Revista Cubana de Ciencias Forestales

Volume 14, 2026, January-December

LIBER CIENCIA
EDITORIAL CIENTÍFICA
UNIVERSIDAD DE PINAR DEL RÍO

UNIVERSIDAD DE PINAR DEL RÍO
HERMANOS SAÍZ MONTES DE OCA

CFORES
REVISTA CUBANA DE CIENCIAS FORESTALES

ISSN: 2310-3469 RNPS: 2347
CFORES Journal, January-December, 2026; Volume 14: e984

Review article

Agroforestry for socioclimatic resilience in temperate zones of the Sierra Norte de Puebla, Mexico

Agroforestería para la resiliencia socioclimática en zonas templadas de la Sierra Norte de Puebla, México

Agrofloresta para resiliência socioclimática em zonas temperadas da Sierra Norte de Puebla, México

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Received: *24/03/2026.*
Approved: *05/05/2026*

ABSTRACT

The Sierra Norte de Puebla, Mexico, faces accelerated degradation of its forest resources due to illegal logging, forest fires, and land-use changes, jeopardizing its socioclimatic stability. The agroforestry systems practiced in the region have been displaced, and their adoption at various scales remains limited due to insufficient integration of public policies, rural financing, and traditional ecological knowledge. The objective of this narrative review was to analyze the available literature on the importance of agroforestry in the temperate zones of the Sierra Norte de Puebla, in order to describe its contribution to ecological stability, food security, and livelihood adaptation to climate variability. The region supports pine-oak forests, montane cloud forests, and riparian forests. It faces significant pressures from deforestation, land-use change, and extractive

activities that threaten to erode the socioclimatic resilience of its communities. The predominant agroforestry practices include the incorporation of forest and fruit trees on farmland, in homegardens , in silvopastoral systems, and on terraces, particularly on plots smaller than 1 ha. Agroforestry represents a productive tradition that warrants technical improvement, as it reduces soil loss, enhances fertility, regulates the hydrological cycle, and diversifies rural incomes. It is concluded that community governance and the integration of traditional knowledge are decisive for this production model to be recognized as a territorial strategy for climate change adaptation and mitigation.

Keywords: agroforestry, pine-oak forest, socio-climatic resilience, terraces.

RESUMEN

La Sierra Norte de Puebla en México, enfrenta una acelerada degradación de sus recursos forestales debido a la tala clandestina, incendios forestales y cambios de uso de suelo; lo que compromete su estabilidad socioclimática. Las formas de agroforestería (AF) que en la región se desarrollan, han sido desplazadas y su adopción a diferente escala es limitada debido a la pobre articulación entre políticas públicas, financiamiento rural y desconocimiento ecológico. El objetivo de esta revisión fue analizar la literatura disponible sobre la importancia de la agroforestería (AF) en las zonas templadas de la Sierra Norte de Puebla, con el fin de describir su contribución a la estabilidad ecológica, la seguridad alimentaria y la adaptación de los medios de vida frente a la variabilidad climática. La región posee bosques de pino-encino, mesófilo de montaña y ribereños, y enfrenta presiones significativas que, derivadas de la deforestación, cambio de uso de suelo y proyectos extractivos, deterioran la resiliencia socioclimática de sus comunidades. La AF predominante incluye árboles forestales y frutales en tierras de cultivo, huertos caseros, silvopastoreo y terrazas; en parcelas menores de 1 ha. La AF es una tradición productiva que debe mejorarse en cuestión técnica, ya que reduce la pérdida de suelo, mejora la fertilidad, regula el ciclo hidrológico y diversifica los ingresos rurales. Se concluye que la gobernanza comunitaria y la integración del

conocimiento tradicional son determinantes para que este modo de producción sea visto como una estrategia territorial de adaptación y mitigación del cambio climático.

Palabras clave: agroforestería, bosque pino-encino, resiliencia socioclimática, terrazas.

