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Study on traditional practices and socio-economic realities of *Gossypium* spp. farmers in Nagaland

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Abstract
This study examines the socio-economic conditions and indigenous practices linked to cotton (*Gossypium* spp.) cultivation in Nagaland, India, emphasizing current status, key challenges, and revival prospects. A survey of 315 households from 20 villages across eight districts highlighted a significant decline in cotton farming due to low yields, limited market access, minimal mechanization, and lack of technical support. Despite these barriers, 85% of respondents expressed willingness to resume cotton cultivation if provided sufficient support. The dominance of traditional methods, limited use of modern techniques, and increasing reliance on non-farm income were also noted. Reviving cotton through targeted interventions, such as farmer training, improved inputs, and institutional support, could enhance rural livelihoods and preserve Nagaland's textile heritage.

Keywords: Nagaland, cotton cultivation, indigenous practices, rural livelihoods, textile heritage, socio-economic study

1. Introduction
Agriculture remains the backbone of India's economy, sustaining millions of rural livelihoods. In Nagaland, a state in India's northeastern region, agricultural development is challenged by rugged terrain, limited cultivable land, and varied climatic conditions, necessitating context-specific and adaptive farming strategies. (GOI, 2023)
Historically, cotton (*Gossypium* spp.) held both economic and cultural significance in Nagaland. It supported local textile production through community-based systems rooted in indigenous knowledge. Globally, cotton is a major cash crop, providing employment to millions and contributing substantially to trade. However, the sector faces increasing challenges such as declining profitability, rising input costs, pest pressures, and competition from synthetic fibres. Environmental concerns related to pesticide use and soil degradation have further accelerated the call for sustainable cultivation practices.
In Nagaland, resilient heirloom cotton varieties were once widely cultivated through polyculture systems and chemical-free methods. These practices fostered biodiversity, social cohesion, and ecological balance. Yet, recent decades have witnessed a sharp decline in cotton cultivation, attributed to synthetic substitutes, lack of institutional support, and inadequate market infrastructure.
While India remains a global leader in cotton acreage and ranks second in production, its productivity lags behind, currently ranked 39th worldwide. Nevertheless, cotton continues to be a strategic crop, supporting over 6 million farmers and nearly 50 million workers across its value chain. (ICAC, 2023) [4].
This study seeks to assess the present condition of cotton farming in Nagaland, identify key constraints, and explore strategies for its sustainable revival. By documenting indigenous practices and capturing farmer perspectives, the research aims to provide actionable recommendations that are economically viable and culturally rooted. (CCI, 2022)

2. Materials and Methods
2.1 Study Area
The study was conducted in 2023 by the North East Initiative Development Agency (NEIDA) across eight districts of Nagaland: Kiphire, Kohima, Peren, Phek, Mokokchung, Zunheboto, Tuensang, and Noklak. These districts were selected to capture agro-climatic,

socio-economic, and cultural diversity. A total of 20 villages under 16 administrative blocks were surveyed to ensure broad representation of cotton farming communities across different ecological zones.

2.2 Sampling Methodology

A mixed sampling strategy was employed, combining purposive and simple random sampling. This ensured the inclusion of both current and former cotton cultivators, allowing for comparative insights. A total of 315 households were selected across the 20 villages, providing a representative sample of farming practices and socio-economic conditions. The sampling design enabled robust analysis of regional variations in cotton cultivation.

Table 1: Distribution of Respondents According to Sample Coverage

Sl. No.	District	Block	Village	Total HH in the village	No. of respondents	% Taken for sampling	Total respondents (District)
1	Kiphire	Kiphire	Phelungre	208	27	12.98	40
		Pungro	Phuvkiuv	460	7	1.52	
			Mongtsuwong	62	2	3.23	
			Zhimkuir	220	4	1.82	
2	Kohima	Botsa	Gariphema	230	11	4.78	11
3	Peren	Peren	Peren Village	104	17	16.35	32
		Jalukie	Jalukie B Village	431	15	3.48	
4	Phek	Sekruzu	Yoruba	690	30	4.35	180
		Kikruma	Phusachodu	1690	30	1.78	
		Chizami	Sumi	112	40	35.71	
			Chizami	285	30	10.53	
		Meluri	Khumiasu	63	20	31.75	
			Meluri	66	30	45.45	
5	Mokokchung	Changtongya	Akhoya	235	1	0.43	2
		Ongpangkong	Khensa	426	1	0.23	
6	Zunheboto	Ghathashi	Lazami	654	22	3.36	22
7	Tuensang	Noksen	Longtang	145	5	3.45	10
		Sangsangnyu	Hakchang	366	5	1.37	
8	Noklak	Pathso	Pathso	472	10	2.12	18
		Noklak	Nokyan	376	8	2.13	
							315

2.3 Data Collection Methods

Household Survey: Structured questionnaires were administered to all 315 households. The tool included both closed and open-ended questions, covering:

a) Demographics (age, gender, household size, marital status)
b) Socio-economic status (education, income sources, occupation)
c) Agricultural practices (landholding, cropping patterns, input usage)
d) Assets and services (consumer goods, livestock, financial inclusion)

This approach enabled the collection of standardized quantitative data while allowing room for qualitative insights.

