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ADB TA-9993 THA: Climate Change Adaptation in Agriculture for Enhanced Recovery and Sustainability of Highlands

Roadmap for Inclusive and Climate-Friendly Agribusiness Investments in Nan Province



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TA 9993-THA: Climate Change Adaptation in Agriculture for Enhanced Recovery and Sustainability of Highlands

Knowledge Product

Roadmap for Inclusive and Climate-Friendly Agribusiness Investments in Nan Province

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Executive Summary

Pathways to Sustainable Agribusiness in Nan Province: A Roadmap for Inclusive and Climate-Resilient Growth

Nan Province, a key agricultural region in northern Thailand, faces increasing environmental and economic challenges, including deforestation, climate variability, soil degradation, and limited access to finance for smallholder farmers. These challenges threaten agricultural sustainability and long-term economic development. However, climate-smart agriculture (CSA) and sustainable agribusiness investments provide an opportunity to transform Nan into a model for inclusive, resilient, and market-driven agriculture.

Nan Province has the potential to become a regional leader in climate-smart agribusiness by leveraging innovative finance, government incentives, private sector engagement, and international development funding. This roadmap outlines pathways to enhance agribusiness competitiveness, strengthen CSA adoption, improve infrastructure, and facilitate access to international markets. It provides a strategic approach to leveraging finance, government incentives, private sector partnerships, and international development funding to support a thriving and climate-resilient agrifood sector. By implementing these investment and policy recommendations, Nan Province can accelerate climate-smart agriculture, improve farmer livelihoods, and drive sustainable economic growth—serving as a model for inclusive and resilient agricultural development in Thailand and the Greater Mekong Subregion.

Key Challenges

Despite its potential, Nan Province's agribusiness sector faces five major constraints:

- (1) Limited Access to Finance – Smallholder farmers and SMEs struggle to secure funding for CSA investments due to reliance on informal credit and high financing costs.
- (2) Infrastructure and Market Barriers – Weak logistics networks, inadequate post-harvest facilities, and high transportation costs restrict market access.
- (3) Certification and Trade Limitations – High costs and complex procedures for Good Agricultural Practices (GAP) and organic certifications limit smallholders' ability to access premium export markets.
- (4) Weak Private Sector Engagement – Agribusiness value chains lack investment in processing, storage, and logistics, reducing competitiveness.
- (5) Gender and Social Inclusion Gaps – Women and indigenous communities have limited land ownership, financial access, and decision-making roles in agribusiness.

Strategic Pathways for Investment and Growth

Expanding Financial and Technical Support for Agribusinesses. Strengthening access to financial resources is essential to accelerating CSA adoption and agribusiness growth. Expanding microfinance programs, concessional loans, and cooperative-led funding mechanisms can support smallholders transitioning to climate-smart practices.

Strengthening Government Incentives and Investment Promotion. Thailand's investment promotion policies can be leveraged to support CSA adoption. Expanding access to the Board of Investment (BOI) incentives, including tax breaks for CSA-related investments such as solar irrigation, biochar, and renewable energy integration, can reduce financial barriers for agribusinesses. Strengthening Provincial Agricultural Office (PACO) programs to enhance farmer training, subsidies, and certification support will improve CSA adoption at the local level. Aligning

agribusiness strategies with Thailand's Bio-Circular-Green (BCG) Economy Model will ensure long-term sustainability and competitiveness.

Enhancing Private Sector Engagement and Public-Private Partnerships (PPPs). Scaling agribusiness investments through impact funding, private sector engagement, and value chain development is critical to increasing competitiveness. Establishing PPP models to improve agribusiness infrastructure, including post-harvest storage, processing, and export logistics, can facilitate private-sector investment. Strengthening high-value CSA crop sectors such as cacao, lemongrass, and pumpkin will position Nan as a leader in sustainable and organic farming for export markets. Attracting impact investors focused on sustainability, gender inclusivity, and community development will further promote climate-smart agribusiness.

Integrating Agritourism and Cultural Heritage for Economic Growth. Agritourism presents an opportunity to link CSA investments with sustainable tourism, creating diversified income streams for farmers. Developing farm-to-table tourism, organic farm experiences, and eco-friendly homestays will integrate agriculture with tourism. Leveraging Thailand's nomination for UNESCO World Heritage status to increase visibility and attract eco-conscious travelers can further boost economic activity in Nan Province. Strengthening marketing partnerships between agribusinesses and tourism operators will expand premium market opportunities for CSA-driven products.

Improving Infrastructure and Trade Connectivity. Enhancing logistics, market access, and cross-border trade is critical to improving agribusiness competitiveness. Upgrading Nan Nakhon Airport and expanding National Highway 101 will lower transportation costs for highland farmers. Supporting ASEAN cross-border trade initiatives will streamline agricultural exports to Lao PDR, Vietnam, and China. Investing in digital platforms for e-commerce and real-time trade data systems will further strengthen market access for Nan's agribusiness sector.

Pathways to Implementation: Policy and Investment Priorities

To transform Nan Province into a climate-smart agribusiness hub, the following implementation strategies should be prioritized:

- (1) Expanding financial access for agribusinesses through blended finance models, microloans, and concessional funding.
- (2) Strengthening agribusiness participation in BOI and PACO-supported incentive programs to facilitate CSA adoption.
- (3) Developing PPP models to drive private-sector investment in agribusiness infrastructure, processing, and logistics.
- (4) Securing funding from international mechanisms such to scale CSA projects aligned with Thailand's climate resilience goals.
- (5) Positioning Nan Province as a leader in agritourism and sustainable trade, integrating CSA products with eco-conscious tourism and regional trade expansion.

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Abbreviations

AANZFTA	ASEAN-Australia-New Zealand Free Trade Agreement
ACMECS	Ayeyarwady-Chao Phraya-Mekong Economic Cooperation Strategy
ADB	Asian Development Bank
AFTA	ASEAN Free Trade Area
AJCEP	ASEAN-Japan Comprehensive Economic Partnership
AKFTA	ASEAN-Korea Free Trade Agreement
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
ASEM	Asia-Europe Meeting
BCG	Bio-Circular-Green Economy Model
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BOI	Board of Investment (Thailand)
COP	Conference of the Parties (United Nations Climate Conferences)
COVID	Coronavirus Disease
CSA	Climate-Smart Agriculture

CSAM	Centre for Sustainable Agricultural Mechanization
DEPA	Digital Economy Promotion Agency
ECRL	East Coast Rail Link
EEC	Eastern Economic Corridor
FAF	ASEAN Cooperation in Food, Agriculture and Forestry
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration (Thailand)
FGD	Focus Group Discussion
GAP	Good Agricultural Practices
GCF	Green Climate Fund
GMP	Good Manufacturing Practices
GMS	Greater Mekong Subregion
HACCP	Hazard Analysis and Critical Control Points
IFAD	International Fund for Agricultural Development
JFPR	Japan Fund for Prosperous and Resilient Asia and the Pacific
MOAC	Ministry of Agriculture and Cooperatives
MOC	Ministry of Commerce
MOIC	Ministry of Industry and Commerce
MRC	Mekong River Commission
NDCs	Nationally Determined Contributions
NEDA	Neighboring Countries Economic Development Cooperation Agency
NESDC	National Economic and Social Development Council
OAE	Office of Agricultural Economics
PAEO	Provincial Agricultural Extension Offices
PGS	Participatory Guarantee System
PPP	Public-Private Partnership
RCEP	Regional Comprehensive Economic Partnership
SDG	Sustainable Development Goals
SMEs	Small and Medium Enterprises
TA	Technical Assistance
THA	Thailand
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization

1. Introduction

1.1 Background

In June 2020, the Asian Development Bank (ADB) approved Technical Assistance (TA) 9993-THA, Climate Change Adaptation in Agriculture for Enhanced Recovery and Sustainability of Highlands, funded by the Japan Fund for Prosperous and Resilient Asia and the Pacific (JFPR). The Ministry of Agriculture and Cooperatives (MOAC) is the executing agency, with the Office of Agricultural Economics (OAE) serving as the coordinating and implementing agency.

The TA aims to reduce climate change vulnerability and enhance the adaptive capacity of highland communities and ecosystems. It also seeks to improve household livelihoods and food security, boost rural employment, and support Thailand's economic recovery following the COVID-19 pandemic. The expected impact is improved agricultural competitiveness in the highlands, with the key outcome being an enabling environment for the adoption of climate-smart agriculture (CSA).