RESUMO

A região da Serra Norte de Puebla, México, enfrenta uma degradação acelerada de seus recursos florestais devido à exploração madeireira ilegal, a incêndios florestais e a mudanças no uso da terra, o que compromete sua estabilidade socioclimática. Os sistemas agroflorestais desenvolvidos na região foram preteridos, e sua adoção em diferentes escalas permanece limitada em razão da insuficiente integração entre políticas públicas, financiamento rural e conhecimento ecológico tradicional. O objetivo desta revisão narrativa foi analisar a literatura disponível sobre a importância da agrofloresta nas zonas temperadas da Sierra Norte de Puebla, a fim de descrever sua contribuição para a estabilidade ecológica, a segurança alimentar e a adaptação dos meios de vida frente à variabilidade climática. A região abriga florestas de pinheiros e carvalhos, florestas nebulares de montanha e matas ciliares, e enfrenta pressões significativas decorrentes do desmatamento, das mudanças no uso da terra e de atividades extrativistas que ameaçam a resiliência socioclimática de suas comunidades. As práticas agroflorestais predominantes incluem a integração de árvores florestais e frutíferas em terras agrícolas, quintais, sistemas silvipastoris e terraços, especialmente em parcelas menores que 1 ha. A agrofloresta representa uma tradição produtiva que requer aprimoramento técnico, pois reduz a perda de solo, aumenta a fertilidade, regula o ciclo hidrológico e diversifica a renda rural. Conclui-se que a governança comunitária e a integração do conhecimento tradicional são decisivas para que esse modelo de produção seja reconhecido como uma estratégia territorial de adaptação e mitigação às mudanças climáticas.

Palavras-chave: agrofloresta, floresta de pinheiros e carvalhos, resiliência socioclimática, terraços.

INTRODUCTION

The Sierra Norte de Puebla (SNP) is of great ecological importance in Mexico due to its high biodiversity, water regulation, and contribution to climate change mitigation. Geographically, the SNP is very large (5,000 km² with 68 municipalities and 635 localities). It is a biological corridor that supports multiple forms of agroforestry (AF), making it fundamental for regional water security, climate stability, and the continuity of ecological processes at the landscape scale (Muthuri *et al* ., 2023).

The temperate region of the SNP harbors humid mountain ecosystems; these environments support diverse species of biological importance. For this study, an altitudinal range of 1,400–2,500 m was chosen (below 1,400 m tends to be warm and humid, and above 2,500 m tends to be cold). The biogeographical criteria considered were the forest types present in pine-oak forests, montane cloud forests, and riparian forests. The climatic criteria included locations with annual rainfall of 1,200–1,500 mm and an average annual temperature of 12–18 °C. This delimitation was adopted as an operational criterion to standardize the interpretation of studies reviewed over the past ten years.

The SNP faces significant pressures stemming from deforestation for agricultural use, illegal logging, crop expansion, and at least 12 extractive projects (gold, silver, feldspar, gas, and oil) that pollute water resources and generate socio-climatic conflicts in communities (Manriquez-Bucio *et al*., 2018). These dynamics have led to loss of vegetation cover, soil degradation, and increased vulnerability to hydrometeorological phenomena such as heavy rains, landslides, and forest fires; in 2023, 8,500 hectares were affected, and in 2024 the figure rose to 29,000 hectares (CONAFOR 2024). Although community initiatives exist that protect the cloud forest through afforestation, ecological degradation persists and demands conservation strategies and community governance.

From an economic perspective, the region is characterized by small-scale family farming rooted in local customs and traditions. Productive diversification and the integration of trees, crops, and livestock increase productivity in the short, medium, and long term (Ntawuruhunga. *et al*., 2023). These forms of production are convenient in mountainous

territories where landscape fragmentation and pronounced altitudinal gradients characterize land use (Manriquez-Bucio *et al*., 2018).

Agroforestry (AF) is a land-use system in which perennial woody species (trees and shrubs) are integrated with agricultural crops and/or livestock on the same land area to obtain products, byproducts, and services in a staggered and continuous manner throughout the year. The tree component is irreplaceable by non-woody species such as bananas, bamboo, papaya, palms, cacti, and/or agaves, whose biological and productive functions are very different. As a scientific discipline rooted in forestry and agriculture, AF has been practiced in Mexico since pre-Hispanic times.