Secondary Data Review: A comprehensive review of relevant literature and official reports was undertaken, including:

a) Government policy documents and agricultural statistics
b) Academic publications on cotton farming in India and the Northeast
c) NGO reports, especially NEIDA's internal datasets
d) Historical and market records related to cotton pricing and yields

This secondary analysis helped contextualize primary data within broader institutional and policy frameworks. (MoT - GOI, 2022)

Field Observations: Direct observations were conducted across the selected villages to document traditional practices in cotton farming, harvesting, ginning, spinning, and weaving. These visits included informal interviews, photo documentation, and assessments of farm tools and textile processes, offering critical context to support survey findings.

2.4 Analytical Techniques

Data were compiled and analyzed using the following tools:

a) Microsoft Excel (Pivot Tables): Used for organizing data, computing percentages and averages, and visualizing trends across respondent groups.
b) SPSS (Statistical Package for the Social Sciences): Applied for descriptive statistical analysis, including means, standard deviations, and crosstabulations to compare findings across districts and blocks.

This dual-approach provided both flexibility and analytical rigor in interpreting the findings.

Results and Discussion

3.1 Demographic Characteristics of Respondents

The study surveyed 315 households across 20 villages in eight districts. All respondents belonged to Scheduled Tribes (ST), representing diverse indigenous groups such as Angami, Ao, Chakhesang, Chang, Khiamniungan, Pochury, Sangtam, Sumi, Yimkhiung, and Zeliang.

The highest representation was from Phek district (57%), followed by Kiphire (13%), Peren (10%), Zunheboto (7%), Noklak (6%), Kohima and Tuensang (3% each), and

Mokokchung (1%). This distribution reflects the diversity of cotton growing communities and provides a strong foundation for comparative regional analysis.

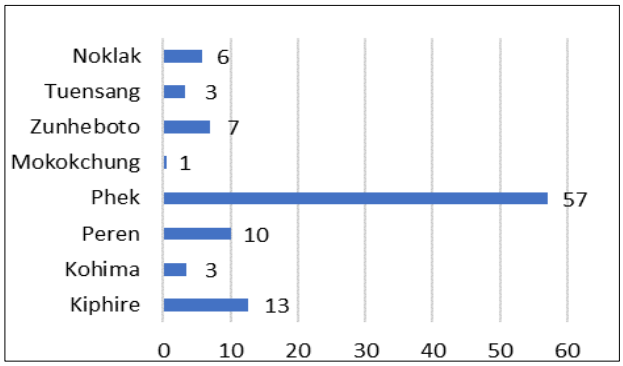

Fig 1: District wise distribution of respondents

3.2 Gender, Age, Family Size, and Marital Status

The respondent profile revealed a significant majority (92.70%) were female, indicating strong female participation in cotton related activities and household level decision making. Male respondents accounted for only (7.30%) of the sample.

The average age of respondents was 56 years, suggesting a predominantly mature farming population. Household composition showed an average family size of five members, reflecting typical rural household structures in the region.

In terms of marital status, the vast majority of respondents were married (96.83%), while (2.86%) were unmarried and (0.32%) reported being separated. These figures provide insight into the social dynamics and stability of the surveyed communities.

Table 2: Gender, Age, Family Size and Marital Status

Sl. No	Characteristics		N (%)
1.	Gender	Male	23 (7.30)
		Female	292 (92.70)
2.	Average Age		56 years
3.	Average Family Size		5 Members
4.	Marital Status	Married	305 (96.83)
		Unmarried	9 (2.86)
		Separated	1 (0.32)

3.3 Caste Composition and Socio-Economic Status

All 315 respondents (100%) belonged to Scheduled Tribes (ST), consistent with Nagaland's tribal demographic profile. This highlights the need for culturally sensitive approaches in agricultural development, particularly for interventions aimed at revitalizing cotton cultivation. (Census of India, 2011) [1].

In terms of economic classification

1. Below Poverty Line (BPL): 93.00%
2. Above Poverty Line (APL): 7.00%

The high concentration of BPL households underscores the economic vulnerability of cotton farming communities. This suggests that any revival strategy must integrate livelihood enhancement and poverty reduction components. (Planning commission, 2014) [11].

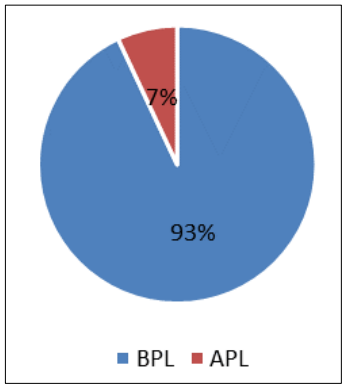

Fig 2: Socio-Economic Status (%)

3.4 Educational Profile

The educational attainment of respondents reveals a predominance of low formal education levels:

1. Illiterate: 31.75%
2. Literate without formal schooling: 10.48%
3. Primary education (Class 1-4): 12.70%
4. Middle school (Class 5-7): 15.56%
5. High school (Class 8-10): 19.86%
6. Higher secondary (Class 11-12): 5.08%
7. Graduates: 0.63%
8. Below primary: 3.49%

These figures indicate that the majority of cotton farmers possess limited educational qualifications, which may restrict access to modern agricultural knowledge, market awareness, and formal training programs. This further reinforces the need for simplified, practical extension strategies tailored to the local context.