The TA consists of four outputs:

- (1) assessing climate change vulnerability in highland agriculture;
- (2) prioritizing and analyzing gender- and COVID-19-responsive CSA practices;
- (3) evaluating agricultural product quality, value addition, and market linkages; and
- (4) strengthening the capacity of local governments and communities to address climate change.

1.2 Rationale and Methodology

Nan Province is a predominantly agricultural region facing significant environmental challenges, including soil degradation, deforestation, and increasing climate variability. These factors threaten agricultural productivity, food security, and rural livelihoods. CSA offers a strategic approach to mitigating these challenges by enhancing resilience, sustainability, and economic viability in the province's agricultural sector.

This knowledge product synthesizes key insights into Nan Province's agricultural and environmental landscape, exploring pathways for integrating CSA practices and scaling sustainable agribusiness development. Developed under ADB TA 9993-THA, it aligns with Thailand's broader climate resilience and post-COVID-19 recovery objectives. By mapping CSA adoption, identifying investment opportunities, and analyzing agribusiness value chains, this document serves as a knowledge resource to guide CSA investments and interventions in Nan Province. It also provides a foundation for CSA and agribusiness investment opportunities by supporting policies, financing mechanisms, and stakeholder roles in fostering

1.3 Methodological Approach

This document integrates stakeholder feedback and builds on foundational analyses and assessments conducted under TA 9993. This report is based on a comprehensive review of multiple sources:

ADB TA 9993 project documents – These include inception reports, monitoring and evaluation studies, and assessments of alternative crops and CSA practices to evaluate CSA implementation, agribusiness opportunities, and relevant policy frameworks in Nan Province.

Stakeholder engagement – Insights were gathered from the International Workshop on CSA (October 2024) and the Private Sector Workshop on Climate-Smart Agriculture (December 2024). These workshops provided expert perspectives on CSA adoption, market access, and financing

strategies, while also engaging local farmers, agribusinesses, financial institutions, and policymakers to understand challenges and investment potential.

Policy review – National and provincial policies, including the 12th National Economic and Social Development Plan (NESDP) and the National Strategy on Agriculture (2018–2037), were examined to align CSA strategies with broader development goals. Additionally, financing mechanisms and incentive structures that could support CSA adoption in Nan Province were assessed.

Value-chain analysis – A localized assessment of the province’s agricultural sector was conducted to evaluate market demand, supply chain gaps, and investment opportunities, particularly for high-value, climate-resilient crops.

Comparative case studies – Successful CSA adoption models from similar highland regions were analyzed to provide practical insights. A comparative analysis of the best regional and international practices helped shape strategic recommendations tailored to Nan Province.

1.4 Key Deliverables

Findings from this structured approach are synthesized into a roadmap outlining short-, medium- and long-term CSA investment priorities. The document serves as a strategic guide for sustainable agribusiness development in Nan Province, integrating policies, financing mechanisms, and stakeholder roles to support a climate-resilient agricultural economy.

This knowledge product, developed under TA 9993 (Output 2, Aide Memoire Action 11), comprises of the comprehensive *KP5: Roadmap for an Inclusive Climate-Friendly Agribusiness Investment Project in Nan Province*. It is supported by two additional volumes:

Volume 1: Value Chain Analysis and Market Demand Assessment – Examines market potential for key agricultural commodities, processing, and branding strategies.

Volume 2: Private Sector and Inclusive Agribusiness Development Action Plan – Focuses on integrating small firms and smallholder farmers into value chains, agribusiness investment opportunities, and policy support for sustainable agrifood systems.

By leveraging insights from these documents, the roadmap provides strategic investment priorities, financing models, and policy recommendations to foster inclusive, climate-smart agribusiness development in Nan Province.

2. Thailand's Agribusiness Outlook (2022-2030)

Thailand's agribusiness sector is undergoing structural changes driven by technological advancements, evolving consumer demand, and policy reforms aimed at enhancing sustainability and competitiveness in global markets. The sector contributes approximately 8% to the national GDP and employs nearly 30% of Thailand's workforce. The country remains a top exporter of rice, rubber, sugar, and tropical fruits, with agricultural exports valued at USD 45.7 billion in 2023, reflecting a 4.3% year-on-year increase (Workshop Report-Private Sector Workshop-02Dec2024). Key trends shaping the sector include the adoption of precision agriculture, digital traceability platforms, and climate-smart farming techniques, in line with Thailand's Bio-Circular-Green (BCG) Economy Model and Thailand 4.0 development agenda.

2.1 Agribusiness Market Growth Projections

Thailand's agriculture market is projected to experience steady expansion, driven by investments in high-value crops such as rice, rubber, palm oil, and fruits. The total gross production value of agriculture is expected to reach USD 28.91 billion by 2025, with a compound annual growth rate (CAGR) of 0.28% from 2025 to 2029, culminating in a market volume of USD 29.24 billion by 2029 (Statista; Research and Markets). Staples like wheat, corn, and sugar are also forecasted to grow due to increasing demand from livestock feed and biofuel production.

- (1) Rice production is anticipated to expand in Marketing Year¹ (MY) 2024/25, with projected output reaching 20.5 million metric tons, driven by expanded acreage and improved yields supported by precision irrigation and genetic enhancements (USDA Foreign Agricultural Service).
- (2) Corn production is forecasted to increase by 4% in MY 2023/24, reaching 5.3 million metric tons, fueled by a recovery in swine production, which boosts feed grain demand. Additionally, government subsidies on high-yield corn varieties are expected to improve productivity (TA International Workshop Report, November 2024).
- (3) Wheat imports are projected to remain steady at 3.2 million metric tons in MY 2024/25, supported by stable inventories and improved domestic corn supply, which reduces reliance on imported feed grains.
- (4) Sugar production continues to trend upward, with 2024 output projected at 11.5 million metric tons, benefiting from favorable weather conditions, advanced irrigation methods, and government-backed sustainability programs (USDA Foreign Agricultural Service).

Government initiatives play a pivotal role in strengthening Thailand's agribusiness sector. Policies such as Thailand 4.0 and precision agriculture programs are fostering modernized farming practices, while subsidies for smart irrigation systems, mechanization, and agro-processing facilities are helping farmers mitigate climate risks and increase productivity. The promotion of Good Agricultural Practices (GAP) and organic farming certifications is further enhancing food security and market access. The workshop discussions emphasized that these programs are particularly crucial for upland farmers and smallholders, who often face challenges in adopting advanced agricultural techniques (Session 4 - Knowledge and Capacity Enhancement of Local Governments and Highland Communities on Climate Change Adaptation).

¹ A marketing year is a 12-month period that varies by crop and country, during which the production, marketing, and trade of a particular agricultural commodity occur. It is used for tracking supply, demand, and trade trends in agricultural markets.

2.2 Technological Innovation in Agribusiness

Thailand is increasingly leveraging digital technologies and smart farming techniques to enhance agricultural efficiency and resilience. The adoption of Internet of Things (IoT) sensors, artificial intelligence (AI), and remote sensing technologies is helping farmers optimize resource use, predict yields, and improve supply chain transparency. The government's Precision Agriculture Initiative, supported by the Digital Economy Promotion Agency (DEPA), is integrating these technologies into national farming strategies to address issues such as climate change, labor shortages, and fluctuating market prices. Key technological advancements include:

- (1) **AI-Powered Crop Monitoring** – AI-driven analytics are being used to monitor soil conditions, detect pests early, and optimize fertilizer application, reducing costs by 15%–20% for commercial farms.
- (2) **Automated Irrigation Systems** – Adoption of smart irrigation has resulted in 25% water savings in pilot programs in Nan Province, significantly improving sustainability and drought resilience (Special Session 2 - Experience Sharing on Pilot Demonstrations by Farmers in Bua Yai, Na Noi District, Nan Province).
- (3) **Blockchain-Based Traceability** – Thailand has launched digital traceability platforms that provide farm-to-table tracking for rice, organic vegetables, and premium fruits, increasing export acceptance in markets such as the EU and Japan.

2.3 Access to International Markets

Thailand remains a key agricultural exporter, benefiting from free trade agreements (FTAs) with ASEAN, China, the EU, and the United States. In 2023, Thailand's top agricultural exports included:

- (1) Rice – USD 5.8 billion (+7% YoY)
- (2) Rubber – USD 6.2 billion (+4.5% YoY)
- (3) Sugar – USD 4.3 billion (+6.1% YoY)
- (4) Processed Fruits – USD 3.9 billion (+9% YoY, led by durian exports to China) (Statista).

Trade compliance is critical for sustaining export growth. Thailand has strengthened adherence to Global GAP, USDA Organic, and EU Sustainable Agriculture Standards, expanding organic farming certification programs to improve access to premium markets.

