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ASSESSMENT OF TRAINING AND DEMONSTRATION IMPACT ON FARMERS' KNOWLEDGE OF FARM MACHINERY ADOPTION IN ASSAM INDIA

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ABSTRACT

The North Eastern Region (NER) of India, with its challenging topography and unique agricultural practices, has faced significant barriers to farm mechanization. This study evaluates the effectiveness of a five days training and demonstration program on farm machinery conducted at the ICAR-Central Plantation Crops Research Institute, Kahikuchi, Assam, targeting farmers from five districts, Udalguri, Darrang, Nalbari, Baksa, and Goalpara during 2024. A total of 125 participants were selected from these districts to assess the impact of training on their knowledge, preferences, and willingness to adopt farm mechanization. The study used a structured questionnaire to analyse participants' socio-demographic profiles, preferred farm machinery, motivations for mechanization, and knowledge sharing tendencies. Statistical analysis, including pre and post-training knowledge assessments, indicated a significant improvement in knowledge scores across all districts, with Baksa showing the highest learning gains and Nalbari the lowest. High t-values and low p-values across districts confirmed the training's impact. Responses varied by district, highlighting the importance of tailored training sessions. The findings also stated the need for locally adapted mechanization policies, accessible training venues, and financial support systems to enhance mechanization adoption and sustainability in NER agriculture.
Keywords **:** Farm machinery, agricultural training, knowledge transfer, farmer perceptions.

Introduction

Agriculture forms the backbone of India's economy, with a significant portion of the population depending on farming for their livelihood. Over the years, the use of farm machinery has revolutionized agricultural practices, contributing to increased productivity, reduced drudgery, and efficient utilization of resources such as seeds, fertilizers, and water. However, the adoption and usage of farm machinery vary significantly across the diverse regions of India, influenced by factors such as soil type, cropping patterns, and geographical conditions (Khambalkar *et al.*, 2012). The growth of agriculture has made machines essential, helping farmers to complete their work quickly and efficiently. Mechanized farming not only enhances cropping intensity through multiple cropping systems but also ensures better management of inputs, ultimately improving agricultural productivity (Singh *et al.*, 2013). Despite these advancements, certain regions, such as the North Eastern states of India, face unique challenges in farm mechanization due to their distinctive topography, climatic conditions, and socio economic constraints.

The North Eastern region of India, comprising eight states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura located between 21.5° N to 29.5° N latitude and 85.5° E to 97.5° E longitude covers about 7.9% of India's total geographical area (approximately 26.23 million hectares), with around 1.74 million square kilometres classified as hilly terrain (Chakravarty *et al.*, 2012). This region is characterized by its diverse topography and climate, which significantly influence agricultural practices and livelihoods. Approximately 70% of the population in North East region relies on agriculture as their primary source of livelihood, with around 5.3 million hectares dedicated to cropped area, making it a cornerstone of the regional economy (Karan, 2024). The agricultural sector encompasses various sub sectors, including field and horticultural

crops livestock, forestry, and aquaculture (GOI, Ministry of Development of North Eastern Region, 2018). However, productivity levels in these regions are generally lower than the national average, partly due to small and fragmented land holdings, which average around 0.42 hectares (Charingia and Borthakur, 2022). Poor adoption of modern agricultural practices, inadequate infrastructure, vulnerability to natural disasters and limited facilities are the main constraints. One of the main constraints affecting productivity in this region is the lack of farm mechanization and low farm power availability in the North East region (Mehta *et al*., 2024). Continued efforts from governmental bodies and research institutions are essential to promote technology adoption among farmers in this diverse region (Vanlalmawia, 2020) and Government initiatives, such as subsidies and training programs, are crucial in promoting mechanization, making it more accessible to small farmers (Ministry of Agriculture and Farmers' Welfare, 2023). Meenambigai and Sreetharaman (2003) reported that training and demonstration is an effective tool for the transfer of technology. They have also asserted that training is the most singular factor affecting individuals' attitude, productivity, improvement and minimization of risks (Gupta *et al.*, 2019; Kumar *et al.,* 2018). Since agricultural technologies and practices are constantly changing, training plays a crucial role in keeping the farmers abreast with these advancements in the agriculture sector (Pandey *et al.*, 2011). Adequate training is essential for farmers to acquire the necessary knowledge and skills in different aspects of farming (Kumar *et al.*, 2018). This is more important for the farmers interested in farm machinery with the unique situation of North East. This study provides an overview of the role of farm machinery in Indian agriculture, with a focus on the unique challenges and opportunities in the North East region. It also highlights the critical role of training in fostering the adoption of mechanization, ultimately aiming to enhance agricultural productivity and livelihood security in the region. Keeping these in view, Central Plantation Crops Research Institute, Research Centre, Kahikuchi, has conducted training and demonstration programs for farmers from various districts of Assam to study the impact on farmers' farm machinery adoption and knowledge enhancement.