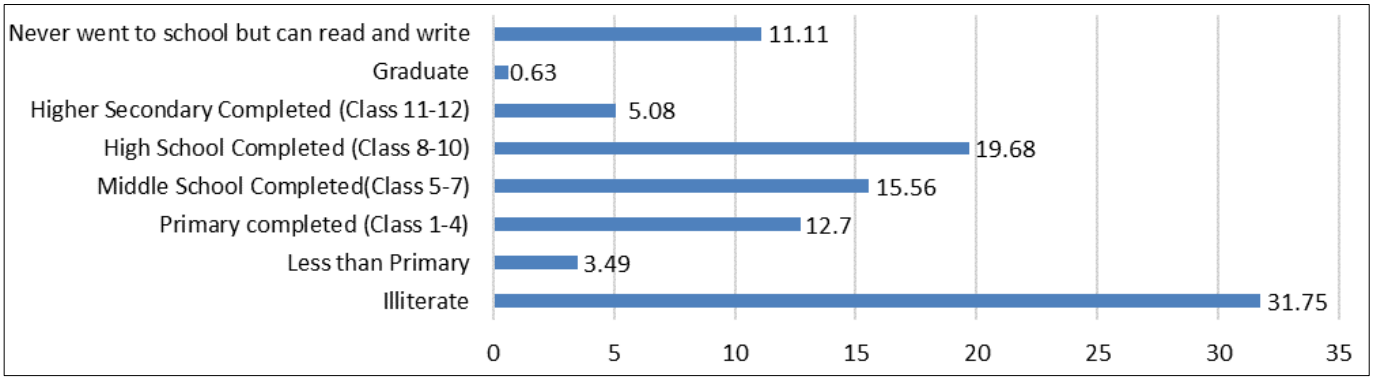

Fig 3: Educational Profile

3.5 Occupation

The economic profile of the surveyed households reveals a strong dependence on agriculture as the primary source of livelihood. A substantial 85.00% of respondents identified farming as their main occupation, underscoring the agrarian nature of rural communities in Nagaland.

Other sources of income included

1. Small businesses - 6.00%
2. Remittances - 4.00%
3. Government employment - 2.00%
4. Animal husbandry - 2.00%
5. Private sector employment - 1.00%

These figures highlight limited diversification in income generating activities, with minimal engagement in formal or private sector jobs. The data suggests that strengthening agricultural support systems and promoting allied activities could be key to enhancing rural livelihoods.

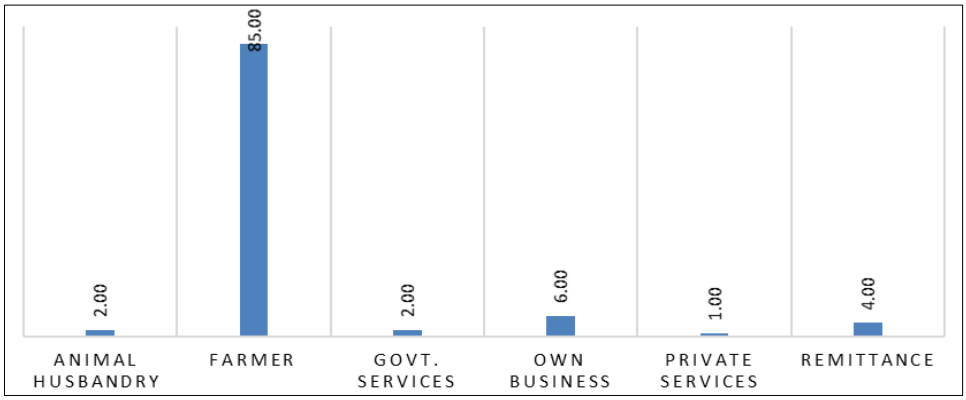

Fig 4: % Economic Activities

3.6 Household Income

The income analysis of the surveyed households reveals a strong dependence on non-agricultural sources. The average annual household income was ₹6,52,279.96, of which:

1. 83.00% originated from non-agricultural activities,
2. 10.00% from livestock-based income, and
3. 6.00% from crop production.

Within the non-agricultural segment, the most significant contributors were:

1. Government services - 36%
2. Remittances - 10%
3. Other sources included private employment, small businesses, daily wage labour, MGNREGA, and handloom activities.

Also, income from cotton cultivation was minimal, averaging only ₹5,125.00 annually just 1.00% of total household income. This stark figure underscores the declining economic relevance of cotton farming in the region and highlights the urgent need for targeted interventions to revitalize the sector.

Table 3: Average Annual Income and % Contribution to Total Annual Income

Sl. No	Activity		Average annual income (Rs.)	% Contribution to Total Income
1	Crop production	Production of Vegetables, Fruits, Spices, Cereals and Pulses	49919.20	6.00
2	Livestock	Piggery, Poultry and Mithun	82269.84	10.00
3	Non-agricultural sector	Government Services	282600	36.00
		Private Services	69903.85	9.00
		Own Business	53773.58	7.00
		Daily wage (Agri Labour)	25750	3.00
		Daily wage (Non Agri labour)	48622.22	6.00
		MGNREGA	50000	6.00
		Handloom	40166.67	5.00
		Remittance	75963.64	10.00
		NFTP	5500	1.00
4	Cotton production	Raw cotton	5125.00	1.00

3.7 Landholding and Ownership

The baseline data indicates that the average landholding per household for agricultural use was 0.94 hectares, while land allocated for residential purposes averaged 0.15 hectares. Among the surveyed households:

1. 93.00% reported owning family held agricultural land,
2. 87.00% had residential land,
3. 3.00% did not own any agricultural land,
4. 1.00% had purchased agricultural land, and
5. 8.00% had purchased residential land.

