

# Agrarian Transition in Monpa Indigenous Farming Systems of Tawang District, Arunachal Pradesh: A Shift towards High-Value Crop Agriculture

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## Abstract:

Agriculture among the Monpa tribe of Tawang District, Arunachal Pradesh, has historically been characterized by indigenous farming systems adapted to the fragile mountain ecosystems of the Eastern Himalayas. These systems integrated crop cultivation, livestock rearing, forest resource utilization, and traditional ecological knowledge to ensure food security and environmental sustainability. However, recent decades have witnessed a significant agrarian transition driven by market integration, infrastructural development, state-led horticultural interventions, and changing livelihood aspirations. Traditional subsistence-based agriculture is increasingly being supplemented or replaced by commercial cultivation of high-value crops such as kiwi, apple, large cardamom, vegetables, medicinal plants, and floricultural products. This transformation reflects broader processes of agricultural commercialization and rural economic restructuring occurring across Northeast India.

The present study examines the nature, drivers, and implications of agrarian transition within Monpa indigenous farming systems. Drawing upon literature on agrarian change, indigenous agriculture, sustainable livelihoods, and mountain farming systems, the paper develops a conceptual framework linking market integration, policy interventions, technological change, and livelihood diversification with agricultural transformation. The analysis suggests that high-value crop agriculture has contributed significantly to household income enhancement, employment generation, and market participation. However, it has also introduced challenges related to biodiversity loss, erosion of traditional agricultural knowledge, increasing market dependence, and environmental vulnerability.

The study argues that sustainable agricultural development in Tawang requires balancing economic modernization with ecological conservation and cultural preservation. Strengthening indigenous knowledge systems, promoting climate-resilient farming practices, and enhancing value-chain support are essential for ensuring inclusive and sustainable agrarian transformation in the Eastern Himalayan region.



**Keywords:** Agrarian Transition, Monpa Tribe, Indigenous Farming Systems, High-Value Crops, Commercial Agriculture, Sustainable Livelihoods, Tawang District, Arunachal Pradesh, Eastern Himalayas.

## 1. Introduction

Agriculture remains one of the most important livelihood activities among indigenous communities inhabiting mountain regions across the world. In the Himalayan region, farming systems have evolved over centuries through continuous interaction between human societies and fragile ecological environments. These systems are characterized by remarkable adaptation to climatic variability, topographical constraints, and limited resource availability. Indigenous agricultural practices often combine crop cultivation, livestock management, forest resource utilization, and community-based institutions, thereby ensuring both livelihood security and ecological sustainability.

The Eastern Himalayan region of India represents one of the world's most significant biodiversity hotspots and is home to numerous indigenous communities possessing rich traditions of ecological knowledge and sustainable resource management. Among these communities, the Monpas of Tawang District in Arunachal Pradesh occupy a unique position owing to their distinctive cultural heritage, Buddhist traditions, and mountain-based agricultural practices. The Monpa community has historically practiced diversified farming systems that integrate cereal cultivation, horticulture, livestock rearing, and forest-based activities within a highly adaptive socio-ecological framework.

Traditional Monpa agriculture has been largely subsistence-oriented, focusing on crops such as barley, buckwheat, millet, wheat, maize, and potatoes. These crops were cultivated primarily for household consumption and were complemented by yak, sheep, cattle, and poultry rearing. Agricultural activities were deeply embedded within local cultural institutions, religious practices, and traditional ecological knowledge systems. Community cooperation, labour exchange arrangements, and customary resource management institutions played crucial roles in maintaining agricultural productivity and social cohesion.

However, the last two decades have witnessed profound transformations within the agrarian economy of Tawang District. Improved road connectivity, expansion of market networks, state-sponsored horticultural development programs, technological interventions, and rising consumer demand for horticultural products have contributed to significant changes in cropping patterns and livelihood strategies. Farmers are increasingly shifting from traditional subsistence farming toward the cultivation of commercially valuable crops such as kiwi, apple, large cardamom, vegetables, medicinal herbs, and ornamental flowers.

This transition reflects broader processes of agrarian change occurring across developing economies, where agricultural systems are becoming increasingly integrated with national and global markets. Agrarian transition generally refers to structural changes in agricultural production systems involving shifts from subsistence-oriented farming to market-oriented commercial agriculture. Such transitions are often associated with changes in land use, labour allocation, production technologies, income sources, and social institutions.

The emergence of high-value crop agriculture in Tawang has generated considerable economic opportunities. Horticultural crops often provide significantly higher returns per unit area than traditional cereal crops, enabling farmers to increase household incomes and diversify livelihood options.

Government initiatives such as the Mission for Integrated Development of Horticulture (MIDH), National Horticulture Mission (NHM), and state-level horticultural promotion schemes have further accelerated this transformation by providing planting materials, technical support, irrigation infrastructure, and market linkages.