Forestry requires strategies and technologies that surpass current traditional practices. Its proper management aims for higher yields and reduced inter- and intraspecific competition among its components (trees, agricultural crops, and livestock), which interact with humans and their environment in a system with inputs (water, solar energy, nutrients, and agricultural inputs) and outputs (products, byproducts, and services) (Escamilla *et al*., 2026). The presence of trees promotes carbon sequestration and improves soil fertility, while the use of tree foliage in silvopastoral systems and the reduction of external inputs contribute to the conservation of functional biodiversity (Reppin. *et al*., 2020).

With proper management, simultaneous objectives can be achieved; for example, pruning woody perennials incorporates biomass into the soil. Removing aerial parts reduces tree competition, as it increases the growth of associated crops due to the incorporation of green manure; with greater solar energy input, root competition between crops and trees is reduced (Moreno *et al*., 2020). Forestry requires a complex understanding of the environment, agriculture, forestry, and the participation of the local population. Forestry in the region has undergone modifications attributed to climate change, the introduction of new species, and changes in land use. In the region, competition for water is more likely for any form of forestry than competition for solar energy, nutrients, and physical space, which depends on the type of drought and stress tolerance.

Forest management and community-based agroforestry initiatives have also been developed that conserve forests and strengthen sustainable practices that improve community governance. For example, agroforestry generates employment, reduces dependence on external inputs, and strengthens food security in highly marginalized areas (Aguilar-Luna *et al*., 2023). Ecological restoration through agroforestry can represent a key strategy for stabilizing food security, contributing to emissions reduction, and minimizing the degradation of natural resources (Quandt *et al*., 2023).

The purpose of AF is to solve rural problems by increasing yields, safeguarding fuel supplies, producing timber and forest raw materials, increasing production, appropriately intensifying land use, improving socio-economic conditions through job creation, and developing systems compatible with local cultural life (Jayakody). *et al*., 2025). These characteristics are consistent with the regional need to move towards production models with low environmental impact and high ecological stability (Ghanbari and Sasanifar. 2025).

Evidence suggests that agroforestry in the Sierra Norte de Puebla integrates ecological restoration, sustainable resource management, and community strengthening as a territorial strategy for climate change adaptation and mitigation. These systems are socially, culturally, and economically acceptable for increasing the production of goods and services with specific levels of inputs and minimal environmental damage (Escamilla *et al*., 2026) . This convergence positions agroforestry as a model that responds to the region's environmental, economic, and cultural challenges. The objective of this narrative review was to analyze the available literature on the importance of agroforestry in the temperate zones of the Sierra Norte de Puebla, in order to describe its contribution to ecological stability, food security, and the adaptation of livelihoods to climate variability.

DEVELOPMENT

Ecological evidence

In the temperate zones of the SNP, the sustainable management of water, soil, and biodiversity is integrated into practices that balance the conservation of natural resources with the productive use of the land. Communities implement forest management practices with trees that promote diverse ecological mosaics while protecting species that contribute to soil stability and biological conservation. In the temperate region of the SNP, the main species of the genus *Pinus* are: *P. ayacahuite, P. cembroides, P. greggii*, *P. montezumae*, *P. oocarpa*, *P. patula*, *P. pringlei*, *P. pseudostrobus*, *P. sargentii*, and *P. teocote*. The main species of the genus *Quercus* are: *Q. affinis*, *Q. aliena*, *Q. candicans*, *Q. castanea*, *Q. crassifolia*, *Q. crassipes, Q. glabrescens*, *Q. laeta*, *Q. laurina*, *Q. obtusata* and *Q. rugosa*. The most important species in riparian forests are: *Alnus acuminata, Alnus jorullensis*, *Plantanus mexicana* and *Taxodium mucronatum*. Other important forest species include: *Abies religiosa, Acrocarpus fraxinifolius*, *Casuarina equisetifolia*, *Cupressus Arizona cypress*, *Cupressus lusitanica*, *Fraxinus udhei*, *Juniperus communis*, *Juniperus deppeana* , *Juniperus faccida*, *Juniperus Monticola* and *Liquidambar styraciflua*.

Tree components in pine-oak forests play a strategic role in climate mitigation, as they function as carbon reservoirs that extend into deep soil layers. Soil constitutes the main terrestrial carbon reservoir, so its conservation increases productivity and mitigation capacity (Ghanbari and Sasanifar. 2025). Reviews of AF in the face of climate indicate that it conserves biodiversity, improves soil quality and water regulation (Quandt *et al* ., 2023); which reinforces the capacity of production systems to recover from extreme events.