Land ownership in Nagaland is deeply embedded in customary norms and traditions. Most village lands are held under communal ownership, managed collectively for the benefit of the community. These lands typically include forests, woodlands, and meadows used for gathering firewood and construction materials, and are not subject to sale under traditional customs (Nagaland State Land Resources Department, 2020) [10].

Clan owned lands also play a vital role, particularly in agriculture and resource gathering. Due to the close-knit

nature of Naga villages, even privately or clan owned lands are accessed and used with a strong sense of shared responsibility.

Individually or family-owned lands are considered private property and are commonly used for food crop cultivation, kitchen gardening, livestock rearing, and tree plantations. These lands are traditionally patrilineally inherited, with sons receiving ancestral property. Customary law restricts daughters from inheriting such land. Moreover, land sales are rare and, when necessary, are typically conducted within the extended family, following traditional consultation norms.

This unique land tenure system reflects the deep cultural ties of the Naga people to their land and presents both opportunities and constraints for agricultural development particularly in terms of individual investment and modernization of farming practices.

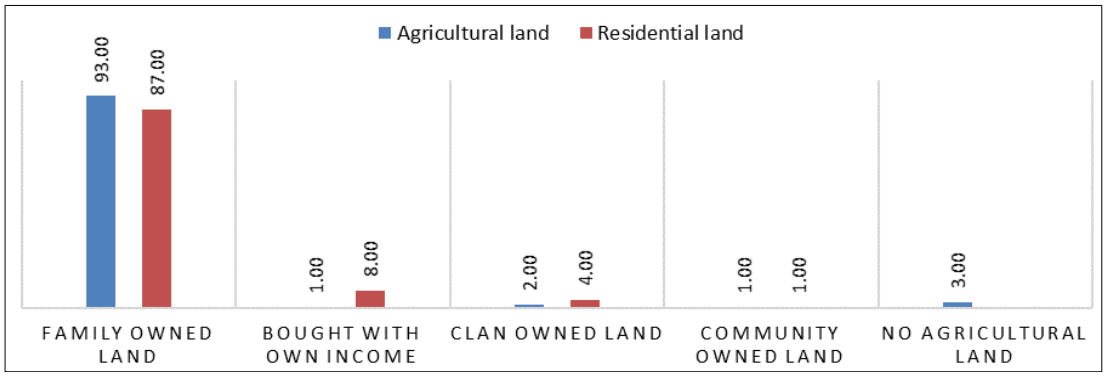

Fig 5: Description of Land Ownership

4. Cotton Cultivation and Practices

4.1 Current Status of Cotton Cultivation

The survey revealed that only 112 respondents (35.56%) were actively engaged in cotton cultivation, while a larger segment 203 respondents (64.44%) had discontinued the practice. Among the eight districts surveyed, cotton farming is currently practiced only in Noklak, Phek, and Tuensang.

Phek district accounted for the highest number of active cotton growers, with 105 respondents, representing 33.33% of the total sample. The average landholding under cotton cultivation across the study area was recorded at 1.06 acres per household.

These findings highlight the limited geographic spread and declining participation in cotton farming, underscoring the need for targeted interventions to revive and sustain cotton cultivation in Nagaland.

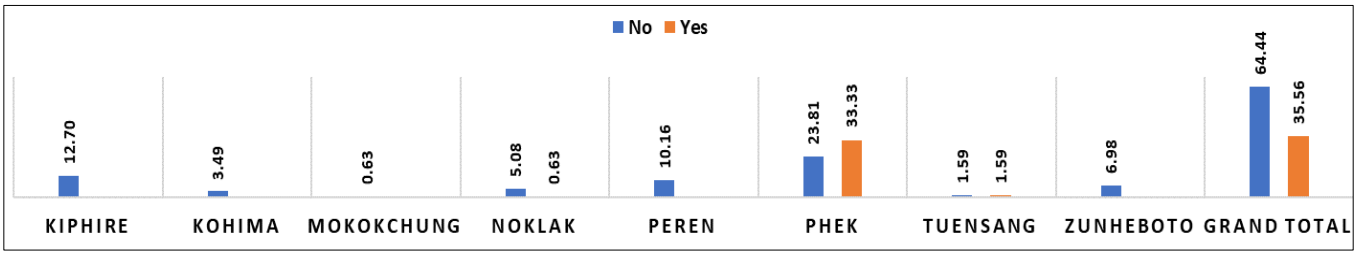

Fig 6: Distribution of Respondents Cultivating Cotton At Present

4.2 Years of Not Practicing Cotton Cultivation

Out of the 315 respondents surveyed, 203 individuals (64.44%) reported having discontinued cotton cultivation. Among these, a significant 64.00% had not practiced cotton farming for more than five years, indicating a long-term decline in engagement with the crop.

This extended period of non-cultivation reflects both structural challenges and shifting livelihood priorities, underscoring the need for targeted interventions to rekindle interest and rebuild capacity among former cotton growers.