Among the various high-value crops introduced in the region, kiwi cultivation has emerged as one of the most successful examples of agricultural diversification. Arunachal Pradesh has become India's leading producer of kiwi fruit, and districts such as Tawang and West Kameng have witnessed rapid expansion of kiwi orchards. Similarly, apple cultivation, protected vegetable farming, floriculture, and medicinal plant cultivation are increasingly contributing to rural incomes and employment generation.

Despite these positive developments, the agrarian transition also raises several important concerns. The replacement of traditional crop varieties by commercially oriented monocultures may contribute to declining agrobiodiversity and increased ecological vulnerability. Traditional agricultural knowledge systems, which have historically guided sustainable resource management practices, may gradually erode as younger generations adopt modern agricultural technologies and market-oriented production strategies. Furthermore, increasing dependence on external markets exposes farming households to fluctuations in prices, demand, and input costs.

Climate change introduces additional complexities to agricultural transformation in mountain regions. Changes in temperature patterns, precipitation regimes, and extreme weather events can significantly affect crop productivity and agricultural sustainability. While some high-value crops may offer opportunities for climate adaptation and income enhancement, they may also increase vulnerability if production systems become excessively specialized or market-dependent.

The growing importance of commercial agriculture in indigenous regions necessitates a deeper understanding of how agrarian transition affects livelihoods, culture, and environmental sustainability. Existing research on agriculture in Arunachal Pradesh has primarily focused on horticultural development, organic farming potential, and agricultural modernization. Comparatively less attention has been devoted to examining the broader implications of agricultural commercialization within indigenous farming systems and its consequences for traditional knowledge, social institutions, and ecological resilience.

The present study seeks to examine the agrarian transition occurring within Monpa indigenous farming systems in Tawang District, Arunachal Pradesh. Specifically, the study aims:

1. To examine the nature and drivers of agrarian transition from traditional subsistence farming to high-value crop agriculture among the Monpa community.
2. To analyse the socio-economic impacts of high-value crop cultivation on rural livelihoods and household income diversification.
3. To assess the sustainability implications of agricultural commercialization for indigenous knowledge systems, agrobiodiversity, and environmental resilience.

Through these objectives, the study contributes to the growing discourse on agricultural transformation, indigenous livelihoods, and sustainable mountain development in the Eastern Himalayas.

## **2. Literature Review**

### **2.1 Agrarian Transition and Agricultural Commercialization**

Agrarian transition refers to structural changes in agricultural systems resulting from technological advancement, market integration, policy interventions, and socio-economic transformation (Bernstein, 2010; Ellis, 2000). Agricultural commercialization has become a major component of rural transformation in developing economies, enabling farmers to diversify production and participate in market-oriented agriculture (Pingali, 2015). Studies in Northeast India indicate that commercialization has contributed to income growth and livelihood diversification but has also increased farmers' exposure to market risks and price volatility (Deb & Tiwari, 2022; Chakraborty & Roy, 2024).

Classical theories of agrarian change often focused on the transition from subsistence agriculture to market-oriented production. Contemporary studies extend this perspective by examining how globalization, rural development policies, and environmental change reshape agricultural systems in diverse socio-cultural contexts. Agricultural commercialization is frequently regarded as a central component of agrarian transition, involving increased production for markets rather than household consumption.

Research suggests that commercialization can generate significant economic benefits by increasing farm incomes, enhancing productivity, and promoting rural employment. However, commercialization may also produce unequal outcomes depending on access to resources, infrastructure, and markets. Smallholder farmers often face challenges associated with price volatility, market uncertainty, and rising production costs.

### **2.2 Indigenous Farming Systems and Traditional Ecological Knowledge**

Indigenous farming systems are founded upon locally evolved knowledge, resource management practices, and ecological adaptations developed over generations (Berkes, 2018). Traditional ecological knowledge contributes significantly to biodiversity conservation, climate adaptation, and sustainable agricultural production (Singh et al., 2022). In Himalayan regions, indigenous farming systems are characterized by crop diversity, mixed farming, and community-based resource governance mechanisms (Rai & Sundriyal, 2021).

Traditional ecological knowledge encompasses accumulated understandings, practices, and beliefs regarding relationships between living organisms and their environments. Indigenous knowledge systems play crucial roles in soil fertility management, crop selection, pest control, water conservation, and biodiversity preservation.

Studies across the Himalayan region indicate that indigenous agricultural practices contribute significantly to environmental sustainability and resilience. Diverse cropping systems reduce production risks, enhance ecosystem services, and support food security. Moreover, indigenous knowledge provides adaptive strategies for coping with climatic variability and ecological uncertainty.

Nevertheless, modernization and market integration increasingly challenge traditional farming systems. The adoption of commercial agriculture may reduce crop diversity, alter land-use patterns, and weaken community institutions responsible for resource management.