Trees in forested areas can perform essential ecological functions for soil protection and improvement: their leaf litter cushions the impact of rain, their canopy intercepts rainfall and reduces its velocity, their roots maintain soil structure, increase porosity and infiltration, and access nutrients in deep horizons (Moreno *et al*., 2020). At the physicochemical level, the incorporation of organic matter improves cation exchange and the availability of N, P, and K; nutrient recycling is optimized by mycorrhizae, and

nitrogen fixation occurs through both leguminous and non-leguminous species (Ghanbari and Sasanifar. 2025). Tree cover generates environmental benefits, which contribute to the recovery of the productive capacity of forest ecosystems in the SNP.

The reduction in wind speed, due to the effect of living barriers (linear agroforestry technology), decreases the evapotranspiration rate by up to 20%, as it mitigates drought stress in trees and crops (Ghanbari and Sasanifar. 2025). The shade of trees modifies the climate, as it reduces heat and temperature variations below their canopy by up to 3 °C (Quandt *et al*., 2023).

AF can contribute to reducing the negative impacts associated with conventional livestock practices and the use of agricultural inputs (Reppin *et al*., 2020). The use of tree foliage in animal feed, with species native to the region such as *Alnus acuminata, Alnus jorullensis*, *Buddleja cordata*, *Erythrina americana*, and *Hibiscus rosa- sinensis,* promotes biological regulation processes. Biological pest control systems and bio-inputs are increasingly common and specific solutions. Incorporating drought-tolerant species stabilizes production, reduces dependence on external inputs, and lowers pollutant emissions. Evidence suggests that agroforestry mitigates climate change, improves food security, and boosts the local economy (Quandt *et al*., 2023).

The interconnection between soil, water, biodiversity, and food production demands strategies that reduce the vulnerability of agroecosystems. In the SNP, forested areas and forest remnants are biological corridors for the dispersal of wildlife, as they use trees for shelter, food, and perches (Sanvicente-López *et al*., 2025). The adoption of practices such as crop diversification, organic soil management, restoration of degraded lands, and water harvesting is recognized as effective ways to increase socioclimatic resilience (Roy *et al* ., 2025) . Recent effects of climate change in the region have impacted agricultural and forestry production in recent years, thus reducing regional economic development (Reppin *et al*., 2020).

In Mexico, the Ministry of Agriculture; the National Forestry Commission; the National Institute of Forestry, Agricultural and Livestock Research; the Ministry of Environment and Natural Resources; and the National Commission for the Knowledge and Use of Biodiversity are allies of the agroforestry producer, since through them government

services are requested such as soil nutritional status, plant health and detection of flood zones, since drones with specialized sensors are used, among others.

Socioeconomic evidence

Productive diversification represents a strategic axis in the SNP: communities integrate family farming and community forest management in pine-oak, riparian, and montane mesophilic forests (Table 1). This integration distributes climatic and economic risks, reduces market uncertainty, and strengthens food security (Quandt *et al*., 2023). Vertical stratification of family farming helps increase the capture of water, solar energy, and nutrients; it captures carbon and stabilizes the system in the face of extreme events (Manaye. *et al*., 2021).

Table 1. *Examples of agroforestry in the temperate zones of the Sierra Norte de Puebla*

Municipality	**System**	**Most important trees**	**Ecological benefits**	**Economic benefits**	**Fountain**
Tetela de Ocampo	Forest management and trees on farmland.	*Pinus* spp. and *Quercus* spp.	Sustainable management with ecosystem services.	Wood.	Aguilar-Luna (2018) .
Caxhuacán	Family gardens	361 species including crops, fruit trees and forestry.	Ecological knowledge and ethnobiological heritage are preserved.	Food self-sufficiency, economic income and family well-being.	Castañeda-Guerrero *et al.* (2020) .
Zacapoaxtla and Cuetzalan	Cornfield interspersed with fruit trees and the Kuojtakiloyan	*Pinus* spp., deciduous fruit trees and coffee plants.	Water evaporation was 20-30% lower compared to a corn monoculture.	No data.	Moreno *et al.* (2020) .
Tlaola	Conversion from monocultures to agroforestry.	*Alnus acuminata, Erythrinaamericana, Juniperus deppeana, Pinus* spp., *Quercus* spp .	Restoration of the montane mesophilic forest.	Diversification of the family economy. The abandonment of agricultural plots was reversed.	Valencia-Trejo *et al.* (2020) .
Cuautempan and Tetela de Ocampo	Forest and fruit trees in farmland, home gardens, trees in pastures, multi-layered.	*Alnus acuminata, Citrus latifolia, Persea Americana, Pinus* spp., and *Quercus* spp.	No data.	The occupation of agricultural lands was: 40% crops, 35% fruit trees, 20% forestry and	Aguilar-Luna *et al.* (2023) .