2.4 Shift in Consumer Demand

Consumer preferences are shifting towards sustainable, health-conscious, and ethically sourced food products. Thailand's organic food market is projected to grow at a CAGR of 8.5% from 2023 to 2030, driven by food safety concerns, environmental awareness, and demand for functional foods (USDA FAS). The Smart Farmer Initiative is helping farmers adapt to evolving market trends by integrating digital agriculture, post-harvest processing, and e-commerce solutions to enhance supply chain efficiency.

2.5 Climate Change and Sustainability

Thailand faces significant climate challenges, with rising temperatures, erratic rainfall, and prolonged droughts impacting agricultural productivity. CSA practices are being widely promoted to reduce greenhouse gas emissions, enhance water-use efficiency, and improve soil health. The Thai government's Climate Resilient Agriculture Program, launched in 2024, has introduced:

- (1) Drought-resistant rice varieties, expected to improve yields by 12% in water-scarce regions
- (2) Agroforestry initiatives, covering 150,000 hectares by 2025, promoting carbon sequestration and biodiversity conservation
- (3) Sustainable mechanization policies, which aim to reduce agricultural emissions by 18% by 2030 (CSAM).

Thailand's agribusiness sector is poised for continued expansion, underpinned by technological innovation, government policies, and strong export demand. The integration of smart farming techniques, digital traceability, and climate-smart agriculture will be key in maintaining Thailand's competitiveness in the global market. Moreover, the country's ability to leverage public-private partnerships, strengthen international trade relationships, and promote sustainable agricultural practices will ensure long-term growth and resilience. However, addressing climate risks, labor shortages, and supply chain disruptions remains crucial in sustaining Thailand's agricultural success in the coming decade. With ongoing investments and strategic policy frameworks, Thailand is well-positioned to remain a leading agricultural powerhouse in Asia while advancing towards a more sustainable and technologically driven agribusiness future.

3. Nan Province Agribusiness Situation Analysis

3.1 Geographical and Environmental Context

Nan Province, located in northern Thailand, is predominantly mountainous, with approximately 85% of its area classified as highlands. This topography creates unique microclimates and influences the suitability of various crops, especially in districts like Na Noi and subdistricts such as Bu Yai, which form part of the Nan watershed – one of Thailand's 25 primary watersheds (Kasikorn Research, 2024). The region experiences a tropical savanna climate (Köppen Aw), with distinct wet and dry seasons. Annual rainfall ranges from 1,200 to 1,600 mm, and issues such as soil erosion and deforestation are prevalent due to traditional agricultural practices like shifting cultivation and monocropping. Climate change impacts, including increased temperature variability and altered precipitation patterns, further affect agricultural productivity.

Historically, Nan Province's agriculture has focused on monoculture crops such as maize (covering approximately 127,000 hectares as of 2016), which have contributed to soil degradation and reduced biodiversity. This focus, along with deforestation, soil degradation, and biodiversity loss. However, recent efforts have shifted towards diversified, high-value crops such as organic rice, cacao, coffee, and medicinal herbs.

The TA 9993 Baseline Survey Report highlights local demographics, economic conditions, and agricultural challenges, advocating for a transition to diversified cropping systems and CSA practices to improve environmental sustainability (ADB TA 9993 Baseline Survey Report, 2023).

Table 1:
Demographics of Bua Yai Subdistrict.

Category	Description	Key Data and Insights	Source
Geographical and Environmental Overview	- Nan Province is predominantly mountainous (85% highlands), with limited lowland areas suitable for agriculture.	- Average rainfall: 1,490 mm; tropical savanna climate. - The highland terrain and microclimates influence crop suitability, favoring certain high-value crops like coffee and avocado. - Environmental challenges: soil erosion, deforestation, and watershed impact.	Climate-Data.org Project Documents
Agricultural Landscape	- Agriculture is the main livelihood, yet terrain limits arable land expansion. - High prevalence of maize in uplands.	- Shifting cultivation and monocropping, mainly maize, have caused soil degradation and loss of biodiversity. - Move toward CSA and alternative practices, like crop rotation and integrated farming, aims to enhance soil health and reduce environmental impact.	Project Documents BSAC-CHEM
CSA Challenges	- Barriers to CSA adoption due to costs, lack of technical skills, and limited infrastructure.	- Financial constraints limit smallholders' ability to invest in CSA technologies like solar irrigation and biochar. - Lack of access to CSA training and awareness of benefits. - Limited market incentives for sustainably grown crops.	TA 9993 Project Documents

Category	Description	Key Data and Insights	Source
Market Access Considerations	Limited access to domestic and international markets for highland crops.	<ul style="list-style-type: none"> - Challenges with transportation from remote areas to markets. - Growing demand for certified (e.g., organic, GAP) products, but high certification costs. - Lack of processing facilities and cold chain logistics restrict market access for perishables. 	Thai Ministry of Commerce Project Documents
Stakeholders			
Farmers	Primarily smallholder farmers, including indigenous groups like the Hmong.	<ul style="list-style-type: none"> - Depend on traditional farming, with limited resources for CSA. - Face barriers to accessing finance, inputs, and modern agricultural practices. 	Project Documents
Cooperatives	Cooperatives provide shared resources, access to markets, and capacity-building for smallholders.	<ul style="list-style-type: none"> - Facilitate CSA training, market linkage, and bulk purchasing. - Key for aggregating produce for high-value markets, though limited in reaching remote farmers. 	
Private Sector Actors	Agribusiness companies focus on input supply, processing, and marketing highland products.	<ul style="list-style-type: none"> - Provide access to inputs and markets for smallholders, though concentrated in urban centers. - Potential for public-private partnerships to promote CSA practices and build market linkages. 	Thailand BOI Project Documents
Government Agencies	Local and national agencies provide policy support, training, and extension services.	<ul style="list-style-type: none"> - Support CSA through training and subsidies but face resource limitations. - Policies exist for organic and GAP certifications, yet adoption is low due to administrative burdens and costs for smallholders. 	Ministry of Agriculture and Cooperatives, Thailand
Non-Governmental Organizations (NGOs)	NGOs promote sustainable agriculture and community-based resource management.	<ul style="list-style-type: none"> - Focus on educating farmers on CSA practices and sustainable land use. - Engage in projects to protect highland ecosystems and promote biodiversity. 	
Marginalized Groups	Women and indigenous communities play essential roles in the agricultural workforce.	<ul style="list-style-type: none"> - Often have limited access to land, finance, and decision-making roles. - Gender inclusion initiatives aim to increase resource accessibility and capacity-building for women. 	BSAC-CHEM

3.2 Climate-Smart Agriculture in Nan Province

The unique landscape of Nan Province presents both opportunities and challenges for agriculture. The Nan Province Landscape Analysis under ADB TA 9993 emphasizes the need for CSA practices adapted to highland areas, such as agroforestry, water management, and soil conservation, to mitigate environmental issues like soil erosion and deforestation (ADB, 2024).

Agroforestry is increasingly being adopted in Nan, with approximately 35% of highland farmers integrating trees into agricultural landscapes. This approach improves biodiversity, prevents erosion, and enhances soil health, contributing to a 15% reduction in soil erosion over the past five years (TA 9993 Report, 2024). Similarly, water management solutions, such as solar irrigation and

rainwater harvesting, have led to a 42% increase in water availability for surveyed farmers, reducing their reliance on seasonal rainfall (ADB TA 9993 Workshop Report-CB3-F, 2024).

Soil conservation practices, particularly biochar application and minimal tillage, have demonstrated significant benefits. Field trials indicate a 12-18% improvement in soil organic matter content after two years of biochar application (ADB TA 9993 Field Work Report, 2024).

Crop diversification strategies have proven effective, with market prices for organically grown cacao increasing by 23% over the past three years, ensuring better economic stability for farmers (ADB TA 9993 Benefit-Cost Assessment, 2024).

Economic Viability of CSA. CSA practices such as biochar and solar-powered irrigation demonstrate strong economic benefits when combined with high-value crops like cacao and lemongrass. Studies show that biochar applications can increase yield productivity by 20%, leading to an estimated income increase of THB 10,000 per hectare per season (ADB TA 9993 Alternative Crop Selection Report, 2024). These crops, when paired with GAP and organic certifications, exhibit strong market potential, aligning with projected industry growth trends.

Supply Chain and Market Gaps. The supply chain in Nan Province remains underdeveloped, with significant gaps between input suppliers and output buyers. Currently, only 40% of farmers have direct access to certified input suppliers, limiting their ability to meet premium market requirements (ADB TA 9993 Baseline Survey Report, 2024). Strengthening these relationships will improve value chain efficiency and expand market access.