Materials and Methods

The present study was conducted for five consecutive days, involving 125 respondents (n) from five districts (Goalpara, Udalguri, Baksa, Darrang and Nalbari) of Assam. From each districts, 25 respondents were selected randomly to ensure unbiased representation. The training and demonstration was conducted at the Research Centre, Kahikuchi, and Guwahati, Assam with presentation, lectures and practical demonstration. Farm machinery like; self-propelled vertical conveyor reaper, power tiller, tender nut punching and slicing device, arecanut leaf plates and cup making devices, brush cutter, turmeric grinder, rice flour mill, rice dehusker, coconut dehusking machine, air compressor, diesel pump set, chain saw, coconut climbing devices, trolley operated power sprayer, post hole digger, rotary tiller, knapsack sprayer, foot pump and rocker sprayers, grafting and pruning knife and fruit harvesting devices were used as the training materials. The hands on demonstrations were aimed to familiarize participants with the operation, maintenance, and utility of these tools in their specific farming contexts. Twenty basic questions on farm machinery were used for testing the farmers' knowledge. Socio personal attributes of the farmers' *viz*., caste, educational qualification, land holding, occupation, annual income, respondent earlier trained in farm machinery, preference of the farm machines, major crop cultivated, availability of common farm machinery, land type and availability of farm machinery repairing centre and perception of the respondent were studied by giving different statement. The responses were statistically analysed using SPSS software, applying both descriptive and inferential statistical tools. The analysis focused on evaluating knowledge enhancement, profiling socio-economic variables, and identifying the key factors influencing the adoption of farm machinery.

Results

Farmers' perception on farm mechanization training

A structured training programme on farm mechanization was conducted for 125 farmers across five districts of Assam-Udalguri, Darrang, Nalbari, Baksa and Goalpara with 25 participants from each location. The aim was to assess changes in perception, identify preferences, and evaluate knowledge improvement post intervention. The results (Table 1) indicate a substantial motivational impact of the training programme. A majority of the respondents (43%) stated that the training inspired them in multiple ways prompting them to update knowledge, purchase machinery, and promote mechanization in their locality. District wise analysis showed that Darrang (64%) and Udalguri (48%) had the highest proportion of respondents under this comprehensive motivation category, whereas Nalbari had the highest proportion (64%) of respondents who specifically showed interest

in update of farm machinery. These findings highlight the positive influence of targeted training programs.

With regard to interest in specific machinery demonstrated during the training, power tillers were found to be the most appealing by 36% of the participants, with highest interest in Udalguri (52%) and Baksa (48%). Brush cutters (32%) and vertical conveyor reapers (19%) also received notable attention. Preferences for the training duration revealed that 37% of respondents favoured 3 days session, and another 36% preferred 7 days session, reflecting a balance between concise and comprehensive training models. Notably, Goalpara had the highest preference for short term training (52%), whereas longer training duration was appreciated in Darrang and Udalguri. In terms of training format, a significant majority (49.6%) advocated for sessions combining both theory and practical learning, followed by 36% who preferred a broad introductory training on various machinery. As for venue preference, 42.4% opted for local grounds or panchayat level venues due to their accessibility, while 39.2% preferred formal settings like research or teaching centres. District level training venues were least preferred. Farmers were also asked about the most suitable machinery for their region and power tillers emerged as the most favoured choice (67%), with exceptional preference in Nalbari (96%) and Darrang (68%). This indicates a strong alignment of farmers' preferences with the region's terrain and farm size.

The training not only improved knowledge but also inspired action. Approximately 40% of respondents expressed willingness to engage in multiple roles such as taking up mechanization as a career, working as trainers, and establishing repair centres. The highest proactive goal was observed in Goalpara (68%) and Udalguri (52%). Among individual choices, 29% were interested in working as motivators/trainers and 22% expressed interest in setting up farm machinery repair units, especially in Nalbari (52%) and Darrang (44%). Regarding the barriers in adoption of farm mechanization, 76% of respondents cited financial limitations as the primary constraint, especially in Udalguri and Nalbari, where all participants unanimously reported this concern. Other obstacles included lack of technical knowledge (11.2%), low awareness (8.8%), and fragmented landholdings (4.0%).