				5% domestic animals.	
Chignahuapan and Aquixtla	Forest management and trees on farmland.	*Pinus* spp., *Quercus* spp .,	112 species were recorded: 13 medium and large mammals, 83 birds, 4 amphibians, and 12 reptiles.	No data.	Chávez-León (2024) .
Chignahuapan and Zacatlán	Trees in farmland, contour trees.	*Pinus* spp., *Quercus* spp., *Ligustrum lucidum,* fruit trees.	Gully prevention	Maintenance of living fences, diversification of their forestry economy.	López-González *et al.* (2024) .
Tetela de Ocampo	Apple-sheep silvopastoral.	*Malus domestica, Pinus* spp .,	The presence of animals increased the soil microbiome. Without animals, bacteria (20%), fungi (15%), and actinobacteria (25%) were reduced.	Economic diversification.	Aguilar-Luna *et al.* (2025) .

The advantages of agroforestry (AF) compared to other land uses include: increased organic matter and nitrogen, control of adverse conditions such as wind and evaporation, provision of shade and animal feed, reduced soil degradation, and availability of marketable products (Dossa *et al*., 2025). The presence of trees promotes nutrient recycling, increases species diversity, and provides posts, firewood, timber, fruit, and animal fodder. It achieves better use of vertical space, mimicking natural ecological patterns. It offers greater and higher-quality biomass, which efficiently recirculates nutrients from deeper soil layers due to the presence of the trees (Ghanbari and Sasanifar 2025 ; Escamilla *et al*., 2026).

Simultaneous family farming consists of the continuous integration of crops, timber trees, fruit trees, animals in pastures, and home gardens. Home gardens have multiple layers that maintain production throughout the year, supply basic family foods, and generate short- and long-term income through products from domestic animals, crops, and trees (Tilinti *et al*., 2024).

The deep roots of woody perennials access water and mineral resources inaccessible to annual crops, maintain production under adverse conditions (such as droughts) (Roy *et al*., 2025), and promote recovery after climatic disturbances (such as the 1999 floods in the SNP). Evidence suggests that agroforestry can improve economic profitability and increase biodiversity, soil quality, and carbon sequestration compared to monocultures (Muthuri *et al*., 2023).

Family farming can be functional, as it combines food productivity with environmental protection according to the sociocultural context (Jayakody. *et al* ., 2025) . Some examples are alley cropping of grasses, with at least one tree component and an annual crop. The intensive silvopastoral system, with at least one tree and two forage grasses (Reppin *et al*., 2020). In the SNP, the predominant features are pine-oak associations, animal associations with forest and/or fruit trees, agroforestry terraces, and the milpa system intercropped with fruit trees.

Conservation agriculture has been adopted in the SNP (National System of Protected Areas) due to the predominance of steep slopes, often exceeding 30–40% across much of its territory; this practice conserves soil and water (CONAFOR 2024). In this regard, Pichón-Rodríguez *et al*. (2023) concluded that agroforestry terraces can reduce soil loss by up to seven times compared to a forest site devoid of vegetation. Terraces are effective because they prevent surface runoff and soil loss on slopes ranging from 27 to 42%, offering a balance between the production of goods and the provision of environmental services such as habitat conservation and carbon sequestration (Manaye. *et al*., 2021).

The restoration of the agroforestry landscape is achieved through the incorporation of trees that improve the structure of the ecosystem, that favor the return of fauna and that restore ecological processes (Ghanbari and Sasanifar 2025). These attributes can make AF an adaptation strategy to cope with droughts and floods. AF is ecological and intensive; for example, in agroforestry terraces, the regeneration of degraded soils and the structural restoration of the landscape are promoted as a long-term ecological recovery mechanism (Pichón-Rodríguez *et al* ., 2023).

