining trend from 25.00% to 19.40%, indicating increasing feasibility and acceptability of the improved package of practices among farmers.

The findings conclude that FLDs play a vital role in accelerating adoption of improved agricultural technologies, reducing yield gaps, and enhancing farmers' income. The demonstrated practices have strong potential for large-scale dissemination across Manipur and similar agro-ecologies.

Keywords: Cabbage, FLD, technology gap, technology index, yield, ICAR, Manipur, adoption

1. Introduction

Cabbage (*Brassica oleracea* var. *capitata* L.), a member of the Brassicaceae family, is one of the most widely cultivated and nutritionally important vegetable crops globally. It ranks among the top twenty vegetables produced worldwide, highlighting its significant role in human diets and food security (FAO, 2014) [8]. The crop is valued for its high moisture content, dietary fiber, and essential nutrients, including vitamin C, vitamin A, B-complex vitamins, calcium, potassium, and iron (Adeniji *et al*., 2010; Hasan & Solaiman, 2011) [1, 9]. In addition, cabbage is a rich source of glutamine, glucosinolates, phenolics, and other antioxidative compounds associated with anti-inflammatory and anti-carcinogenic properties (Caunii *et al*., 2010; Kusznierewicz *et al*., 2008) [5, 12].

In Manipur, particularly in Churachandpur district, cabbage is a major winter-season vegetable crop contributing substantially to household nutrition and farmer livelihoods. Despite favorable agro-climatic conditions, productivity remains low due to the predominance of traditional cultivation practices, use of low-yielding local varieties, inadequate nutrient and pest management, and limited awareness of scientific production technologies. Consequently, a large gap persists between farmers' yields and the potential yield achievable through recommended agronomic practices.

Frontline Demonstrations (FLDs), implemented through the Indian Council of Agricultural Research (ICAR), serve as an effective extension approach for validating and disseminating improved technologies under real farm conditions. By demonstrating high-yielding varieties and standardized production packages, FLDs help bridge knowledge gaps, assess technology feasibility, and enhance farmer adoption. This study evaluates the impact of FLDs on cabbage production in Churachandpur district to quantify yield improvement and understand technology adoption dynamics.

The study was undertaken with the following objectives:

1. To evaluate the performance of improved cabbage production technologies under farmers' field conditions through FLDs.
2. To quantify the yield gap between improved practices and existing farmer practices.
3. To estimate extension gap, technology gap, and technology index.
4. To enhance farmer knowledge and adoption of scientific cabbage cultivation practices.

2. Materials and Methods

2.1 Study Area

The study was conducted in eight villages of Churachandpur district—Tollen, Kholmun, Talian, Henkot, Yaiphakol, Mata, Matiyang, and L. Molvom—selected based on cabbage-growing potential and farmer interest. The district receives 1,000-1,200 mm annual rainfall with cool, favorable temperatures during rabi, making it suitable for cabbage cultivation.

2.2 Frontline Demonstrations (FLDs)

A total of 20 FLDs were carried out over four seasons (2012-13 to 2015-16). Each demonstration covered 0.2 ha, while an adjacent plot under local practices served as a control for comparison.

2.3 Technologies Demonstrated

Table 1 presents the key differences between FLD interventions and farmers' practices, extracted from the source file.

Table 1: Comparison of Improved (FLD) and Existing Farmer Practices

Operation	Existing practice	Cabbage Demonstration package
Variety	Local variety	Demonstrate high yielding variety Green Hero as recommended by ICAR Research Complex NEH Region Tripura Centre.
Sowing and transplanting	Broad casting in nursery, transplanting as per farmers suitability	Raised quality seedlings in the raised nursery beds, line sowing and transplant after 5-6-week-old seedlings with 4-6 leaves. Transplanting is done in the evening. Immediately after transplanting, irrigation is provided. Recommended spacing i.e. row to row and plant to plant 60 cm x 45cm.
Manure and Fertilizers application	Less fertilizers dose	FYM or compost @ 15 to 20 tonnes/ha is incorporated in the soil during land preparation. Besides FYM, N: P: K @ 100:80:60 kg/ha is applied. Full amount of phosphorus and potash along with half amount of nitrogen is applied at the time of transplanting. Remaining amount of nitrogen is applied in two split doses i.e. 30 and 45 days after transplanting as top dressing.
Intercultural operations	No weeding, few or no irrigation is given. Earthing-up is rarely practiced	Two weeding, shallow hoeing to loosen the soil for better aeration and earthing-up after 30 - 40 after transplanting. Light and frequent irrigation followed as and when required. Application of recommended plant protection chemicals as occurrence of pest and diseases
Pest Management	Only local methods	IPM (Bacillus thuringiensis, Dimethoate)
Harvesting	Non-standard	Harvest at maturity based on head firmness