To overcome these issues, respondents suggested awareness training (49%), financial incentives (30%), and hire purchase systems (9%) as key strategies to promote mechanization. A notable 40% of respondents showed readiness to train neighbouring farmers, while 30% and 27% intended to motivate and share knowledge with family members, respectively, indicating a positive ripple effect on knowledge diffusion within farming communities.

Table 1 : Comparison on farmers perception on mode of training on farm machinery in various districts of Assam (N=125)

Statement	Udalguri (Count, %)	Darrang (Count, %)	Nalbari (Count, %)	Baksa (Count, %)	Goalpara (Count, %)	Total (Count, %)
The training has motivated you to:						
1. Seriously think about machinery of farm updates (I)	10 (40%)	4 (16%)	16 (64%)	5 (20%)	11 (44%)	46 (37%)
2. Purchase some farm machine (II)	2 (8%)	1 (4%)	3 (12%)	4 (16%)	3 (12%)	13 (10%)
3. Work for the mechanization in your area (III)	1 (4%)	4 (16%)	1 (4%)	5 (20%)	2 (8%)	13 (10%)
4. All of the above (IV)	12 (48%)	16 (64%)	5 (20%)	11 (44%)	9 (36%)	53 (43%)
Most interesting machine in training:						
1. Practical on power tiller	13 (52%)	9 (36%)	6 (24%)	12 (48%)	5 (20%)	45 (36%)
2. Practical on self-propelled vertical conveyor reaper	4 (16%)	2 (8%)	6 (24%)	6 (24%)	6 (24%)	24 (19%)
3. Practices on brush cutter	3 (12%)	14 (56%)	10 (40%)	4 (16%)	10 (40%)	41 (32%)
4. Practices on sprayers	5 (20%)	0 (0%)	3 (12%)	3 (12%)	4 (16%)	15 (12%)
Optimum time for farm mechanization training:						
1. 1 day	7 (28%)	1 (4%)	5 (20%)	3 (12%)	2 (8%)	18 (14%)
2. 3 days	7 (28%)	10 (40%)	8 (32%)	8 (32%)	13 (52%)	46 (37%)
3. 5 days	0 (0%)	1 (4%)	9 (36%)	5 (20%)	1 (4%)	16 (13%)
4. 7 days	11 (44%)	13 (52%)	3 (12%)	9 (36%)	9 (36%)	45 (36%)
Most suitable machine for your area:						
1. Power tiller	12 (48%)	17 (68%)	24 (96%)	16 (64%)	15 (60%)	84 (67%)
2. Sprayers	6 (24%)	0 (0%)	0 (0%)	1 (4%)	0 (0%)	7 (6%)
3. Pumpset	1 (4%)	0 (0%)	0 (0%)	0 (0%)	2 (8%)	3 (2%)
4. Paddy harvester	6 (24%)	8 (32%)	1 (4%)	8 (32%)	8 (32%)	31 (25%)