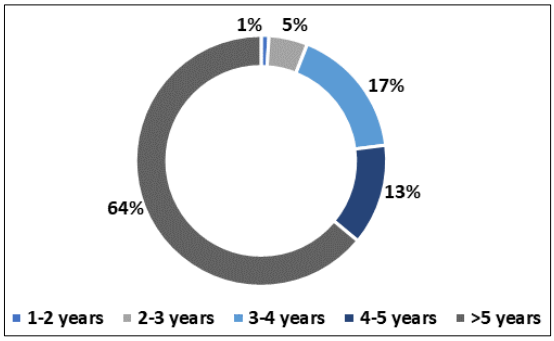

Fig 7: % No. of years not practicing cotton cultivation

4.3 Respondents' Conditional Interest in Cotton Cultivation

The survey findings reveal that a substantial proportion 85% of respondents from the study area expressed a willingness to engage in cotton cultivation, contingent upon the provision of external support. This support may encompass financial assistance, access to quality seeds, technical guidance, or infrastructural improvements aimed at revitalizing cotton farming in the region. The high level of conditional interest suggests that cotton cultivation remains a viable agricultural option, provided that enabling mechanisms are put in place to address existing barriers and incentivize farmer participation.

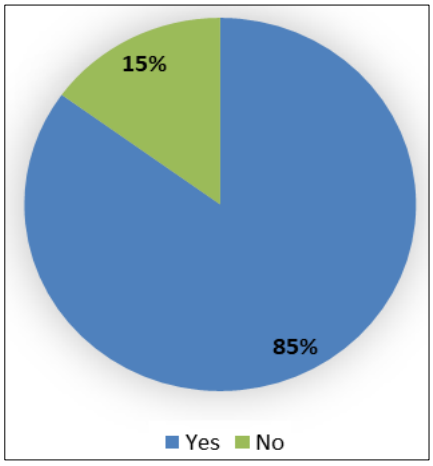

Fig 8: % HH Interested in Cotton Cultivation

4.4 Seed Type and Sourcing

Cotton cultivation in the study area is overwhelmingly reliant on traditional seed varieties. A significant 94.98% of respondents reported using heirloom, non-hybrid, open-pollinated cotton seeds, which have been preserved and passed down through generations. These seeds are well adapted to local agro-ecological conditions and reflect the deep-rooted agricultural heritage of the region (Kumar and Singh, 2018) [8].

Only 5.02% of respondents used perennial cotton varieties, specifically introduced in Yoruba village through the initiative led by Exotic Echo. This limited adoption of externally introduced or improved seed varieties highlights a strong dependence on traditional seed sources and suggests a lack of access to, or awareness of, modern alternatives that could potentially enhance productivity and resilience.

4.5 Procurement and use of Traditional Farm Tools

To address evolving socioeconomic and agricultural challenges, traditional farm tools and implements have been developed and refined over generations, drawing on local knowledge and experience. These tools, designed to support self-sufficient farming practices, are typically constructed from readily available materials such as stone, wood, and iron. They are either handcrafted by local artisans or produced as standardized factory-made implements.

Local craftspeople serve as the primary source for the supply, maintenance, and repair of these farming tools. In many villages, artisans are responsible for producing nearly all (approximately 100%) of the hand tools and traditional implements used in agricultural activities. Although the quality of these tools may be inconsistent, they are generally made from mild steel and repurposed scrap metal, which is forged and hardened through quenching techniques.

Despite their limitations, these tools are valued for their cost-effectiveness in terms of labour, financial investment, and time efficiency. Each implement is typically associated with a specific stage in the agricultural cycle, including land preparation, sowing, weeding, irrigation, harvesting, and post-harvest processing. Their continued use reflects both the adaptability of traditional practices and the resilience of local farming communities in the face of modern agricultural demands.

4.6 Training on Cotton Cultivation

The study revealed that none of the respondents (100%) had ever participated in any formal training related to cotton cultivation. This lack of exposure to structured learning opportunities highlights a critical gap in the dissemination of agricultural knowledge and best practices among cotton farmers in the region.

To enhance productivity and profitability, it is imperative that farmers receive targeted training aimed at updating their existing knowledge base and equipping them with modern cultivation techniques. Developing an effective training module requires a systematic assessment of the specific needs of cotton growers. Such a module should ensure that appropriate training is delivered to the right individuals, in a suitable format, and at an optimal time in the agricultural cycle. Addressing these training needs is essential for improving farm-level decision-making, adopting sustainable practices, and ultimately revitalizing cotton production in the region.

4.7 Labour Dynamics in Cotton Cultivation

In the context of cotton cultivation in Nagaland, labour is primarily sourced from within the household. Family members working on their own land are classified as family labour, while individuals either landed or landless who work on other farms for remuneration are considered hired labour. Given that cotton is typically cultivated on small-scale farms and primarily for subsistence purposes, the reliance on hired labour is minimal.

The study indicates that only 17.81% of respondents employed hired labour, whereas 82.19% relied exclusively on family labour for cotton farming activities. Labour is most commonly required during land preparation, weeding, and harvesting operations.

The declining availability of agricultural labour can be attributed to several socioeconomic factors. These include inter-sectoral labour migration, where individuals shift to non-farm sectors in pursuit of higher and more stable incomes, and out-migration to urban centres. Also, changing social dynamics and increased educational attainment among the younger generation have contributed to a reduced interest in agricultural work. These horizontal shifts toward secondary and tertiary sectors have led to a noticeable contraction in the agricultural labour pool.