### **2.3 Mountain Agriculture in the Eastern Himalayas**

Mountain agriculture plays a critical role in sustaining livelihoods across the Himalayan region despite challenges associated with topographical constraints, climatic variability, and limited infrastructure (Jodha, 2005). Research indicates that diversification into horticultural crops has emerged as an

important livelihood strategy for mountain farmers seeking higher economic returns (Sharma, 2020; Das et al., 2023).

The Eastern Himalayas possess exceptional biological diversity and diverse agro-ecological zones suitable for a wide range of agricultural activities. Farming systems in the region often combine crops, livestock, forests, and common property resources within integrated livelihood frameworks.

Recent studies highlight increasing agricultural diversification within mountain regions as farmers respond to changing market opportunities and climatic conditions. High-value horticulture, organic farming, and niche agricultural products have emerged as important pathways for livelihood enhancement. However, researchers caution that commercialization should be pursued carefully to avoid ecological degradation and social exclusion.

## **2.4 High-Value Crop Agriculture in Arunachal Pradesh**

Arunachal Pradesh possesses significant potential for horticultural development due to its varied climatic conditions, rich biodiversity, and relatively low levels of chemical input use. Government policies have increasingly promoted horticulture as a strategy for rural development and poverty reduction.

Kiwi cultivation represents one of the most successful horticultural innovations in the state. Since its introduction, kiwi production has expanded rapidly, generating substantial economic returns for farming households. Similar trends are observed in apple cultivation, large cardamom production, floriculture, and vegetable farming.

Studies indicate that high-value crops contribute to income diversification, employment generation, and improved market integration. However, successful commercialization depends on access to infrastructure, extension services, quality planting materials, and efficient marketing systems.

## **2.5 Sustainable Livelihoods and Agricultural Transformation**

The Sustainable Livelihoods Framework provides a useful lens for understanding the impacts of agricultural transformation. According to this framework, livelihood outcomes are influenced by interactions among natural, human, social, financial, and physical capital assets.

High-value agriculture can strengthen livelihood assets by increasing income opportunities and enhancing market participation. Nevertheless, sustainability depends on maintaining ecological integrity and social resilience. Excessive dependence on commercial crops may increase vulnerability to market fluctuations and environmental shocks.

Recent scholarship emphasizes the importance of balancing economic development with environmental sustainability and cultural preservation. This perspective is particularly relevant for indigenous communities whose livelihoods and identities are closely connected to traditional land-use systems.

## **2.6 Research Gap**

Existing literature provides valuable insights into horticultural development, agricultural commercialization, and indigenous farming systems in Northeast India. However, limited research has systematically examined the broader agrarian transition occurring within Monpa indigenous farming systems of Tawang District. Most studies focus on specific crops or technological interventions rather than exploring how commercialization reshapes socio-economic relations, indigenous knowledge systems, and environmental sustainability.

Furthermore, there remains a lack of integrated conceptual frameworks linking market integration, policy interventions, livelihood diversification, and sustainability outcomes within indigenous mountain

agricultural systems. The present study seeks to address this gap by providing a comprehensive analysis of the drivers, processes, and implications of agrarian transition among the Monpa community.