State reforestation programs complement these efforts, planting thousands of trees each year that restore degraded land cover and expand ecosystem services. Forestry helps increase productivity, diversify production, and preserve biodiversity by expanding forest cover and contributing to the reduction of greenhouse gas emissions (Ntawuruhunga *et al*., 2023). AF is promoted as a multipurpose and multifunctional system that generates simultaneous private and public goods.

Governance

Community forest governance is understood as the set of norms, institutions, and decision-making processes through which rural communities in the SNP (National System of Protected Areas) conserve and sustainably use their forest resources. This approach involves collective territorial control, forest-use planning, community monitoring, and the equitable distribution of benefits. It balances biodiversity conservation, the provision of ecosystem services, and local socioeconomic well-being (Dossa *et al*., 2025).

Forest management functions as a form of collective organization and environmental governance, as ejidos apply local knowledge, uses, and customs to increase forest cover (up to 8% in the SNP); they generate jobs and reduce youth migration (Ceballos-Pérez 2020). In Chignahuapan and Zacatlán, SNP, forest management constitutes mosaics with AF, where forest cover has grown 0.58% from 2003 to 2021, as a result of the collective appropriation by agrarian communities and territorial governance agreements based on collectivity (Vásquez-Maldonado *et al*., 2023).

Resource management faces daily pressures such as illegal logging, land-use change, and extractive projects, making the strengthening of governance and public policies essential. Building participatory community governance includes local networks, cooperatives, and producer organizations to strengthen collective decision-making capacities (Dossa *et al*., 2025). Governance increases local adaptive capacity by facilitating access to resources, technical knowledge, and financing for productive projects (Figure 1).

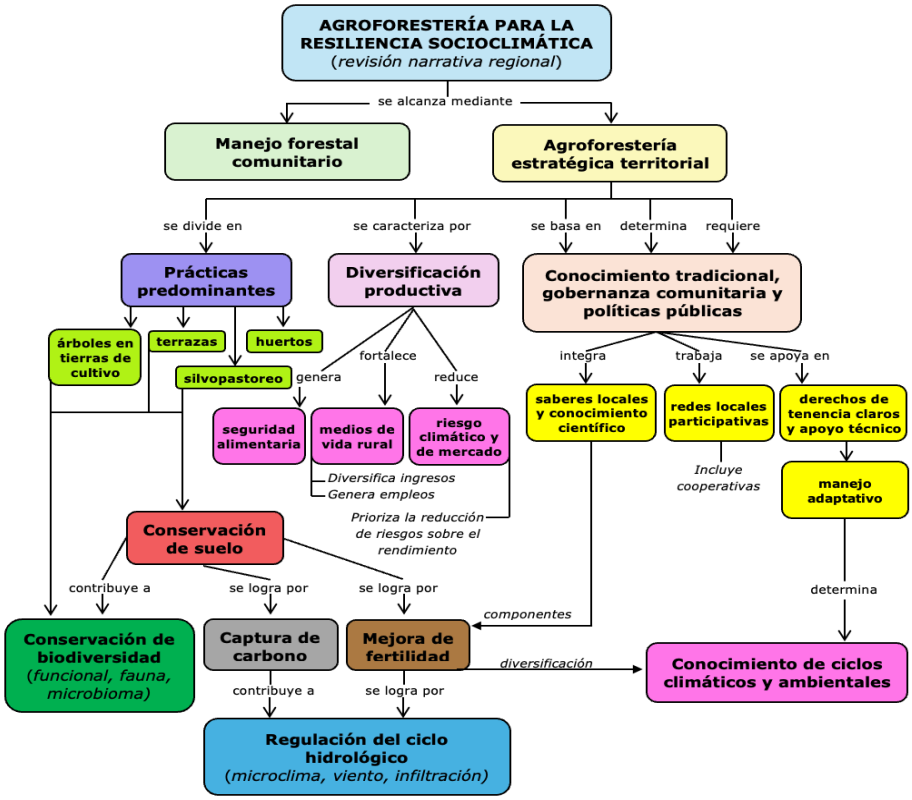


Figure 1. - *Conceptual map of the importance of agroforestry for socio-climatic resilience in the temperate zones of the Sierra Norte de Puebla, Mexico*

Several studies have demonstrated the existence of clear land tenure rights, organizational capacities, and technical support; community governance reduces deforestation and improves sustainable management. Forest resource management in the SNP is characterized by the participation of the communities (Nahua, Totonac, Otomi, Tepehua, and mestizo) who manage the forests. These processes integrate land-use planning and local monitoring that maintain vegetation cover, protect soils from erosion, and regulate the hydrological cycle (Aguilar-Luna 2018).