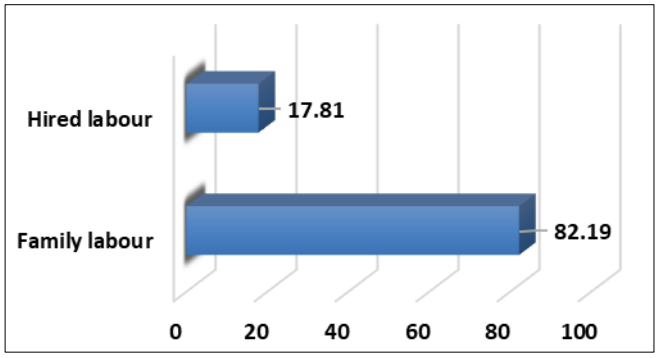

Fig 9: % Of Hired Workers

4.8 Sowing Practices in Cotton Cultivation

The study revealed that cotton farmers in the region predominantly employ two traditional methods of sowing: dibbling and broadcasting. Among the respondents, 53.42% reported using the dibbling method, wherein seeds are manually placed into holes at regular intervals, allowing for better spacing and depth control. In contrast, 46.58% practiced broadcasting, a technique involving the scattering of seeds over the soil surface, which is less labour-intensive but may result in uneven germination and plant distribution.

The preference for dibbling among a slight majority of farmers suggests an inclination toward precision in sowing, potentially linked to efforts to optimize plant growth and yield. However, the continued use of broadcasting reflects the persistence of traditional, labour-saving practices, especially in contexts where mechanization and technical support are limited.

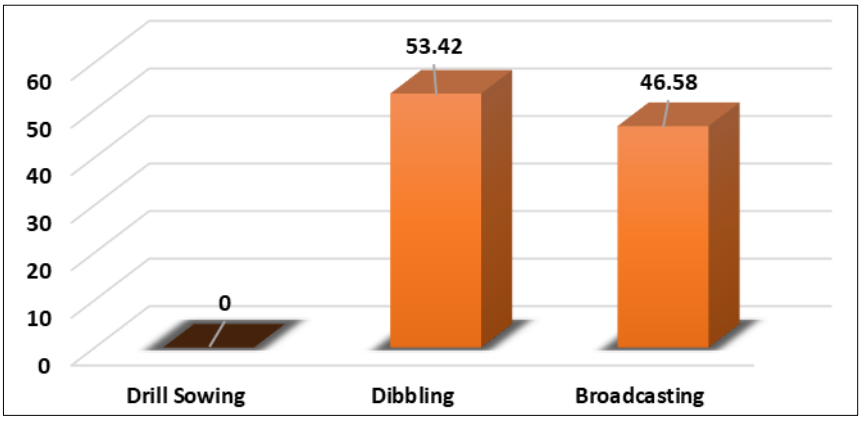

Fig 10: Sowing Method

4.9 Seed Rate and Spacing Practices

The study found that none of the respondents (100%) adhered to the recommended seed rate of 8-10 kg per acre or the standard spacing of 60 × 30 cm for cotton cultivation. Instead, 52.05% of farmers practiced random spacing, while 47.95% followed self-devised spacing patterns based on indigenous knowledge and experience.

Farmers reported uncertainty regarding appropriate seed rates and spacing, attributing this to a lack of extension services and technical guidance specific to cotton farming. In the absence of formal training or advisory support, traditional practices passed down through generations, continue to dominate sowing decisions. While these methods reflect local adaptation and resilience, they may not align with agronomic best practices, potentially affecting crop performance and yield (CICR, 2021).

4.10 Sowing Period

The study revealed that all respondents (100%) adhered to the recommended sowing period for cotton cultivation, which spans from March to May. This uniformity in sowing time reflects a strong alignment with traditional agricultural calendars and local climatic conditions.

Farmers attributed their timely sowing practices to informal knowledge-sharing networks, including guidance from progressive farmers, peer interactions, and accumulated experience over years of cotton farming. These community-based sources of information have proven effective in disseminating practical knowledge, compensating to some extent for the limited formal extension services available in the region.

4.11 Integrated Nutrient Management Practices

The study found that 100% of the cotton growers cultivated their crops without the application of any form of nutrients or manure, relying entirely on natural soil fertility. While this approach reflects traditional practices and low-input farming systems, it raises concerns regarding long-term soil health and crop productivity.

Soil health management is a critical component of sustainable agriculture. Healthy, biologically active soils are more resilient to environmental stresses such as drought and nutrient deficiencies, compared to poorly managed or degraded soils. The application of both inorganic fertilizers (e.g., urea, single super phosphate [SSP], muriate of potash [MOP]) and organic manures (e.g., farmyard manure [FYM], vermicompost, and other organic

amendments) plays a vital role in replenishing soil nutrients and enhancing productivity.

To achieve sustainable cotton production, the adoption of Integrated Nutrient Management (INM) is strongly recommended. INM involves the judicious combination of organic and inorganic nutrient sources to maintain soil fertility, improve crop yields, and reduce environmental impacts. Promoting awareness and training on INM practices among cotton farmers is essential for transitioning from traditional to more scientifically informed nutrient management strategies.

4.12 Awareness and Practice of Nipping in Cotton Cultivation

Nipping is a cultural practice in cotton cultivation that involves the removal of the apical portion of the plant, typically 5 to 6 cm of the terminal shoot to regulate vegetative growth and promote the development of lateral (sympodial) branches. This practice is generally recommended at around 95 days after sowing (DAS) for the main shoot and 105 DAS for sympodial branches, with the aim of enhancing plant architecture and improving yield potential.