Certification and Market Access. Certification schemes such as GAP and PGS are crucial for market entry, particularly for export-oriented products. However, many smallholder farmers struggle with certification costs and procedural complexities. Surveys indicate that 78% of smallholder farmers require financial assistance to afford GAP certification, which can cost up to THB 5,000 per application (ADB TA 9993 Workshop Report-CB7-F, 2024).

Performance of CSA Technologies. Initial data from CSA demonstrations reveal notable improvements in water savings and soil health. For instance, solar-powered irrigation systems have reduced water consumption by 30%, leading to enhanced yield consistency (ADB TA 9993 Demonstration Report, 2024). However, further tracking is needed to measure long-term impacts.

Gender and Social Inclusion. Women's involvement in CSA remains limited due to restricted access to land, credit, and decision-making power. Female farmers receive 35% less financial support than their male counterparts, underscoring the need for gender-sensitive policy interventions and targeted capacity-building initiatives (ADB TA 9993 Workshop Report-CB1-F, 2024).

CSA Demonstrations and Crop Performance. CSA demonstrations under TA 9993 illustrate the financial and productivity advantages of CSA practices. Cacao and avocado have shown promising returns, with a projected production increase of 18% over the next three years. Additionally, demand for organic lemongrass has grown by 28% in local and regional markets (ADB TA 9993 Benefit-Cost Assessment, 2024).

Digital Transformation Prospects. Challenges persist in infrastructure gaps, high initial costs, and limited digital literacy, particularly in rural areas. Overcoming these barriers through targeted investments, training programs, and public-private partnerships is essential (Tripoli & Schmidhuber, 2020). Nan's highland regions, with their diverse crops such as organic rice, coffee, and medicinal herbs, can benefit significantly from digital technologies and CSA practices. These innovations can enhance productivity, facilitate market access through traceability systems, and integrate smallholder farmers into digital value chains, ultimately promoting climate-resilient and sustainable agriculture (ADB, 2024).

3.3 Emerging Opportunities and Challenges in Nan's Agribusiness Sector

Nan Province's agribusiness sector is at a critical juncture, where CSA innovations, digital transformation, and market access improvements can significantly shape its future. While CSA

adoption presents substantial benefits, smallholder farmers continue to face financial, technical, and infrastructural barriers that must be addressed to ensure sustainable development.

One of the key challenges facing farmers in Nan is the financial burden of CSA adoption. Many smallholders struggle to afford technologies such as biochar application, solar-powered irrigation, and sustainable soil management techniques. Expanding credit access and providing financial incentives, such as subsidies for renewable energy-powered irrigation systems, can lower barriers to entry and accelerate adoption. Financial institutions and government programs should collaborate to create CSA investment schemes tailored to the needs of smallholder farmers, ensuring long-term economic viability.

Another essential factor in CSA sustainability is community-led soil health monitoring. Farmer-led monitoring systems empower agricultural communities to take ownership of soil conservation efforts, ensuring that best practices are consistently applied. These systems should be supported by localized training programs that enable farmers to track and improve soil fertility over time. Integrating traditional knowledge with scientific methodologies will enhance soil health management and build resilience against climate-related risks.

Crop diversification remains an effective strategy for reducing dependency on traditional monocultures and improving economic stability. However, smallholders require greater access to processing facilities and market linkages to realize the full benefits of diversified farming. Strengthening local agricultural cooperatives and investing in small-scale processing infrastructure can help farmers add value to their crops, thereby increasing profitability. Connecting farmers with regional and international buyers will further enhance their ability to compete in premium markets.

Digital technology plays a crucial role in modernizing Nan's agribusiness sector. Digital tools, including mobile-based advisory services, blockchain for supply chain transparency, and big data analytics for market prediction, can help farmers optimize production and reach higher-value markets. However, limited digital literacy and high initial costs remain significant barriers. Policymakers and agribusiness stakeholders must focus on expanding digital agriculture training and ensuring that digital solutions are accessible and affordable for all farmers.

Certification and quality standards continue to be a major hurdle for smallholders seeking market expansion. The complexity and costs associated with certification processes, such as Good Agricultural Practices (GAP) and Participatory Guarantee Systems (PGS), deter many farmers from obtaining them. To address this issue, decentralized training hubs should be established to guide farmers through certification requirements and help them navigate the necessary procedures efficiently. Financial support mechanisms, such as cost-sharing models for certification fees, could also enhance participation.

Infrastructure development is another pressing issue in Nan's agribusiness sector. Limited access to climate-smart storage facilities increases post-harvest losses, reducing profitability for farmers. Investing in modernized storage and transportation infrastructure, particularly in cold-chain logistics, will improve product preservation and market competitiveness. Strengthening rural transportation networks will also reduce logistical costs and enhance supply chain efficiency, making it easier for farmers to connect with markets.

Gender inclusivity remains a critical aspect of sustainable agribusiness development. Women-led cooperatives have demonstrated strong market potential, particularly in value-added CSA products. Expanding access to land, credit, and leadership opportunities for women in agriculture will foster a more inclusive and resilient agribusiness ecosystem. Gender-sensitive policies should focus on ensuring equitable resource allocation and capacity-building initiatives that empower female farmers.

4. Developing an Investment Roadmap for Nan Province: Setting the Scene and Key Considerations

Nan Province, located in northern Thailand, plays a crucial role in the country's agricultural and environmental landscape. Its mountainous terrain, diverse ecosystems, and unique cultural heritage present both opportunities and challenges for sustainable development. However, the province faces critical issues such as deforestation, climate variability, land degradation, and financial constraints among smallholder farmers. Addressing these challenges has been a priority for national and international stakeholders, particularly through Thailand's CSA and investment strategies. These efforts align with Thailand's commitment to sustainable agriculture, agrotourism, and rural development.

During ADB TA 9993 workshops with agribusiness stakeholders, key investment priorities for Nan Province were identified, including enhancing financial access for smallholder farmers, strengthening market linkages for sustainable agricultural products, leveraging public-private partnerships (PPPs) to improve agribusiness infrastructure, aligning government incentives with CSA and sustainable value chain development, and developing Nan's agrotourism potential while ensuring environmental conservation. This roadmap presents the investment landscape in Nan Province, outlining key financial mechanisms, policies, and strategic areas for sustainable economic growth.

4.1 Support Provided for Agribusinesses and CSA in Nan Province

4.1.1 Local and Microfinance Institutions/Local Financing in Nan

Access to finance remains a significant barrier for smallholder farmers transitioning to CSA. Many farmers rely on informal lenders with high-interest rates, limiting their ability to invest in modern CSA technologies. Only 30% of smallholder farmers in Nan have access to formal financing for CSA investments, and most microfinance loans range between THB 30,000–100,000, often insufficient for larger-scale sustainable investments. However, farmer cooperatives and village funds have played an increasing role in providing low-interest loans for CSA technologies, helping smallholders finance the adoption of efficient irrigation systems, renewable energy for farming, and organic agriculture.

Village funds and cooperatives have proven to be instrumental in bridging financial gaps for CSA adoption. Over 70% of village funds in Nan support agriculture-related investments, particularly for organic transition and agroforestry initiatives. Membership in farmer cooperatives has grown by 20% over the past five years, leading to increased collective investments in post-harvest processing and value chain improvements. A notable example is the Bua Yai Organic Farmers' Cooperative, which provides shared financial resources for CSA infrastructure, allowing farmers to engage in sustainable agricultural practices without the burden of excessive debt.

4.1.2 Government Incentives, Investment Promotion Strategy, and Support Programs

Thailand offers strong investment incentives for sustainable agriculture and agribusiness. The Board of Investment (BOI) provides up to 8 years of corporate tax exemptions, subsidized loans, and grants for businesses adopting organic farming, solar-powered irrigation, biochar, and water management technologies. The Provincial Agricultural Office (PACO) in Nan supports CSA through financial aid, training programs, and land-use policies, working with international organizations to secure funding for soil conservation, agroforestry, and organic certification.

Public-Private Partnerships (PPPs) are expanding agribusiness infrastructure in Nan. Investments in cold storage and logistics have reduced post-harvest losses, while value-added processing facilities have increased farmer incomes by 15–25%. Renewable energy solutions, such as solar-powered drying for herbs and spices, are also gaining traction. PPP-backed CSA investments have grown by 18% in five years, reflecting rising demand for sustainable, high-value crops like organic cacao, coffee, and herbal products.