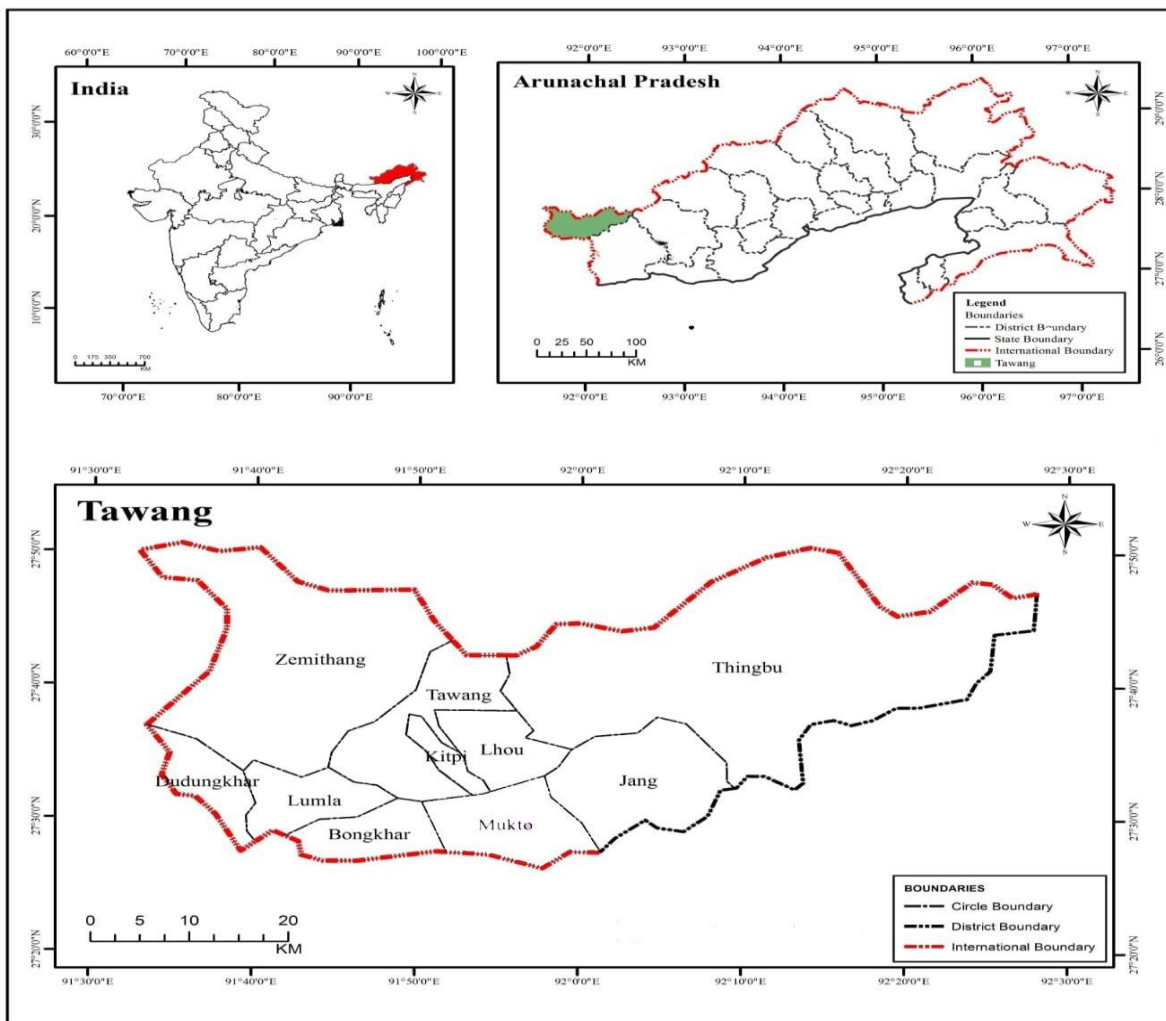
### 3. Study Area: Tawang District, Arunachal Pradesh

#### 3.1 Geographic Setting

Tawang District is located in the northwestern part of Arunachal Pradesh and shares international boundaries with Tibet (China) in the north and Bhutan in the west. The district occupies a strategic position within the Eastern Himalayan region and is characterized by rugged mountainous terrain, deep valleys, alpine meadows, and extensive forest cover. The district lies approximately between 27°30'N to 28°15'N latitude and 91°30'E to 92°40'E longitude, with elevations ranging from approximately 2,000 meters to over 6,000 meters above sea level (Government of Arunachal Pradesh, 2023).

The region experiences a cool temperate to alpine climate with substantial seasonal variation in temperature and precipitation. Annual rainfall ranges from 1,500 mm to 2,500 mm, largely influenced by the southwest monsoon. Snowfall is common in higher elevations during winter months and significantly influences agricultural calendars and cropping patterns (Sharma, 2020).

Figure 1. Location Map of Tawang District



Source: Prepared using GIS data from Survey of India and Government of Arunachal Pradesh.

### 3.2 Demographic and Socio-Cultural Characteristics

The district is predominantly inhabited by the Monpa tribe, one of the major Scheduled Tribes of Arunachal Pradesh. The Monpas practice Tibetan Buddhism and possess a rich cultural heritage reflected in their agricultural practices, community institutions, festivals, and traditional ecological knowledge systems (Bora, 2021).

Agriculture, livestock rearing, handicrafts, and increasingly tourism constitute the primary livelihood activities of the local population. The social organization of Monpa society historically facilitated collective labour arrangements, resource sharing, and community-based natural resource management, contributing significantly to agricultural sustainability (Singh et al., 2022).

### 3.3 Agricultural Potential

The agro-climatic diversity of Tawang supports cultivation of a wide range of crops including cereals, vegetables, fruits, medicinal plants, and fodder species. The district's cool climate and relatively low use of chemical inputs provide favorable conditions for organic agriculture and high-value horticulture development (ICAR, 2024).

Recent government interventions have promoted kiwi cultivation, apple orchards, floriculture, and protected vegetable production as strategies for livelihood enhancement and agricultural modernization.

## 4. Traditional Monpa Indigenous Farming Systems

### 4.1 Historical Evolution

The traditional farming systems of the Monpa community evolved through centuries of adaptation to mountain environments characterized by limited cultivable land, climatic uncertainty, and ecological fragility. These systems represent a complex integration of agriculture, livestock husbandry, forestry, and community-based resource management (Tiwari & Tripathi, 2017).