However, the study revealed that none of the respondents (100%) were aware of the nipping technique, and consequently, no farmers practiced terminal shoot removal. This lack of awareness indicates a significant knowledge gap in crop management practices, which may be attributed to limited access to extension services and technical training.

The absence of nipping practices among farmers suggests an opportunity for targeted interventions through farmer education and demonstration programs. Promoting awareness of such agronomic techniques could contribute to improved crop performance and higher productivity in cotton cultivation.

4.13 Pruning Practices in Cotton Cultivation

Pruning in cotton cultivation involves the removal of excess branches and leaves approximately 45 cm above the soil surface, typically performed after harvest. This practice is particularly relevant for perennial cotton varieties, where pruning stimulates the emergence of latent buds from stem nodes, branches, and leaf axils within 10 to 15 days. These buds subsequently develop into sympodial branches within 40 to 50 days, contributing to the regeneration and continued productivity of the plant.

In cases of complete crop failure due to biotic or abiotic stress such as extensive bud and boll shedding pruning may be recommended even prior to harvest as a recovery strategy.

The study observed that pruning was practiced exclusively in perennial cotton, which was found only in Yoruba village under Phek district. Consequently, only 13.70% of respondents adopted pruning, while the remaining 86.30% cultivated annual cotton, where pruning is not applicable due to the crop's single-season lifecycle.

This limited adoption underscores the need for differentiated agronomic recommendations based on cotton type and local growing conditions. Extension efforts should consider promoting pruning techniques in areas where perennial cotton is viable, while focusing on alternative management strategies for annual varieties.

4.14 Weed Control Measures

The study revealed that 100% of the respondents relied exclusively on manual hand weeding as their primary method of weed control. This traditional approach, which involves the physical removal of weeds using basic hand tools, remains the most widely practiced and time-tested method, particularly effective against annual weeds that do not regenerate after uprooting.

The continued reliance on manual weeding reflects broader limitations in the adoption of modern agricultural mechanization within the study area. Geographical constraints such as steep slopes, small terraced plots, and undulating terrain pose significant challenges to the use of contemporary tools and machinery. As a result, farmers depend on locally produced traditional implements, crafted from readily available raw materials at relatively low cost.

The availability and efficient utilization of farm power play a crucial role in enhancing agricultural productivity. While mechanization is a key driver of agricultural development, its implementation

requires not only appropriate tools and energy sources but also terrain suitable technologies. In the context of the study area, promoting context-specific mechanization solutions such as lightweight, portable equipment adapted to hilly terrains could help bridge the gap between traditional practices and modern efficiency (Singh *et.al*, 2019).

4.15 Farmers' Perception of Insect Pests in Cotton Fields

The study revealed a low level of awareness among cotton farmers regarding insect pest issues, with 84.93% of respondents demonstrating limited understanding of pest related damage and its impact on cotton productivity. Only 15.07% of farmers were able to identify the damage caused by insect pests, indicating a significant knowledge gap in pest ecology and crop protection.

When asked about specific pest observations

1. 17.35% reported the presence of sucking pests, particularly leaf hoppers.
2. 32.88% observed bollworm infestations.
3. A majority of 49.77% did not observe any insect pests in their fields.

In terms of pest management practices

1. 56.62% of respondents did not employ any pest control measures, whether biological, mechanical, cultural, or chemical.
2. 43.38% managed pest incidence indirectly through weed control, which may offer limited effectiveness against targeted insect pests.

This lack of awareness and action is concerning, as insect pests especially sucking pests and bollworms can significantly reduce cotton yield and quality. The findings underscore the urgent need for farmer education and capacity building programs, particularly in Integrated Pest Management (IPM). IPM promotes eco-friendly, sustainable pest control strategies that minimize environmental harm and reduce dependency on chemical pesticides.

Improving extension services is critical to disseminating IPM knowledge and practices. Training programs should focus on:

1. Pest identification and life cycles.
2. Damage symptoms and thresholds.
3. Safe and effective control methods.
4. Risks associated with indiscriminate pesticide use.

Empowering farmers with scientific knowledge and practical tools can transform their perceptions and practices, leading to more resilient and sustainable cotton production systems (Kranthi, 2021).