Willingness to:						
1. Take up farm mechanization as a career	1 (4%)	2 (8%)	5 (20%)	2 (8%)	1 (4%)	11 (9%)
2. Work as a motivator and trainer	11 (44%)	4 (16%)	7 (28%)	10 (40%)	5 (20%)	37 (29%)
3. Set up farm machinery repairing centre in your area	0 (0%)	11 (44%)	13 (52%)	1 (4%)	2 (8%)	27 (22%)
4. All of the above	13 (52%)	8 (32%)	0 (0%)	12 (48%)	17 (68%)	50 (40%)
Suggestion on future training on farm mechanization:						
1. Focus on one or two machine and give a complete training on it	2 (8%)	4 (16%)	4 (16%)	0	1 (4%)	11 (8.8%)
2. Give preliminary ideas on all type of machine	13 (52%)	6 (24%)	8 (32%)	14 (56%)	4 (16%)	45 (36.0%)
3. Theory and practical class simultaneously	7 (28%)	13 (52%)	13 (52%)	11 (44%)	18 (72%)	62 (49.6%)
4. None of the above	3 (12%)	2 (8%)	0	0	2 (8%)	7 (5.6%)
Venue of Training:						
1.Research/teaching centre	7 (28%)	19 (76%)	11 (44%)	9 (36%)	3 (12%)	49 (39.2%)
2. Local ground/school/panchayat	11 (44%)	4 (16%)	8 (32%)	12 (48%)	18 (72%)	53 (42.4%)
3. District headquarter	1 (4%)	1 (4%)	1 (4%)	4 (16%)	0	7 (5.6%)
4. Sub-divisional headquarters	6 (24%)	1 (4%)	5 (20%)	0	4 (16%)	16 (12.8%)
Most acute problem in purchase of farm machine:						
1.Financial	25 (100%)	18 (72%)	25 (100%)	13 (52%)	14 (56%)	95 (76.0%)
2. Lack of technical knowledge	0 (0%)	4 (16%)	0 (0%)	7 (28%)	3 (12%)	14 (11.2%)
3. Fragmented land holding	0 (0%)	2 (8%)	0 (0%)	0 (0%)	3 (12%)	5 (4.0%)
4. Lack of awareness	0 (0%)	1 (4%)	0 (0%)	5 (20%)	5 (20%)	11 (8.8%)
Suggestions for rapid mechanization:						
1. Organize awareness training	12 (48%)	12 (48%)	20 (80%)	10 (40%)	9 (36%)	63 (49%)
2. Organize hire purchase system	2 (8%)	3 (12%)	3 (12%)	3 (12%)	1 (4%)	12 (9%)
3. Provide financial incentive	9 (36%)	4 (16%)	2 (8%)	11 (44%)	12 (48%)	38 (30%)
4. None of the above	2 (8%)	0 (0%)	0 (0%)	1 (4%)	3 (12%)	6 (5%)
Position regarding training knowledge sharing:						
1. Will pass this knowledge to your family member	2 (8%)	7 (28%)	10 (40%)	8 (32%)	8 (32%)	35 (27%)
2. Motivate your family member to take up farm mechanization	6 (24%)	6 (24%)	13 (52%)	5 (20%)	8 (32%)	38 (30%)
3. Train your neighbour	16 (64%)	12 (48%)	2 (8%)	11 (44%)	9 (36%)	50 (40%)
4. Not interested at all	1 (4%)	0 (0%)	0 (0%)	1 (4%)	0 (0%)	2 (2%)

Comparative analysis of pre and post-evaluation knowledge scores across districts

The effectiveness of farm mechanization training programme was measured by comparing the knowledge levels of participants before and after the intervention across five districts-Udalguri, Darrang, Nalbari, Baksa, and Goalpara. The results, presented in Table 2, show a significant improvement in knowledge scores following the training in all districts. The average knowledge scores increased notably in each with highest improvement in Baksa, where the mean score increased by 8.28, followed by Darrang (7.04) and Udalguri (6.76). Goalpara and Nalbari also showed improvements of 4.68 and 3.84 points, respectively. These gains suggest that the training was particularly effective in districts where participants had lower initial knowledge like Baksa district. All improvements were found to be statistically significant, with p-values less than 0.01, confirming the positive impact of the training intervention. The t-values ranged from 6.80 in Nalbari to 14.03 in Baksa, indicating strong and consistent learning outcomes. The correlation coefficients between pre- and post-training scores varied across districts, reflecting differing levels of learning consistency among participants. Higher correlations in Darrang ($r = 0.73$) and Udalguri ($r = 0.49$) indicated more uniform improvement in farmers' knowledge. Conversely, lower correlations in Nalbari ($r = 0.16$) and Baksa ($r = 0.29$) suggested greater variability in individual learning, which could be attributed to differences in prior knowledge, interest, or exposure to mechanization practices.

These findings indicate that designing training programs tailored to district-specific learning needs and initial knowledge levels can significantly improve the effectiveness of capacity building efforts.

Table 2 : Comparative analysis of pre and post-evaluation knowledge scores across districts

District	Pre Mean Scores	Post Mean Scores	Mean Difference	Std. Deviation	Correlation	t-value	Sig. (2-tailed)
Udalguri	11.08	17.84	-6.76	3.35	0.49	-10.10	0.0
Darrang	12.08	19.12	-7.04	3.30	0.73	-10.68	0.0
Nalbari	13.76	17.6	-3.84	2.82	0.16	-6.80	0.0
Baksa	6.72	15.0	-8.28	2.95	0.29	-14.03	0.0
Goalpara	13.72	18.4	-4.68	2.27	0.45	-10.32	0.0