International financing plays a key role in CSA expansion. ADB provides technical assistance and concessional loans, while the World Bank supports value chain development and farmer training. The Green Climate Fund (GCF) funds projects in agroforestry, carbon sequestration, and water management. However, only 40% of eligible farmers are aware of available funding, highlighting the need for capacity-building workshops and better access to finance through local banks and international lenders.

4.2 Leveraging Agrotourism and Cultural Heritage for Sustainable Development in Nan Province

Nan's UNESCO World Heritage nomination, which received Cabinet approval in March 2024, is a significant step toward promoting sustainable tourism development for historic sites, cross-border tourism links with Luang Prabang (Lao PDR), and infrastructure upgrades, including Nan Nakhon Airport expansion.

The province's agrotourism sector presents opportunities for investment, including farm-to-table tourism experiences, cultural heritage trails linking traditional farming practices with eco-tourism, and sustainable homestays integrating local farming communities. Workshop participants emphasized the need for training programs to help farmers engage in agritourism while preserving sustainable land-use practices.

Nan Province is well-positioned for sustainable investment growth, particularly in CSA, agrotourism, and high-value agribusinesses. By leveraging local financing, government incentives, private sector partnerships, and international development funding, the province can enhance its agricultural resilience, strengthen its value chains, and promote sustainable tourism development.

Box 1:

Green Climate Fund (GCF)

The **Green Climate Fund (GCF)** is a global initiative established under the United Nations Framework Convention on Climate Change (UNFCCC) to support developing countries in their efforts to combat climate change by promoting low-emission and climate-resilient development pathways. The GCF provides financial assistance for projects and programs that aim to mitigate greenhouse gas emissions and adapt to the impacts of climate change.

In **Thailand**, the GCF collaborates with national entities to implement climate-related projects. While there are no GCF-funded projects specifically targeting Nan Province, the fund's initiatives in Thailand focus on areas such as sustainable agriculture, renewable energy, and climate resilience, which are relevant to the region's development goals. For instance, the GCF has supported projects aimed at enhancing the resilience of rural communities to climate-induced water insecurity and promoting energy efficiency in industrial enterprises. **Green Climate Fund**

Nan Province, with its agricultural economy and vulnerability to climate change impacts, could benefit from GCF-funded projects that promote Climate-Smart Agriculture (CSA) practices, sustainable land management, and biodiversity conservation. Engaging with the GCF through Thailand's National Designated Authority (NDA) could open opportunities for funding initiatives tailored to the province's specific needs. Potential projects could focus on diversifying crop production, implementing sustainable farming techniques, and enhancing the resilience of local communities to climate variability.

To explore funding opportunities, stakeholders in Nan Province can collaborate with the Office of Natural Resources and Environmental Policy and Planning (ONEP), which serves as Thailand's NDA to the GCF. By developing project proposals that align with GCF's investment criteria and the province's climate adaptation and mitigation priorities, Nan can access financial resources to support its sustainable development objectives.

5. Investments in the Pipeline for Boosting Economic Development in Nan

There are several noteworthy investment projects aimed at enhancing its infrastructure, agricultural practices, and economic development. These can contribute to the sustainable development of Nan Province by enhancing infrastructure, promoting sustainable agricultural practices, and supporting economic growth through strategic investments.

5.1 National and Provincial Infrastructure Projects

Nan Province has been the focus of several national and provincial infrastructure and transport projects aimed at enhancing connectivity, promoting economic development, and preserving cultural heritage. These projects aim to enhance Nan Province's infrastructure, boost economic development, and preserve its cultural heritage, positioning it as a significant hub for tourism and trade in the region. Investment in infrastructure is also pivotal for Nan Province's development. Projects aimed at improving transportation networks, such as upgrades to National Highway 101 and enhancements to Nan Nakhon Airport, improve market connectivity for agricultural products. Cross-border infrastructure projects facilitated by **the Neighboring Countries Economic Development Cooperation Agency (NEDA)** enhance trade opportunities with neighboring countries, potentially opening new markets for farmers in Nan Province.

Nan Nakhon Airport Upgrade. To enhance air connectivity and accommodate increased tourist arrivals, the Thai government has instructed the Ministry of Transport to upgrade Nan Nakhon Airport, aiming to attract more tourists and boost the local economy.

Improvement of National Highway 101. To improve road connectivity between Thailand and Lao PDR, Thailand's Department of Highways has been improving sections of National Highway 101 in Nan Province, which connects to Laos' National Road No. 2 at the Huai Kon border crossing point. These improvements aim to enhance regional connectivity and support economic development by facilitating cross-border trade and transportation.²

Thaiwatsadu Investment in Nan Province. In 2022, CRC Thaiwatsadu Company Limited, under Central Retail, invested 300 million baht to launch a 17,000-square-meter store in Nan Province. This investment aims to cater to the growing demands for construction materials in the Upper Northern region, supporting the province's economic growth, tourism, construction, and real estate sectors.³

Preparation for UNESCO World Heritage Status. To promote Nan as a cultural World Heritage city, the government is mobilizing efforts to nominate Nan Province for UNESCO World Heritage status. This includes educating citizens and improving infrastructure, such as land and air transportation systems, to support cultural tourism and stimulate the local economy.⁴

5.2 Cross-Border Trade and Competitiveness Enhancement

To strengthen cross-border trade and competitiveness, the 2021 Provincial Government Action Plan for Nan Province outlines a series of strategic initiatives aimed at infrastructure upgrades, capacity-building, and regional cooperation. The plan prioritizes:

² World Highways.

³ Central Retail.

⁴ Thailand Government

- (1) Huai Kon Cross-Border Facility Upgrades. Investments in infrastructure improvements at the Huai Kon border crossing aim to streamline trade and transportation between Nan Province and neighboring countries. (Source: World Highways)
- (2) Capacity Building for Cross-Border Traders and Businesses. The action plan supports training programs to equip local traders and businesses with the necessary skills and knowledge to effectively engage in cross-border commerce. (Source: World Highways)
- (3) Facilitation of Cross-Border Dialogues. Strengthening communication and cooperation between stakeholders across borders is a key priority to address trade challenges and enhance regional opportunities. (Source: World Highways)

These initiatives are part of a broader regional strategy to improve connectivity, exemplified by the development of National Road No. 2 (NR2) in neighboring Lao PDR, which links to Thailand through Nan Province. Infrastructure investments like these are expected to enhance trade routes connecting Thailand, Vietnam, and China, ultimately driving economic growth in Nan Province.

Table 2:
Key infrastructure and transport projects relevant to Nan Province.

Project	Objective	Details	Reference
Nan Nakhon Airport Upgrade	Enhance air connectivity and boost tourism	The Ministry of Transport is upgrading Nan Nakhon Airport to accommodate more tourists, aiming to stimulate the local economy.	thailand.go.th
Improvement of National Highway 101	Improve road connectivity between Thailand and Laos	The Department of Highways is upgrading sections of Highway 101, which connects to Laos at the Huai Kon border, facilitating cross-border trade.	worldhighways.com
UNESCO World Heritage Site Preparation	Promote Nan as a cultural heritage city	Efforts are underway to nominate Nan for UNESCO status. Improvements include transport infrastructure to support tourism and stimulate the economy.	thailand.go.th
Cross-Border Trade & Competitiveness Enhancement	Boost trade and competitiveness at the Huai Kon border	The 2021 Provincial Action Plan for Nan focuses on improving the Huai Kon cross-border facilities and supporting local businesses with capacity building.	documents1.worldbank.org

5.3 Thailand Neighboring Countries Economic Development Cooperation Agency (NEDA) Connectivity Pipeline Initiatives

NEDA of Thailand also has several initiatives relevant to Nan Province, focusing on enhancing regional connectivity and promoting economic development. These projects are part of NEDA's efforts to strengthen cross-border connectivity, thereby fostering economic growth and cultural exchange between Nan Province and its neighboring regions.

Chiangman–Luang Prabang Mekong Bridge Project. Construction of a bridge over the Mekong River, connecting Ban Chiangman in Laos to Luang Prabang, thereby linking Nan Province in Thailand to Luang Prabang Province in Laos, NEDA has provided technical assistance for the feasibility study and detailed design of this bridge, which aims to facilitate transportation and boost tourism between Nan and Luang Prabang, a UNESCO World Heritage city. [Chiang Man Luang Prabang Bridge](#)

Hongsa–Ban Chiangman Road Construction. Development of a 114-kilometer road connecting Hongsa District to Ban Chiangman in Laos, enhancing access between Nan Province and Luang

Prabang. This project, supported by NEDA, aims to improve transportation infrastructure, promoting trade and tourism between Thailand and Laos⁵.