Agriculture among the Monpas was historically designed to maximize household food security while minimizing environmental degradation. Production decisions were guided not only by economic considerations but also by cultural norms, religious values, and ecological knowledge accumulated over generations (Rai & Sundriyal, 2021).

### 4.2 Cropping Systems

Traditional Monpa agriculture was dominated by subsistence-oriented mixed cropping systems. Farmers cultivated crops such as:

- Barley
- Buckwheat
- Wheat
- Maize
- Millet
- Potatoes
- Local vegetables

Crop diversification reduced production risks and enhanced resilience against climatic fluctuations and pest outbreaks (Maikhuri et al., 2001).

**Table 1: Major Traditional Crops Cultivated by Monpa Farmers**

Crop	Traditional Use	Agricultural Significance
Barley	Staple food	Cold climate adaptation
Buckwheat	Food and rituals	High-altitude suitability
Wheat	Household consumption	Food security
Millet	Traditional foods	Drought tolerance
Potato	Subsistence and market	Nutritional importance
Local vegetables	Household consumption	Dietary diversity

*Source: Compiled from field studies and secondary literature.*

### 4.3 Livestock Integration

Livestock constituted an integral component of Monpa farming systems. Yaks, cattle, sheep, goats, and poultry provided manure, milk, meat, wool, transportation, and draft power. The integration of crop and livestock production facilitated nutrient recycling and enhanced farm sustainability (Jodha, 2005). Seasonal migration of livestock to alpine pastures represented an important adaptation strategy that optimized utilization of mountain resources while reducing pressure on cultivated lands.

### 4.4 Indigenous Knowledge Systems

Traditional ecological knowledge played a central role in agricultural decision-making. Farmers possessed detailed knowledge regarding:

- Seasonal weather patterns
- Soil characteristics
- Seed selection
- Crop rotations
- Pest management
- Water conservation

This knowledge enabled efficient resource management and contributed to long-term agricultural sustainability (Berkes, 2018).

### 4.5 Emerging Challenges

Despite their resilience, traditional farming systems face increasing challenges due to:

- Labour shortages
- Youth migration
- Market integration
- Climate variability
- Declining profitability of subsistence agriculture

These factors have accelerated the transition toward commercial high-value crop production.

## 5. Methodology

### 5.1 Research Design

The study adopts a qualitative-conceptual research design supported by secondary data analysis. The approach is appropriate for examining broader patterns of agrarian transformation and understanding the socio-economic and environmental implications of agricultural change among indigenous communities.

### 5.2 Data Sources

Secondary information was collected from:

- Peer-reviewed journal articles
- Government reports
- Census publications
- ICAR reports
- Department of Horticulture statistics
- Books and monographs on Himalayan agriculture
- Indigenous knowledge literature

The study synthesizes information from multiple disciplinary perspectives including agricultural economics, rural sociology, geography, environmental studies, and indigenous studies.

### 5.3 Analytical Framework

The analysis is organized around four dimensions:

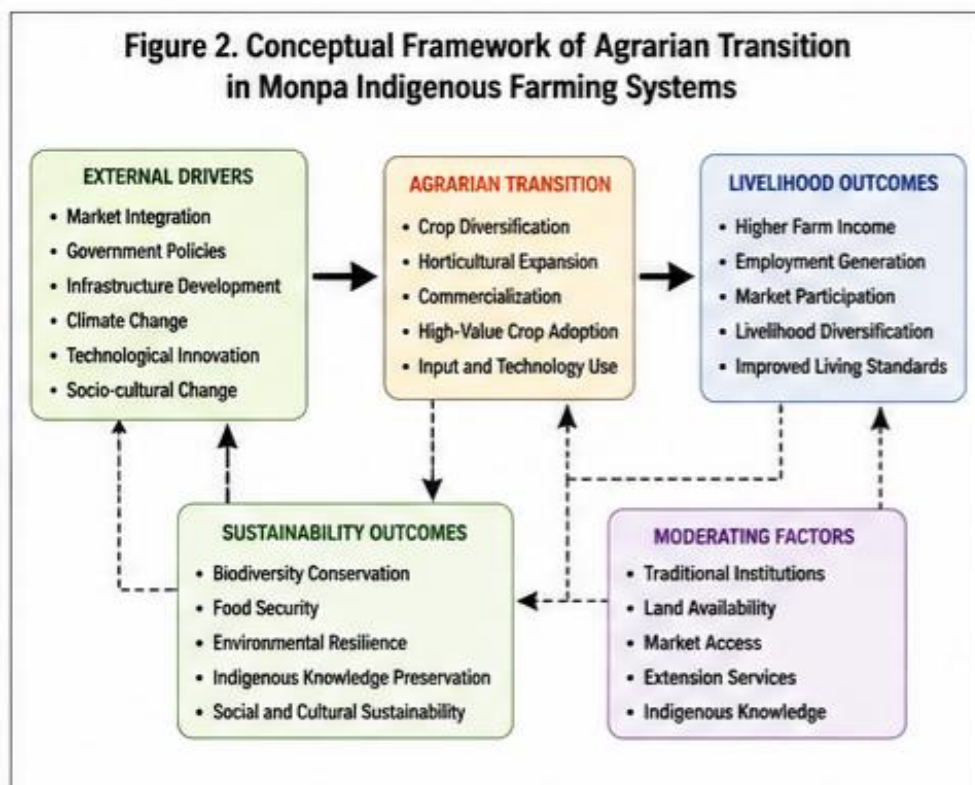
1. Traditional farming systems
2. Drivers of agrarian transition
3. Livelihood outcomes
4. Sustainability implications