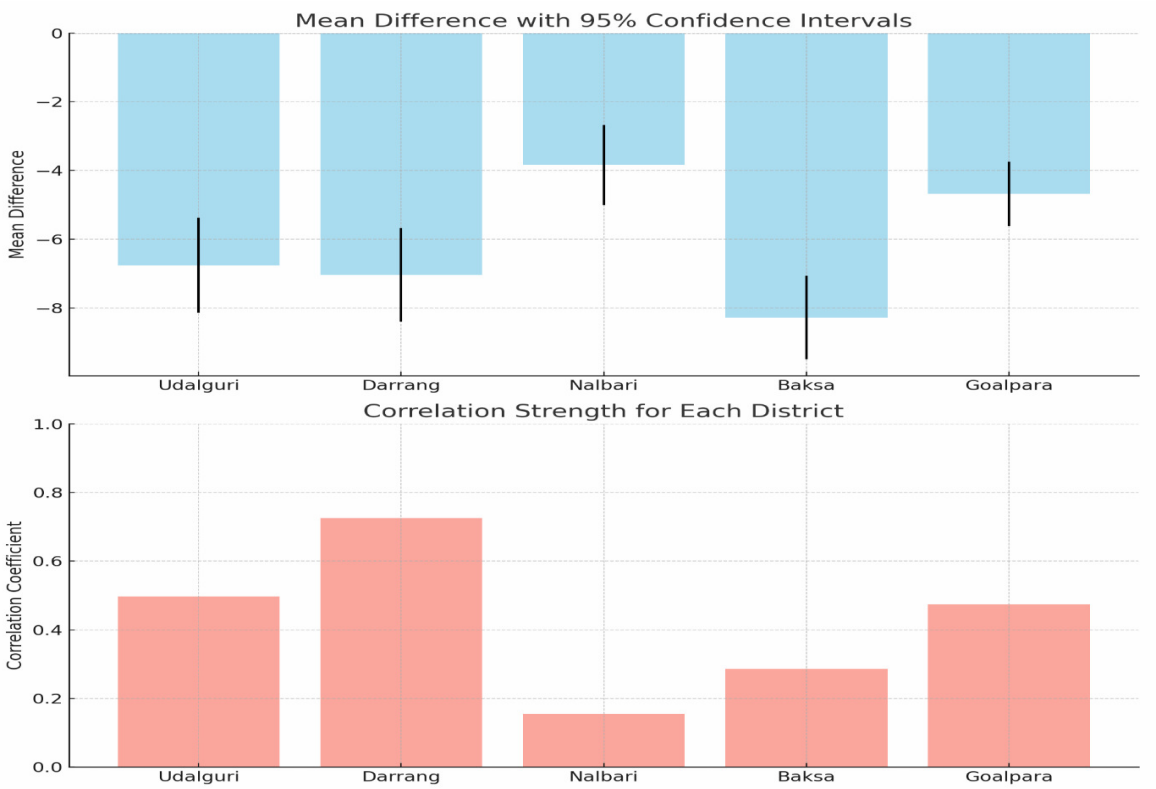

Fig. 1 : Mean knowledge improvement and correlation strength across districts

Knowledge level of respondents before and after training intervention

The training programme led to a notable improvement in the knowledge levels of participating farmers, as shown in Table 3. Prior to the intervention, a majority of respondents (55.2%) were in the high knowledge category, while 31.2% had medium knowledge and 13.6% were in the low category. This suggests that more than half of the farmers had some prior familiarity with farm mechanization concepts. Following the training, the proportion of respondents in the high knowledge category increased significantly to 84.0%, while the medium and low categories decreased to 14.4% and 1.6%, respectively. This shift clearly indicates the effectiveness of the training in enhancing participants' understanding.

The mean knowledge score increased from 11.47 (pre-training) to 17.59 (post-training). The coefficient of variation also dropped from 35.98% to 12.19%, reflecting improved consistency and a more uniform knowledge level among participants after the training. These results highlight the strong impact of structured training interventions in building farmers' capacity and narrowing knowledge disparities across diverse participant groups.