Table 3:
Regional Connectivity Initiatives.

Project	Objective	Details
Chiangman–Luang Prabang Mekong Bridge Project	To construct a bridge over the Mekong River, linking Ban Chiangman (Laos) to Luang Prabang, enhancing connectivity between Nan Province (Thailand) and Luang Prabang Province (Laos).	NEDA has supported a feasibility study and detailed design for this bridge, which aims to boost transportation and tourism between Nan Province and Luang Prabang, a UNESCO World Heritage site. (chiangman-luangprabangbridge.com)
Hongsa–Ban Chiangman Road Construction	To build a 114-kilometer road connecting Hongsa District to Ban Chiangman in Laos, improving access between Nan Province and Luang Prabang.	Supported by NEDA, this project focuses on enhancing transportation infrastructure to promote trade and tourism between Thailand and Laos. (chiangman-luangprabangbridge.com)

5.4 Local and Community Projects

Other projects that promote sustainable agriculture in Nan Province include:

- (1) **Nan Cultivation of Wisdom Project.** Kasikorn Bank in collaboration with the Thailand Science Research and Innovation (TSRI), has implemented the Cultivation of Wisdom project over twelve years (2012–2024) in Nan Province. This initiative focuses on developing learning processes and promoting sustainable development based on Environmental, Social, and Governance (ESG) criteria, aiming to create a knowledge-based society and enhance the quality of education in the region. (Kasikorn Bank)
- (2) **Integrated Rural Livelihood Development Model Project.** The Mae Fah Luang Foundation, together with the Royal Initiative Discovery Foundation, initiated a model project in Nan Province to address issues such as forest encroachment, monoculture, and the use of chemical fertilizers. The project focuses on improving soil fertility, introducing terraced rice fields, and promoting sustainable farming practices to regain forest cover and increase agricultural yields. Mae Fah Luang Foundation
- (3) **Mae Fah Luang Foundation’s Rural Livelihood Model.** This project introduces agroforestry and terraced farming to address forest degradation while increasing local farmer incomes (Mae Fah Luang Foundation).
- (4) **Nan Sandbox Project** is a partnership between the private sector, local communities, and government focuses on forest restoration and sustainable land management under the “72-18-10 framework” (Bangkok Post).

⁵ Chiang Man Luang Prabang Bridge

6. National, Regional Strategies, and Cooperation Mechanisms to Address Food Security, Climate Change and Sustainable Development

6.1 National Plans and Strategies Relevant to Nan Province

Climate Smart Agriculture offers a framework that addresses the interlinked challenges of food security and climate change by sustainably increasing agricultural productivity, adapting and building resilience to climate change, and reducing greenhouse gas emissions where possible. These are addressed in various national, regional strategies and cooperation mechanisms.

At the national level, the Thai government, recognizing the environmental challenges in Nan compounded by climate variability, which poses risks to crop yields and farmer livelihoods through irregular rainfall patterns and increased incidence of extreme weather events, has developed several national strategies to promote sustainable agriculture and climate resilience. Key policies include the 20-Year National Strategy (2018–2037), the Climate Change Master Plan (2015–2050), and the Bio-Circular-Green (BCG) Economy Model. These strategies emphasize sustainable resource management, the adoption of advanced agricultural technologies, and the integration of environmentally friendly practices.

Several national plans and strategies guide agricultural development and investment in Nan Province. These strategies guide agricultural development and investment in the province, focusing on sustainability, technological advancement, and resilience to environmental challenges.

- (1) **20-Year National Strategy (2017–2036)**. This overarching framework aims to transition Thailand into a high-income nation by 2036, emphasizing security, prosperity, and sustainability. It serves as a foundation for sector-specific plans, including agriculture.
- (2) **20-Year Agriculture and Cooperatives Strategy (2017–2036)**. Aligned with the National Strategy, this plan focuses on strengthening farmers and cooperatives, enhancing productivity and quality standards, boosting competitiveness through technology and innovation, ensuring sustainable resource management, and improving public administration in agriculture.
- (3) **Thirteenth National Economic and Social Development Plan (2023–2027)**. As part of the National Strategy's implementation, this plan emphasizes sustainable agricultural practices, climate resilience, and the adoption of advanced technologies to enhance productivity and environmental sustainability.
- (4) **Bio-Circular-Green (BCG) Economy Model**. This model promotes sustainable development by integrating bioeconomy, circular economy, and green economy principles. In agriculture, it encourages practices that reduce environmental impact, promote resource efficiency, and add value to agricultural products.
- (5) **Climate Change Master Plan (2015–2050)**. This long-term plan addresses climate change adaptation and mitigation across sectors, including agriculture. It outlines strategies to enhance resilience, reduce greenhouse gas emissions, and promote sustainable agricultural practices.
- (6) **Thailand 4.0 Policy**. Aimed at transforming Thailand into a value-based economy, this policy emphasizes innovation, technology, and creativity. In agriculture, it supports the adoption of smart farming technologies and practices to increase efficiency and productivity.

Table 4:
National Strategies that would Impact Nan Province.

Plan/Strategy	Focus Areas	Relevance to Nan Province
20-Year National Strategy (2017–2036)	Developing Thailand through security, prosperity, and sustainability	Provides a long-term vision supporting sustainable, inclusive agricultural development in Nan Province
20-Year Agriculture and Cooperatives Strategy (2017–2036)	Strengthening agricultural resilience and sustainability	Enhances productivity through technology, quality improvements, and sustainable practices
Thirteenth National Economic and Social Development Plan (2023–2027)	Balanced growth with social and environmental sustainability	Supports climate-resilient agriculture, productivity improvement, and rural poverty reduction
Bio-Circular-Green (BCG) Economy Model	Promotes bioeconomy, circular economy, and green economy principles	Supports environmentally friendly agricultural practices and value-added, sustainable farming
Climate Change Master Plan (2015–2050)	Strategies for climate resilience and sustainable resource use	Guides adoption of Climate-Smart Agriculture (CSA) practices in response to climate variability
Thailand 4.0 Policy	Transition to a value-based, technology-driven economy	Encourages smart agriculture technologies for highland efficiency and productivity
National Organic Agriculture Development Strategy (2017–2021)	Expanding organic production and standards	Supports organic farming, providing a sustainable alternative for Nan’s highland crops
Strategic Plan on Food Safety (2017–2021)	Enhancing food safety and quality standards	Assists Nan farmers in producing competitive, high-quality products
Master Plan on Agriculture under the National Strategy (2018–2037)	Competitive, sustainable agriculture with technology integration	Aligns with goals to improve smallholder resilience and productivity in Nan
National Plan for Soil and Water Conservation (2017–2026)	Sustainable soil and water management	Addresses erosion and conservation needs, critical for Nan’s highland agriculture
Thailand’s Nationally Determined Contributions (NDCs) under the Paris Agreement	Greenhouse gas reduction and climate resilience	Encourages CSA to reduce climate impacts and promote sustainable practices in agriculture
Thailand Food Innovation Strategic Plan (2016–2021)	Innovation in food and agriculture for high-value products	Supports diversification and value addition in Nan’s agricultural sector

Plan/Strategy	Focus Areas	Relevance to Nan Province
Eastern Economic Corridor (EEC) Development Plan	Industrial and technological advancement, especially for export	Influences policies toward modern, tech-driven agriculture across Thailand
Thailand Irrigation Development Strategy (2018–2037)	Developing irrigation infrastructure to support agriculture	Essential for addressing water scarcity and improving highland irrigation systems in Nan
Digital Economy and Society Development Plan	Promotes digital adoption across sectors, including agriculture	Supports initiatives like smart farming and traceability, benefiting smallholders in Nan
Smart Farmers Development Strategic Plan (2019–2022)	Building farmer skills in modern agricultural practices and technology	Empowers Nan farmers with knowledge to adopt CSA and improve efficiency
Strategic Plan for Sustainable Agriculture (2017–2021)	Sustainable agriculture with focus on agroforestry, organic, and conservation farming	Encourages CSA techniques to support long-term sustainability in highland agriculture
Agricultural Development Plan under the Twelfth National Economic and Social Development Plan (2017–2021)	Agricultural innovation, food security, and rural income growth	Outlines CSA and other innovations to support highland farming and resilience in Nan

6.2 Relevant Regional Cooperation Mechanisms and Frameworks

At the regional level, Thailand's participation in initiatives such as the Association of Southeast Asian Nations (ASEAN) Economic Community (AEC) and the Greater Mekong Subregion (GMS) Program fosters cooperation in agricultural development, trade, and environmental conservation. Trade agreements like the Regional Comprehensive Economic Partnership (RCEP) expand market opportunities for agricultural products from Nan Province, potentially enhancing income for local farmers.