A thematic analysis approach was employed to identify major trends and relationships within the literature.

### 6. Conceptual Framework

The conceptual framework illustrates how external drivers influence agricultural transformation among Monpa farming households and subsequently affect livelihood and sustainability outcomes.

Figure 2. Conceptual Framework of Agrarian Transition in Monpa Indigenous Farming Systems



The framework suggests that agricultural commercialization is shaped by both external drivers and local socio-cultural conditions. Sustainable outcomes depend on maintaining a balance between economic modernization and ecological resilience.

**Table 2: Drivers of Agrarian Transition in Tawang District**

Driver	Influence on Agriculture
Road Connectivity	Improved market access
Government Schemes	Promotion of horticulture
Technological Adoption	Improved productivity
Climate Variability	Crop diversification
Rising Market Demand	Expansion of high-value crops

**Table 3: Traditional Agriculture versus High-Value Crop Agriculture**

Dimension	Traditional Farming	High-Value Crop Agriculture
Objective	Subsistence	Commercial
Main Crops	Cereals and millets	Kiwi, apple, cardamom
Market Orientation	Low	High
Income Potential	Moderate	High
Input Requirement	Low	Moderate to High
Risk Type	Climatic	Climatic and Market

**Table 4: Potential Sustainability Impacts of Agrarian Transition**

Positive Impacts	Negative Impacts
Higher farm income	Biodiversity loss
Employment generation	Market dependency
Livelihood diversification	Traditional knowledge erosion
Horticultural development	Monocropping tendencies
Rural entrepreneurship	Price volatility

## 7. Findings and Discussion

### 7.1 Drivers of Agrarian Transition among the Monpas

The transformation of Monpa agriculture from subsistence-oriented production to commercially driven high-value crop cultivation is the result of multiple interconnected factors. Unlike abrupt agricultural modernization, the transition observed in Tawang District has evolved gradually through interactions among state policies, market opportunities, infrastructural development, demographic changes, and environmental conditions.

#### 7.1.1 Market Integration and Commercial Opportunities

One of the most significant drivers of agrarian transition in Tawang has been the increasing integration of local agriculture with regional and national markets. Historically, geographical isolation limited the commercial potential of agricultural production. Most households cultivated crops primarily for self-consumption, with limited surplus entering local markets. Improved transportation networks and expanding demand for horticultural products have substantially altered this situation.

High-value crops such as kiwi, apple, vegetables, and medicinal plants provide considerably higher economic returns compared to traditional cereals. Farmers increasingly perceive horticultural production as a viable pathway for improving household income and reducing economic vulnerability. The emergence of organized markets and growing consumer preference for organically produced fruits and vegetables have further strengthened incentives for commercialization.

The increasing monetization of rural economies has also encouraged households to diversify livelihood strategies. Agricultural production is no longer viewed solely as a means of food security but as a source of market income capable of supporting education, healthcare, housing improvements, and other household expenditures.

### **7.1.2 Government Interventions and Horticultural Promotion**

State support has played a crucial role in accelerating agricultural transformation. Government agencies have actively promoted horticultural development through the distribution of planting materials, farmer training programs, irrigation support, and technical assistance.

The promotion of kiwi cultivation represents one of the most visible examples of policy-driven agricultural diversification in Arunachal Pradesh. Improved varieties, extension services, and demonstration projects have encouraged widespread adoption among farming households. Similar initiatives have supported apple orchards, protected cultivation technologies, floriculture, and vegetable production.

Government efforts have also contributed to increased awareness regarding market-oriented farming practices, value addition, and entrepreneurship. These interventions have reduced entry barriers for farmers interested in adopting high-value crops and have facilitated broader participation in commercial agriculture.

### **7.1.3 Infrastructure Development**

Infrastructure development has significantly influenced agrarian transition in mountain regions. Improved roads, transportation services, communication networks, and market facilities have enhanced farmers' ability to access inputs and sell produce.