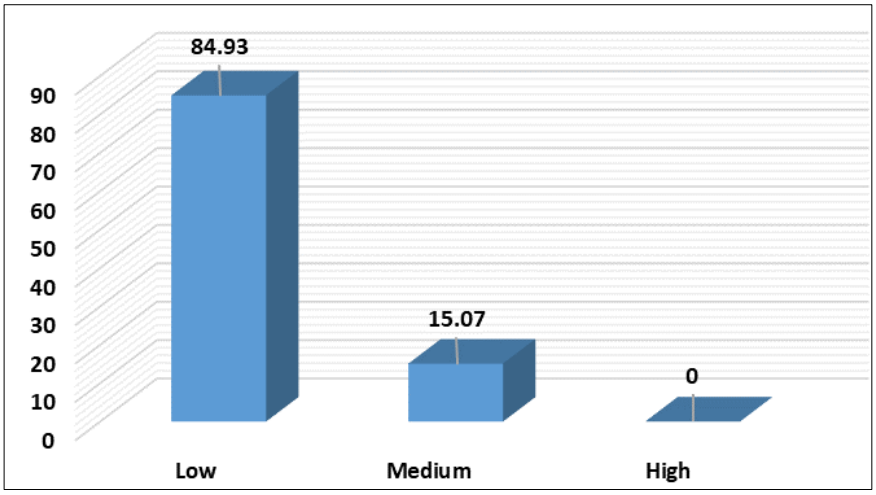

Fig 11: Pest Incidence Observed in Cotton

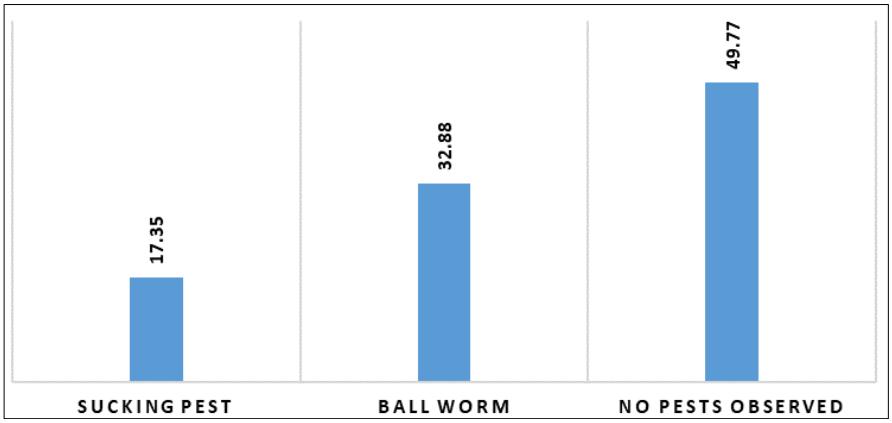

Fig 12: % Of Insect Pest Observed

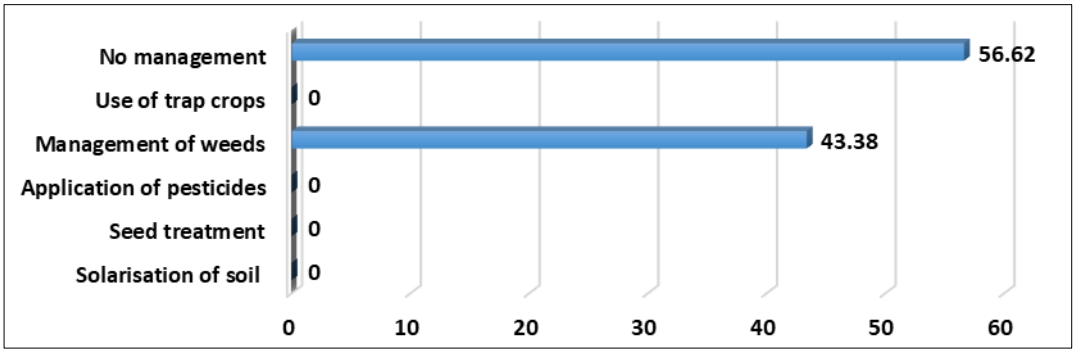

Fig 13: Pest Management Practices

4.16 Annual Yield of Cotton and Implications for Productivity Enhancement

The study revealed that the average annual yield of cotton in the region was 12.00 kg/acre for annual cotton and 13.26 kg/acre for perennial cotton. These figures reflect low productivity levels compared to national averages, and highlight the instability in cotton production across the study area.

Yield variability is influenced by a combination of genetic, agronomic, and regional factors, and is not a fixed value. Advancements in crop management practices and varietal development can significantly alter yield potential over time. However, in Nagaland, the adoption of modern and adaptable technologies for cotton cultivation remains limited. This technological gap, compounded by social and infrastructural constraints, contributes to the persistent yield disparity.

To address these challenges and enhance sustainable cotton production, a multi-pronged strategy is recommended. This includes:

1. Varietal improvement through research and breeding programs.
2. Technology dissemination via extension services.
3. Capacity building initiatives such as:

- Exclusive meetings of cotton scientists.
- Intensive awareness campaigns.

- Extension worker training sessions.
- Informal farmer training and field demonstrations.
- Exposure trips and media outreach.
- Sharing of success stories from other cotton-growing regions.

Implementing these strategies either individually or in combination can significantly strengthen ongoing efforts to popularize cotton production technologies and improve yield outcomes in the region (CICR, 2022).

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6. Conclusion
The study reveals a significant decline in traditional cotton (*Gossypium* spp.) cultivation in Nagaland, driven by low productivity, lack of technical training, limited market access, and the absence of modern agricultural interventions. Despite these challenges, the historical and cultural significance of cotton in the region remains strong, with most respondents expressing a willingness to revive cotton farming if adequate support is provided. The findings highlight that cotton continues to be cultivated in limited areas, primarily using heirloom seeds and indigenous methods, but without scientific agronomic practices. Socio-economic data further indicates that the majority of households rely heavily on non-agricultural income, signalling a shift away from farming as a viable livelihood.
Revitalizing cotton cultivation in Nagaland requires an integrated approach, including the introduction of region-specific agronomic practices, training on sustainable production techniques, improvement in access to quality seeds and tools, and establishment of institutional linkages for processing and market development. Strengthening extension services and promoting the cultural value of indigenous textiles can further motivate communities to engage in cotton farming. With strategic intervention, cotton cultivation in Nagaland holds potential not only as a means of livelihood enhancement but also as a way to preserve and promote the region's unique cultural identity.

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