2.4 Data Collection

Data were collected on:

- Demonstration yield (q/ha)
- Farmer practice yield (q/ha)
- Potential yield (400 q/ha)
- Extension gap
- Technology gap
- Technology index

Formulas Used

- Technology Gap = Potential Yield − Demonstration Yield
- Extension Gap = Demonstration Yield − Farmer Practice Yield
- Technology Index = [(Potential Yield − Demonstration Yield)/Potential Yield] × 100

3. Results and Discussion

3.1 Yield Performance

The results from four years of frontline demonstrations (FLDs) clearly showed that adoption of improved production technologies significantly enhanced cabbage yield compared to existing farmers' practices. Demonstration yields ranged from 320 to 335 q/ha, whereas traditional practices produced only 140 q/ha, leading to a yield increase of 128.57-139.29%. Similar yield advantages from improved agronomic practices in cole crops have been reported by Meena *et al.* (2018) [13], Teggelli *et al.* (2015) [20], and Choudhary *et al.* (2018) [6], confirming that hybrid varieties combined with balanced nutrient management consistently outperform local seed and traditional methods.

The high yield under FLDs can be attributed to the superior genetic potential of the hybrid variety 'Green Hero', which is known for its compact heads, uniform maturity, and tolerance to biotic stress (Hasan & Solaiman, 2011) [9]. Additionally, improved nursery management, appropriate spacing (60 × 45 cm), and soil testing-based fertilizer application resulted in vigorous vegetative growth and optimal canopy development. Studies by Adeniji *et al.* (2010) [1] and ICAR (2017) [10] have emphasized that plant spacing, nutrient status, and seedling Vigor are major determinants of cabbage yield, which directly aligns with the improvements observed in the present study.

3.2 Extension Gap Analysis

The extension gap, i.e., the difference between demonstration yield and farmers' practice yield, ranged from 180-195 q/ha. A large extension gap indicates low adoption of scientific cultivation practices in the region. Similar gaps have been observed in cabbage and other vegetable FLDs across India (Samui *et al.*, 2000; Singh & Chand, 2004; Yadav *et al.*, 2018) [16, 18, 21], suggesting that without effective extension approaches, yield potential remains unrealized.

The persistent extension gap points to several constraints:

1. Limited access to quality hybrid seeds, as reported in studies by Biswas *et al*. (2015) [4] and Baruah *et al.* (2015) [2].
2. Poor knowledge of pest and nutrient management, especially in tribal and hilly regions (Rao *et al.*, 2014) [15].
3. Lack of scientific nursery raising techniques, which affect seedling vigor and final yield.

The FLDs helped bridge this gap by providing input support and hands-on training, which resulted in better skill development, as also highlighted by Bhardwaj *et al*. (2017) [3].

3.3 Technology Gap

The technology gap (potential yield − demonstration yield) decreased from 80 q/ha in 2012-13 to 65 q/ha in 2015-16. This decreasing trend indicates improved adaptability and successful refinement of the demonstrated technologies over time. According to Samui *et al.* (2000) [16], a reduction in technology gap reflects farmers' increasing capacity to implement scientific recommendations accurately.

The persistence of some gap is expected because potential yield (400 q/ha) is generally obtained under optimal research-station conditions with full resource availability. Field-level constraints such as unpredictable rainfall patterns, soil fertility variation, sporadic pest outbreaks, and labor shortages naturally limit demonstration yields (Sharma *et al*., 2013; Pal & Chatterjee, 2012) [17, 14]. Nevertheless, the consistent decline in technology gap shows that farmers increasingly adopted the improved practices and better understood hybrid performance.

3.4 Technology Index

The technology index ranged from 25.00% (initial year) to 19.40% (final year). A lower technology index denotes higher feasibility and acceptance of the technology under real farming situations. Declining technology index over the years signifies that the recommended package of practices is more farmer-friendly, economically viable, and suited to local agro-ecological conditions.

Similar decreasing trends have been documented in cole crops and other vegetables under FLDs by Singh *et al.* (2016) [19], Meena *et al.* (2018) [13], and Choudhary *et al.* (2018) [6], further supporting the current findings. The results imply that once farmers gain experience with a new technology, adoption accelerates, and performance improves.