Development partners also play a significant role in supporting Nan Province's transition toward sustainable agriculture. The Asian Development Bank (ADB), through its Country Partnership Strategy for Thailand (2021–2025), focuses on enhancing competitiveness, connectivity, resilience, and sustainability. ADB's technical assistance for climate-smart agriculture supports the adoption of sustainable farming practices tailored to highland conditions. The World Bank's Thailand Agricultural Development Strategy Review provides policy recommendations for sustainable agricultural development, which are directly applicable to Nan Province.

Organizations like the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) implement programs such as the Thai-German Climate Programme, assisting in the implementation of climate-resilient agricultural practices. The Food and Agriculture Organization (FAO) and the International Fund for Agricultural Development (IFAD) contribute to food security and rural development initiatives, supporting smallholder farmers in adopting sustainable practices and improving market access.

The regional cooperation schemes and framework programs in Table 4 align with Nan Province's goals by way of promoting sustainable agriculture, climate adaptation, market access, and regional trade. These initiatives provide frameworks, technical support, and funding opportunities that are

critical to developing resilient, climate-smart, and market-oriented agriculture in the highland regions of Nan.

Table 5:
Regional Cooperation Mechanisms and Frameworks.

Regional Plan/Initiative	Focus	Relevance to Nan Province
ASEAN Economic Community (AEC)	Economic integration across ASEAN to promote trade, investment, and competitiveness	Supports cross-border trade and access to ASEAN markets for Nan's agricultural products, potentially increasing export opportunities for highland crops
ASEAN Climate Change Initiative (ACCI)	Regional cooperation on climate change adaptation and resilience	Encourages Climate-Smart Agriculture (CSA) and best practices for climate resilience in agriculture, aligning with the needs of Nan's highland farmers
ASEAN Framework for Agricultural Cooperatives	Strengthening agricultural cooperatives and sustainable farming	Promotes cooperative-based development in Nan, enhancing market access, economies of scale, and resource sharing for smallholder farmers
Greater Mekong Subregion (GMS) Strategic Framework (2012–2022)	Regional cooperation for sustainable development and economic integration	Enhances connectivity and infrastructure, crucial for linking Nan's highland products to regional markets; supports sustainability in agriculture through regional projects
GMS Core Agriculture Support Program (CASP)	Promotes sustainable agriculture, food safety, and biosecurity in the GMS	Supports sustainable and climate-resilient farming practices in Nan, while enhancing food safety standards and improving market access within the GMS
GMS Program on Enhancing Agri-Food Trade and Market Integration	Strengthening agri-food value chains and regional market access	Helps Nan Province farmers access larger GMS markets, focusing on quality improvements and standards for trade
Regional Comprehensive Economic Partnership (RCEP)	Trade and economic partnership between ASEAN and other Asia-Pacific countries	Expands market opportunities for Nan's agricultural exports by lowering trade barriers, especially for organic and high-value crops that meet export standards
ASEAN Cooperation in Food, Agriculture and Forestry (FAF)	Focus on food security, sustainable forestry, and resilient agriculture in ASEAN	Supports forest conservation in Nan and promotes resilient agricultural practices to address food security and environmental sustainability
ACMECS (Ayeyarwady-Chao Phraya-Mekong Economic Cooperation Strategy)	Sustainable development and regional cooperation among Mekong countries	Provides funding and support for sustainable agriculture and rural development, relevant for conservation and economic growth in Nan's agricultural sector
ASEAN Standards for Organic Agriculture (ASOA)	Regional standards for organic certification and production	Encourages organic certification and standardization for Nan farmers, making organic products more competitive in ASEAN markets

Regional Plan/Initiative	Focus	Relevance to Nan Province
ASEAN Sustainable Agrifood Systems (ASEAN SAS)	Sustainable agriculture and food production practices across ASEAN	Promotes sustainable farming practices, soil and water management, and CSA in highland areas like Nan, ensuring long-term agricultural productivity
Mekong River Commission (MRC) Strategic Plan	Regional cooperation on water management, climate resilience, and sustainable development in the Mekong River Basin	Addresses water management needs and climate adaptation strategies, supporting the conservation of water resources essential for agriculture in Nan's highlands
UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific) Sustainable Agriculture Development	Sustainable agriculture initiatives in Asia-Pacific, focusing on food security and poverty reduction	Offers capacity-building, technical assistance, and policy support for sustainable farming practices that benefit Nan's rural communities
Asia-Pacific Economic Cooperation (APEC) Food Security Roadmap	Ensure food security through sustainable agriculture, resilient supply chains, and technology adoption	Promotes CSA and technology adoption for food security, relevant for ensuring Nan's highland agricultural sustainability
ASEAN-Japan Cooperation on Agriculture and Food Security	Enhancing food security, productivity, and sustainable agriculture	Provides funding and technical assistance for CSA practices, helping Nan's farmers improve yields and adapt to climate challenges
Asia-Europe Meeting (ASEM) Cooperation on Food Security	Address food security, technology transfer, and agricultural development	Encourages best practices in sustainable agriculture, supporting CSA adoption and market expansion for Nan's produce
UN Food and Agriculture Organization (FAO) Regional Initiative for Zero Hunger in Asia and the Pacific	Eradicating hunger through resilient agriculture and sustainable food systems	Provides guidelines and resources for enhancing food security and resilient farming in Nan Province through CSA and sustainable practices

6.3 Bilateral Agreements with Neighboring Countries: Relevant to Nan

Thailand has established several bilateral agreements with neighboring countries to enhance agricultural development and investment, which are particularly relevant to regions like Nan Province. These bilateral agreements facilitate the exchange of agricultural technologies, best practices, and market access, directly benefiting agricultural development in Nan Province. They support the adoption of sustainable practices, improve productivity, and open new markets for local farmers. Key agreements include:

6.3.1 Thailand-Laos Cooperation

- (1) Memorandum of Understanding (MoU) on Agricultural Cooperation. This MoU facilitates collaboration in areas such as crop production, livestock development, and agricultural research. It promotes the exchange of knowledge and technology, benefiting farmers in border provinces like Nan.
- (2) Cross-Border Trade Agreements. These agreements simplify trade procedures for agricultural products, enabling farmers in Nan to access markets in Laos more efficiently.

6.3.2 Thailand-Myanmar Cooperation

- (1) MoU on Agricultural Development. This agreement focuses on joint initiatives in sustainable agriculture, pest management, and irrigation systems. It supports the sharing of best practices that can be applied in Nan Province.
- (2) Border Trade Agreements. These agreements facilitate the movement of agricultural goods between Thailand and Myanmar, providing market opportunities for Nan's agricultural products.

6.3.3 Thailand-Cambodia Cooperation

- (1) MoU on Agricultural Cooperation. This MoU emphasizes collaboration in agricultural research, development of high-yield crop varieties, and capacity building for farmers. Such initiatives can enhance agricultural productivity in Nan.
- (2) Cross-Border Trade Facilitation. Agreements aimed at reducing trade barriers help farmers in Nan access Cambodian markets, promoting regional trade.

6.3.4 Thailand-China Cooperation

- (1) Agreement on Agricultural Project Cooperation (2020). Supported by the Lancang-Mekong Cooperation Special Fund, this agreement includes projects on food safety, pest and disease control, and soil management. These projects provide valuable insights into and technologies applicable to Nan's agricultural sector.⁶

6.3.5 Thailand-Vietnam Cooperation.

- (1) MoU on Agricultural Cooperation. This agreement focuses on joint research and development in agriculture, including the exchange of technologies and best practices. Such cooperation can inform sustainable agricultural practices in Nan.
- (2) Trade Agreements. These agreements aim to enhance the export and import of agricultural products, offering market expansion opportunities for Nan's farmers.

6.4 Regional Trade Agreements Relevant to Nan Province

Thailand is a member of several trade agreements that directly or indirectly impact agricultural development and investment in regions like Nan Province. Trade agreements collectively reduce trade barriers, increase access to technology, and create export opportunities for Thai agricultural products, which can directly support growth and diversification in Nan Province's agriculture sector. They also broadly align with sustainable practices and have potential to stimulate investment in climate-smart and high-value agriculture.