Table 3 : Knowledge level of respondent before and after training intervention (N=125)

Category	Pre-intervention (Before training)	Post-intervention (After training)
Low Knowledge Level (%)	13.6% (17 respondents)	1.6% (2 respondents)
Medium Knowledge Level (%)	31.2% (39 respondents)	14.4% (18 respondents)
High Knowledge Level (%)	55.2% (69 respondents)	84.0% (105 respondents)
Range	1 - 18	10 - 20
Mean Score	11.47	17.59
Standard Deviation (SD)	4.13	2.14
Coefficient of Variation (CV)	35.98%	12.19%

Discussion

The structured farm mechanization training given to 125 farmers in five districts of Assam significantly improved their knowledge, motivation, and willingness to adopt new practices. These results agree with other studies and successful extension efforts in Assam and support national programs like SMAM and FMTTIs that promote skill development and subsidized mechanization (Ministry of Agriculture and Farmers Welfare, 2025). About 43% of the participants reported being motivated in all aspects seeking new updates, purchasing equipment, and promoting mechanization in their local areas. This multi-dimensional motivation supports the observations reported by Ahmed *et al.* (2020); Parray *et al.* (2019), and Singh *et al.* (2023), who found that participatory and demonstration based programs greatly increase farmers' readiness to adopt mechanization. Comparable results were also noted in the CIAE, Bhopal training programs, where the combination of theory and practical sessions led to strong behavioural changes (ICAR-CIAE, 2019).

The preference for power tillers (36%) and brush cutters (32%) reflects their suitability to local farm structures and terrain. This observation is consistent with Singh *et al.* (2019), who reported that customized mechanization solutions for fragmented land holdings led to higher adoption rates. Similarly, a survey by Rajkhowa *et al.* (2020) in the North Bank Plains of Assam found that farmers preferred tools suited to field conditions, cropping patterns, and farm size. Most participants (86%) preferred a hybrid training pattern, favoring 3 to 7 days session that combined theoretical learning with practical experience. Similar approaches have been recommended by Deshmukh *et al.* (2016) and Roy *et al.* (2017) for improving learning effectiveness. ICAR-led mechanization programs also highlight that integrating theory and practical boosts participant engagement (ICAR-CIAE, 2019). Additionally, 42% of farmers chose local venues such as panchayat or school for training, supporting Ghosh *et al.* (2015), who noted that proximity increases attendance and peer learning. Community based training further strengthens peer support and encourages informal knowledge sharing (Sharma *et al.*, 2020). The training led to a statistically significant improvement in knowledge ($p < .01$), with the highest gain observed in Baksa (8.28), a district that initially had lower baseline scores. Similar results were reported by Mondal *et al.* (2021) in Assam, where on campus interventions achieved greater effectiveness. The correlation patterns indicate the importance of customized training models: districts with higher baseline knowledge, such as Darrang ($r = .73$), showed steady learning progress, while those with limited prior exposure (Baksa and Nalbari) exhibited more variation, a trend also noted by Nain and Chandel (2010). After the training, the coefficient of variation dropped sharply from 35.98% to 12.19%, reflecting a more even distribution of knowledge among participants. Kumar *et al.* (2018) similarly found that structured training programs help narrow learning gaps between different groups. Achieving such uniformity is key to inclusive capacity building and reducing rural disparities. However, 76% of participants identified financial constraints as the main challenge, highlighting ongoing affordability issues reported in earlier studies (Patel *et al.*, 2018). Singh *et al.* (2020) also noted that fewer than 10% of eligible farmers receive government subsidies, pointing to implementation gaps. Strengthening subsidy delivery and promoting custom hiring centres could significantly enhance mechanization adoption (Singh *et al.*, 2019; Singh *et al.*, 2020).

This study highlights the crucial need for demand driven, district specific training programs to promote farm mechanization in Assam. Enhancing farmers' technical knowledge, ensuring access to suitable machinery, and addressing financial limitations are key to improving agricultural productivity in the region. The results underscore the importance of decentralized, skill focused training initiatives that enable farmers to adopt and share mechanization practices effectively. Well designed training programs not only build individual capacity but also drive community wide progress toward sustainable and efficient farming systems in Assam.

Conclusion

The five days training conducted at ICAR-CPCRI, Kahikuchi, proved effective in enhancing farmers' understanding of farm machinery. The study highlights the crucial role of structured, location specific training in improving farmers' knowledge, motivation, and adoption of mechanization practices in Assam. Significant improvements in knowledge levels and positive perception changes across the five study districts -Udalguri, Darrang, Nalbari, Baksa, and Goalpara demonstrating the impact of hands on training and demonstration. The findings indicate not only greater interest in adopting suitable machinery such as power tillers but also a strong willingness among farmers to share knowledge within their communities. However, financial limitations remain a major obstacle to adoption, emphasizing the need for supportive measures like subsidies, accessible credit, and custom hiring centres. Overall, the study underscores that well designed training programmes,

supported by enabling infrastructure and financial mechanisms, are essential for promoting inclusive and sustainable mechanization in Assam, leading to improved agricultural productivity and rural livelihoods.

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