Historically, poor connectivity restricted agricultural commercialization due to high transportation costs and limited market access. Recent improvements have enabled farmers to transport perishable horticultural products to distant markets, thereby increasing profitability and reducing post-harvest losses.

Infrastructure expansion has also improved access to agricultural information, weather forecasts, extension services, and technological innovations, all of which contribute to agricultural modernization.

### **7.1.4 Climate and Agro-Ecological Advantages**

The agro-climatic conditions of Tawang provide favorable opportunities for cultivating temperate fruits and high-value horticultural crops. The district's altitude, temperature regime, and relatively low chemical input use create suitable conditions for organic and premium agricultural products.

As climatic conditions continue to change, farmers increasingly seek crops that offer higher returns and greater adaptability. Horticultural diversification is often perceived as a strategy for reducing livelihood risks associated with declining productivity of traditional farming systems.

## 7.2 Transformation of Cropping Patterns

One of the most visible indicators of agrarian transition is the changing composition of agricultural production. Traditional cereal-based systems are gradually being supplemented or replaced by commercially valuable crops.

### 7.2.1 Decline of Traditional Subsistence Crops

Traditional crops such as barley, buckwheat, millet, and wheat historically formed the foundation of Monpa agriculture. These crops provided food security and were closely linked to cultural traditions and local food systems.

However, several factors have contributed to declining cultivation of these crops:

- Lower market value compared to horticultural crops.
- Labour-intensive production practices.
- Changing dietary preferences.
- Increasing availability of market-purchased food grains.
- Expansion of commercial farming opportunities.

While traditional crops continue to be cultivated in some areas, their relative importance within household farming systems has diminished.

### 7.2.2 Expansion of High-Value Crops

The expansion of horticultural crops has emerged as the defining feature of contemporary agricultural transformation in Tawang.

Kiwi cultivation has gained particular prominence due to:

- Favourable climatic suitability.
- Strong market demand.
- Higher profitability.
- Government support.
- Relatively stable prices.

Similarly, apple orchards, vegetable cultivation, floriculture, and medicinal plant production have expanded significantly. These crops generate higher returns per unit area and provide opportunities for greater integration with commercial markets.

The transition toward horticulture reflects broader changes in farmer aspirations, production strategies, and economic priorities.

## 7.3 Livelihood Impacts of High-Value Crop Agriculture

### 7.3.1 Household Income Enhancement

Perhaps the most significant outcome of agricultural commercialization has been increased household income. High-value crops generally generate substantially greater economic returns than traditional cereals, enabling households to improve living standards and diversify expenditure patterns.

Income generated through horticulture contributes to:

- Educational investments.
- Healthcare access.
- Housing improvements.
- Agricultural reinvestment.
- Asset accumulation.

This trend aligns with broader evidence indicating that commercialization can serve as an important mechanism for rural poverty reduction and livelihood enhancement.

### **7.3.2 Employment Generation**

Commercial horticulture requires greater labour inputs for orchard establishment, crop management, harvesting, grading, packaging, and marketing. Consequently, agricultural diversification has created new employment opportunities within rural communities.

Employment benefits extend beyond farming households and include:

- Seasonal labourers.
- Transport providers.
- Traders.
- Input suppliers.
- Processing enterprises.

The emergence of agricultural value chains contributes to broader rural economic development.

### **7.3.3 Livelihood Diversification**

The transition toward commercial agriculture has facilitated livelihood diversification among Monpa households. Many families combine horticultural production with tourism, handicrafts, livestock rearing, and small businesses.

Diversification enhances livelihood resilience by reducing dependence on a single income source. This is particularly important in mountain environments characterized by environmental uncertainty and fluctuating market conditions.

## **7.4 Implications for Indigenous Knowledge Systems**

While commercialization has generated economic benefits, it has also influenced the transmission and application of indigenous agricultural knowledge.

Traditional Monpa farming systems relied heavily on locally adapted knowledge relating to:

- Crop diversity.
- Soil management.
- Seasonal calendars.
- Seed selection.
- Water conservation.
- Community resource governance.

The increasing adoption of commercial crops may reduce reliance on some traditional practices. Younger generations often exhibit greater interest in market-oriented production technologies than in traditional farming knowledge.

Nevertheless, indigenous knowledge continues to play an important role in managing local agro-ecosystems. Sustainable agricultural development should therefore seek to integrate traditional knowledge with scientific innovations rather than replacing indigenous systems entirely.

## **7.5 Environmental Sustainability and Agrarian Change**

### **7.5.1 Positive Environmental Outcomes**

Certain aspects of horticultural development may contribute positively to environmental sustainability.

Potential benefits include:

- Increased vegetation cover through orchards.
- Reduced soil erosion on slopes.