The integration of local and scientific knowledge generates relevant innovations that reorient production systems toward more sustainable models. The participation of the rural population, the design of public policies, and the strengthening of community governance are fundamental, as they shape collective adaptive capacities (Dossa *et al*., 2025) . The literature on resilient agriculture highlights the role of local knowledge as the basis for the adaptive management of natural resources (Roy *et al*., 2025).

In the SNP, the traditional knowledge of the peoples has guided the management of their territory through practices such as diversified milpa farming, shade-grown coffee plantations, medicinal use of plants, and selection of useful tree species. This local ecological knowledge has favored the conservation of biodiversity and the natural regeneration of forests (Aguilar-Luna 2018); it constitutes a strategic resource for adaptation to climate change (Muthuri *et al*., 2023).

The combination of trees, agricultural crops, livestock, and agroforestry techniques exemplifies how integrating local knowledge produces high-quality food with low environmental impact. From an economic perspective, family farming can be characterized by its profitability, reduction of external inputs, and job creation, as it increases the viability of production units in marginalized regions. These characteristics strengthen rural livelihoods and contribute to a more diversified local economy (Escamilla *et al*., 2026).

Diversifying income sources provides tangible goods such as fruit, timber, meat, fodder, and medicinal plants; in turn, it strengthens rural livelihoods. Recent research indicates that rural communities participate in the design, implementation, and management of family farming, thus significantly increasing their socioeconomic benefits (Jayakody. *et al*., 2025). Public policies that integrate traditional knowledge, local capacities and organizational structure are essential for AF to scale in a sustainable way.

The use of family farming can provide socioeconomic and cultural benefits such as: risk reduction through production diversification, employment of family labor, and maintenance of deeply rooted cultural customs (Moreno *et al*., 2020). In the cases reviewed, it was observed that family farming is used in community development projects, in situations where the employment of labor is needed to meet basic needs in rural areas.

Traditional land-use systems in the SNP commonly emphasize reducing crop risks more than optimizing production. Crop and animal husbandry systems in less fertile areas include intercropping with various species, intercropping, and complex rotation schemes. Subsistence farming favors the planting of tubers, vegetables, and various herbs. Commercial farming favors forestry, livestock raising, and the production of

fruits such as *Annona. cherimola, Casimoroa edulis*, *Citrus aurantium*, *Citrus latifolia*, *Crataegus mexicana*, *Cydonia oblonga*, *Eriobotrya japonica*, *Ficus carica, Inga edulis, Inga vera, Juglans regia, Malus domestica, Persea Americana*, *Prunus armeniaca*, *Prunus persica, Prunus serotin, Punica granatum, Pyrus communis, Rubus adenotrichus, Rubus idaeus* and *Rubus Ulmifolius.* In the SNP, more subsistence crops are grown in remote areas, and a greater proportion of market crops are produced in areas near municipal centers. There is a constant capacity for expenditures for consumption. The need for labor is staggered throughout the year, as it is a system with reduced economic demands.

CONCLUSIONS

Agroforestry in the temperate zones of the Sierra Norte region of Puebla is a fundamental strategy for socioclimatic resilience, as it integrates productive diversification with ecological restoration and the sustainable management of natural resources. It contributes significantly to the conservation of soil, water, and biodiversity, while simultaneously strengthening food security and diversifying the rural economy. The integration of traditional knowledge, community governance, and public policies is crucial for expanding this production system as a territorial model for adaptation to socioclimatic variability.

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***Conflicts of interest*:**

The authors declare no conflicts of interest.

Authors' contribution:

The authors have participated in the writing of the work and analysis of the documents.

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