3.5 Influence of Improved Production Technologies

3.5.1 Role of Hybrid Variety 'Green Hero'

Hybrid cabbage varieties possess heterosis advantages such as vigorous growth, higher head density, and disease tolerance. Studies by Caunii *et al.* (2010) [5] and Kusznierewicz *et al.* (2008) [12] also suggest that hybrids maintain higher nutrient content, which indirectly correlates with better yield and quality. The superior performance of 'Green Hero' is consistent with earlier reports on hybrid vigour in cabbage (Meena *et al*., 2018) [13].

3.5.2 Effect of Scientific Nursery Practices

Raising seedlings on sterilized nursery beds minimizes damping-off and ensures uniform, healthy transplants. As reported by Adeniji *et al.* (2010) [1], high-quality seedlings are essential for achieving high yields in Brassicaceae vegetables. The FLD approach standardized nursery techniques, contributing to better field establishment and yield.

3.5.3 Nutrient Management

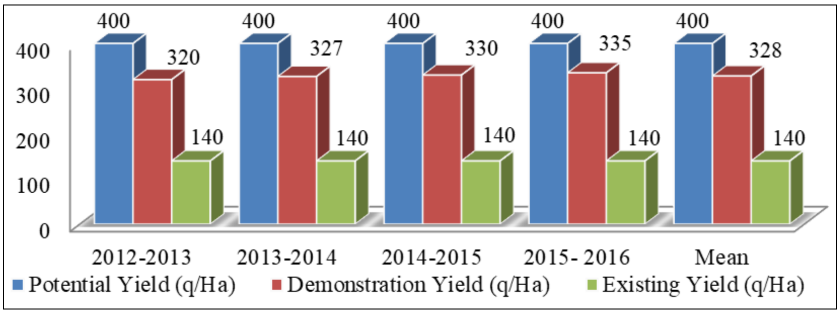
Application of 100:80:60 kg NPK/ha along with FYM significantly enhanced vegetative growth and head formation. Balanced nutrition is known to increase chlorophyll content, photosynthetic rate, and biomass accumulation in cabbage (Hasan & Solaiman, 2011; ICAR, 2017) [9, 10]. Dramatic yield improvement under FLDs confirms these findings.

3.5.4 Integrated Pest Management

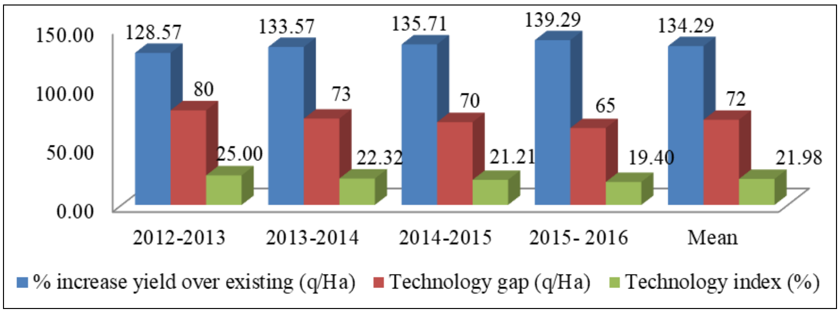
Major pests—diamondback moth (*Plutella xylostella*), aphids, and cutworms—are responsible for 30-60% yield losses in cabbage if unmanaged (Kumar *et al.*, 2019) [11]. The adoption of need-based IPM components (Bt formulations, Dimethoate, neem extracts) effectively reduced pest incidence in FLD plots compared to farmer practice, contributing significantly to higher yields. Similar success of IPM interventions has been reported in cole crops by Choudhary *et al.* (2018) [6].

Table 2: Exploitable productivity, technology gaps, technology index, as grown under FLD and existing package of practices.

Years	Area (ha)	No. of FLDs	Yield (q/ha)			% increase yield over existing	Technology gaps (q/ha)	Technology index (%)
			Potential	Demonstrations	Existing practices			
2012-2013	1	4	400	320	140	128.57	80	25.00
2013-2014	2	7	400	327	140	133.57	73	22.32
2014-2015	2	3	400	330	140	135.71	70	21.21
2015-2016	2	6	400	335	140	139.29	65	19.40
Mean	7	20	400	328.00	140.00	134.29	72.00	21.98



Graph 1: Exploitable productivity as grown under FLD and existing package of practices.



Graph 2: Increase in yield, technology gap and technology index as grown under FLD and existing package of practices.

4. Conclusion

The present study clearly demonstrates that the adoption of improved cabbage production technologies through Frontline Demonstrations (FLDs) significantly enhances productivity and reduces yield variability under farmer field conditions in Churachandpur district of Manipur. The hybrid variety 'Green Hero,' when integrated with scientific nursery management, balanced nutrient application, and effective pest and disease management, consistently outperformed traditional practices, resulting in yield gains of 128-139%. The marked reduction in technology gap (80 to 65 q/ha) and technology index (25.00% to 19.40%) across the study period reflects increasing compatibility, feasibility, and farmer acceptance of the demonstrated interventions.