- Improved land productivity.
- Greater incentives for long-term land stewardship.
- Expansion of organic farming practices.

Given the relatively low use of chemical fertilizers and pesticides in many parts of Arunachal Pradesh, horticultural development may support environmentally friendly agricultural systems.

### **7.5.2 Emerging Ecological Concerns**

At the same time, commercialization may create environmental challenges.

Potential risks include:

- Declining agrobiodiversity.
- Expansion of monoculture production.
- Increased dependence on external inputs.
- Reduced cultivation of traditional crop varieties.
- Greater vulnerability to pest outbreaks and market shocks.

The replacement of diverse traditional farming systems with specialized commercial production can reduce ecological resilience and increase long-term sustainability risks.

### **7.6 Agrarian Transition and Sustainable Development**

The evidence suggests that agrarian transition among the Monpas cannot be understood solely as a process of economic modernization. Rather, it represents a multidimensional transformation involving changes in livelihoods, culture, ecological relationships, and social institutions.

The challenge for policymakers is to ensure that commercialization contributes to sustainable development without undermining the ecological and cultural foundations of indigenous farming systems. Future agricultural strategies should emphasize inclusive growth, biodiversity conservation, climate resilience, and the preservation of traditional ecological knowledge.

## **8. Policy Implications**

The findings of this study have several important policy implications.

### **8.1 Strengthening Sustainable Horticulture**

Government agencies should continue promoting high-value crops while ensuring environmentally sustainable production practices. Organic farming, climate-resilient technologies, and integrated pest management should receive greater emphasis.

### **8.2 Market and Value Chain Development**

Improved market infrastructure, cold storage facilities, transportation networks, and farmer cooperatives can enhance profitability and reduce marketing constraints.

### **8.3 Conservation of Indigenous Knowledge**

Policies should support documentation and transmission of traditional ecological knowledge. Indigenous agricultural practices should be incorporated into extension programs and educational initiatives.

### **8.4 Biodiversity Protection**

Programs promoting high-value crops should simultaneously encourage conservation of traditional crop varieties and agro-biodiversity.

### **8.5 Youth Engagement**

Agricultural entrepreneurship programs can attract younger generations to farming while supporting innovation and rural development.

## 9. Conclusion

The agrarian transition occurring within Monpa indigenous farming systems of Tawang District reflects broader processes of agricultural commercialization and rural transformation taking place across the Eastern Himalayas. Improved market access, infrastructural development, government interventions, and favourable agro-climatic conditions have encouraged the adoption of high-value crops such as kiwi, apple, vegetables, and medicinal plants.

The shift toward commercial horticulture has generated significant socio-economic benefits, including increased household income, employment opportunities, and livelihood diversification. However, the transition also presents challenges related to biodiversity conservation, market dependency, environmental sustainability, and the preservation of indigenous agricultural knowledge.

The study demonstrates that agrarian transition is not merely an economic phenomenon but a complex socio-ecological process involving interactions among markets, policies, cultural traditions, and environmental systems. Sustainable agricultural development in Tawang will require balancing commercialization with ecological resilience and cultural continuity. Integrating indigenous knowledge with scientific innovation offers a promising pathway toward achieving this objective.

## 10. Future Research Directions

The present study highlights several avenues for future research that can deepen understanding of agrarian transition and agricultural commercialization among indigenous communities in the Eastern Himalayas. First, there is a need for household-level empirical studies to quantitatively assess changes in income, expenditure patterns, asset accumulation, and livelihood security resulting from the adoption of high-value horticultural crops. Such studies would provide concrete evidence regarding the economic benefits and distributional impacts of agricultural transformation. Second, longitudinal research on land-use change and cropping pattern transformation is essential to understand how traditional agricultural landscapes are evolving over time and how these changes influence ecological sustainability and food security. Third, future investigations should explore the gender dimensions of agrarian transition, particularly the changing roles, responsibilities, and decision-making power of women within commercializing farming systems. Understanding gendered impacts is crucial for designing inclusive agricultural development policies.

Furthermore, research is required to examine the effects of climate change on high-value crop production, especially in fragile mountain ecosystems where shifts in temperature, precipitation, and extreme weather events may significantly affect agricultural productivity. Comparative studies across different indigenous communities of Northeast India would also be valuable in identifying common patterns and region-specific experiences of agrarian transformation. In addition, there is a need to evaluate the biodiversity implications of horticultural expansion, including its effects on traditional crop varieties, agroecosystem resilience, and conservation of indigenous genetic resources. Finally, future studies should focus on agricultural value chains, market linkages, and entrepreneurship opportunities associated with high-value crops to identify strategies for enhancing farmer incomes, reducing market risks, and promoting sustainable rural development. Collectively, these research directions can contribute to a more comprehensive understanding of the socio-economic, cultural, and environmental consequences of agrarian transition in indigenous mountain regions.

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