The substantial extension gap highlights the critical need for continued extension support, capacity building, and dissemination of evidence-based technologies, particularly in remote and tribal farming communities. The success of FLDs reaffirms their role as an efficient mechanism for accelerating technology adoption, minimizing production risks, and improving economic returns. Overall, the study underscores the importance of structured extension programmes in bridging scientific advances with grassroots cultivation practices, thereby contributing to enhanced vegetable productivity, livelihood security, and sustainable agricultural development in the North-Eastern Himalayan region.

References

1. Adeniji TA, Alozie YE, Igbozulike AO, Ekeledo N. Proximate, mineral and vitamin analysis of cabbage (*Brassica oleracea* L.). J Food Sci Technol. 2010;47(2):220-224.
2. Baruah A, Borah D, Hazarika M. Impact of frontline demonstrations on adoption of improved vegetable cultivation practices in Assam. Indian J Ext Educ. 2015;51(3):68-72.
3. Bhardwaj RK, Singh AK, Kumari R. Role of farmer trainings in adoption of improved agricultural technologies. J Community Mobil Sustain Dev. 2017;12(1):129-134.
4. Biswas PK, Dutta D, Das P. Effect of technological interventions on yield and economics of cabbage under FLD in North Bengal. J Krishi Vigyan. 2015;4(1):47-50.
5. Caunii A, Cuciureanu R, Zakar AI, Tonea E, Giuchici C. Chemical composition of cabbage and its antioxidant activity. Ann Univ Oradea. 2010;I(17):1289-1296.
6. Choudhary BR, Dashora LN, Sharma KC, Singh P. Yield gap analysis and impact of frontline demonstrations on productivity of cabbage. Int J Curr Microbiol Appl Sci. 2018;7(5):1458-1464.
7. Dahama AK. Organic farming for sustainable agriculture. Agrobios Newsl. 2007;5(3):22-25.
8. FAO. FAOSTAT statistical database: Global vegetable production. Rome: Food and Agriculture Organization of the United Nations; 2014.
9. Hasan MA, Solaiman AHM. Nutrient content and biochemical properties of different cabbage cultivars. Bangladesh J Agric Res. 2011;36(4):593-602.
10. ICAR. Package of practices for vegetable crops. New Delhi: ICAR-National Horticultural Research and Development Foundation; 2017.
11. Kumar A, Jena S, Sahoo BK. Integrated pest management strategies for diamondback moth in cabbage. J Entomol Res. 2019;43(2):245-252.
12. Kusznierewicz B, Śmiechowska A, Bartoszek A, Namieśnik J. The effect of post-harvest treatment and storage on antioxidant activity of white cabbage. Food Chem. 2008;107(4):1672-1680.
13. Meena BS, Meena RP, Sharma D. Productivity enhancement through frontline demonstrations in cole crops. J Krishi Vigyan. 2018;6(2):123-127.
14. Pal S, Chatterjee N. Constraints of vegetable cultivation in eastern India: A field study. Indian J Ext Educ. 2012;48(3-4):76-79.
15. Rao MS, Kaur P, Singh G. Adoption of improved vegetable production practices among hill farmers. Int J Agric Sci. 2014;10(1):540-544.
16. Samui SK, Maitra S, Roy DK, Mandal AK, Saha D. Evaluation of frontline demonstration on groundnut. J Indian Soc Coast Agric Res. 2000;18(2):180-183.
17. Sharma RK, Singh KP, Singh A. Climate variability and its impact on cabbage production in hilly regions. Indian J Hortic. 2013;70(3):428-432.
18. Singh D, Chand R. Adoption of improved agricultural technologies by vegetable growers in Himachal Pradesh. Agric Econ Res Rev. 2004;17(2):315-318.
19. Singh R, Yadav V, Mishra D. Technological gap and constraints in adoption of improved vegetable cultivation practices. J Community Mobil Sustain Dev. 2016;11(1):35-40.
20. Teggelli RG, Patil BL, Halepeth R. Impact of frontline demonstrations on the yield of cabbage. Karnataka J Agric Sci. 2015;28(4):597-599.
21. Yadav VP, Gupta S, Singh S. Yield gap analysis of major vegetables in farmer fields. Ann Hortic. 2018;11(1):91-97.
22. Devi L, Singh TB, Khumanthem MC. Extension gap analysis in vegetable crops in Manipur. J Ext Educ. 2020;32(4):52-58.