⁶ LMC China

- (1) **ASEAN Free Trade Area (AFTA).** Reduces tariffs on agricultural and other goods between ASEAN member states. Provides market access to neighboring ASEAN countries, enabling easier export of crops and agricultural products from Nan Province, and benefits from reduced tariffs on agricultural imports.
- (2) **ASEAN-China Free Trade Agreement (ACFTA).** Aims to reduce and eliminate tariffs on goods, with special provisions for agriculture. Facilitates export opportunities for agricultural products to China, a key market for Thai agricultural goods. It also encourages investment in agriculture and agribusiness from Chinese companies.
- (3) **ASEAN-Japan Comprehensive Economic Partnership (AJCEP).** Promotes free trade, with focus areas including agriculture, forestry, and fisheries. Increases export potential for high-value crops and agricultural goods and offers technical assistance in areas like sustainable agriculture and agricultural technology.
- (4) **ASEAN-Korea Free Trade Agreement (AKFTA).** Reduces tariffs and non-tariff barriers, supporting trade in agricultural products. Expands market access to Korea for Thai agricultural exports and allows for technology sharing and investment in areas such as climate-smart agriculture.
- (5) **ASEAN-Australia-New Zealand Free Trade Agreement (AANZFTA).** Eliminates tariffs on most goods, including agricultural products, between ASEAN countries, Australia, and New Zealand. Enhances export opportunities for crops and agricultural products to Australia and New Zealand and supports sustainable agricultural practices through technical assistance.
- (6) **Regional Comprehensive Economic Partnership (RCEP).** Broad agreement between ASEAN countries and partners like China, Japan, South Korea, Australia, and New Zealand, covering trade in goods, services, and investments. The largest regional trade agreement Thailand participates in, RCEP opens extensive markets for Thai agricultural exports and promotes investment in sustainable agriculture and agribusiness.
- (7) **Thailand-Chile Free Trade Agreement.** Reduces tariffs on goods including agricultural products between Thailand and Chile. Expands agricultural export opportunities for niche products from Thailand to South American markets, diversifying market access.
- (8) **Thailand-Peru Free Trade Agreement.** Promotes trade in agricultural and industrial goods between Thailand and Peru, including tariff reduction. Provides new market access for agricultural exports to South America, which can drive further diversification of crops and products.
- (9) **BIMSTEC Free Trade Area Framework Agreement.** Links Bay of Bengal countries, focusing on trade in goods, services, and investment, including agriculture. Enhance trade routes and opens new regional markets for agriculture while fostering collaboration on agricultural technology and practices.
- (10) **Thailand-European Union Free Trade Agreement (under negotiation).** Although not yet finalized, this anticipated FTA aims to open access to European markets, with a focus on high-quality agricultural products. Expected to improve market access for Thai agricultural exports to Europe, especially for high-value, certified, and sustainable agricultural products, which aligns with CSA goals in Nan.

Table 6:
Regional Trade Agreements.

Trade Agreement	Scope	Relevance to Nan Province
ASEAN Free Trade Area (AFTA)	Reduces tariffs on goods, including agricultural products, among ASEAN countries	Provides market access to ASEAN countries with reduced tariffs, encouraging export of Nan's agricultural products and affordable imports of inputs.
ASEAN-China Free Trade Agreement (ACFTA)	Reduces tariffs, with special focus on agriculture	Enables export opportunities to China, a major market for Thai agriculture; encourages Chinese investment in Thai agribusiness, including Nan.
ASEAN-Japan Comprehensive Economic Partnership (AJCEP)	Promotes trade and technical cooperation in agriculture, forestry, and fisheries	Increases export potential for high-value crops; offers technical assistance for sustainable agriculture and modern farming practices.
ASEAN-Korea Free Trade Agreement (AKFTA)	Reduces tariffs and non-tariff barriers on agricultural products	Expands market access to Korea for Thai agricultural goods; facilitates sharing of technology and expertise in climate-smart agriculture.
ASEAN-Australia-New Zealand Free Trade Agreement (AANZFTA)	Eliminates tariffs on goods, supports agriculture trade	Opens export channels to Australia and New Zealand; provides support for sustainable farming practices through technical cooperation.
Regional Comprehensive Economic Partnership (RCEP)	Comprehensive trade agreement among ASEAN, China, Japan, Korea, Australia, and New Zealand	Provides the largest market access for Thai exports; promotes investment in sustainable and high-value agriculture, supporting development in regions like Nan.
Thailand-Chile Free Trade Agreement	Reduces tariffs on agricultural goods between Thailand and Chile	Expands agricultural export opportunities to South America, diversifying markets for Nan's unique or niche agricultural products.
Thailand-Peru Free Trade Agreement	Promotes trade in agricultural products with tariff reductions	Offers new market access for agricultural exports in South America, enabling further diversification in crop production.
BIMSTEC Free Trade Area Framework Agreement	Links Bay of Bengal countries for trade and investment, including agriculture	Strengthens trade routes and access to regional markets; promotes collaboration on agricultural technology and sustainable practices suitable for highlands like Nan.
Thailand-European Union Free Trade Agreement (under negotiation)	Anticipated reduction of barriers for Thai agricultural products in the EU market	Expected to increase market access for high-quality agricultural exports to Europe, supporting CSA practices in Nan by encouraging sustainable, certified agricultural products suitable for premium markets.

6.5 Development Partner Strategies

Development banks and international donor partners have formulated strategies to support agricultural development in Thailand, including Nan Province. These strategies have components that target promoting sustainable agricultural practices, enhancing climate resilience, and improving market access, directly benefiting agricultural development in Nan Province.

6.6 ADB Thailand Country Operations Business Plan (COBP) 2021-2025

Asian Development Bank (ADB) Country Partnership Strategy for Thailand (2021–2025). Enhancing competitiveness, connectivity, resilience, and sustainability. Emphasizes sustainable agriculture, climate resilience, and regional integration, aligning with Nan's needs for sustainable agricultural practices and improved connectivity. These initiatives from ADB align with regional development goals, potentially enhancing sustainable agriculture, transport connectivity, and green finance in provinces like Nan. Below is a summary of relevant initiatives from the Thailand COBP that support agricultural and infrastructure development.

Table 7:
ADB Thailand Country Partnership Strategy for Thailand (COBP).

Initiative	Description	Sector	Funding & Source	Year	Impact on Nan Province
Climate Change Adaptation in Agriculture for Enhanced Recovery and Sustainability of Highlands	Focus on climate adaptation in agriculture, targeting highland areas for sustainable practices.	Agriculture & Rural	Japan Fund for Poverty Reduction (JFPR) - \$2 million	2020	Supports climate-smart agriculture in mountainous areas like Nan.
Greater Mekong Subregion (GMS) Logistic Study	Research on logistics in the GMS, which includes Thailand's northern regions.	Regional Cooperation	Technical Assistance - GMS Program	Ongoing	Identifies logistics improvements that benefit remote regions like Nan.
Scaling Smart Energy and Energy Efficiency Solutions	Promotes smart energy use and energy efficiency.	Energy	Climate Investment Fund - \$0.8 million	2020	Could address energy efficiency in agricultural processes.
National Railway Improvement Project	Enhances national railway infrastructure, including connectivity to northern provinces.	Transport	ADB Loan - \$300 million	2021	Potentially improves accessibility to Nan, supporting trade.
Green Finance and Innovative Facility for Investment Projects	Financing green projects and innovations in Thailand.	Multi-sector	ADB and co-financing - \$500 million	2022	Supports sustainable investment opportunities in agriculture.

The World Bank's Thailand Agricultural Development Strategy Review assesses and proposes strategic pathways for sustainable agricultural development. Its recommendations are directly applicable to Nan, offering guidance on improving productivity and sustainability in the region's agricultural sector. Similarly, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has launched initiatives such as the Thai-German Climate Programme, which assists in implementing

climate-resilient agricultural practices, and the Sustainable Rice Platform, which promotes sustainable rice cultivation, a vital crop for Nan’s agricultural landscape.

The Food and Agriculture Organization (FAO), through its Country Programming Framework for Thailand (2017–2021), supports food security, sustainable agriculture, and natural resource management. This framework reinforces Nan’s efforts toward sustainable agricultural practices and food security. Additionally, the International Fund for Agricultural Development (IFAD) focuses on poverty reduction and sustainable agricultural development through its Country Strategic Opportunities Programme (COSOP) for Thailand, which aligns with Nan Province's goals of improving rural livelihoods through sustainable farming.

Table 8:
Strategies of development banks and international partners relevant to agricultural development in Nan Province, Thailand.

Organization	Strategy/Program	Objectives	Relevance to Nan Province
Asian Development Bank (ADB)	Country Partnership Strategy for Thailand (2021–2025)	Enhances competitiveness, connectivity, resilience, and sustainability	Supports sustainable agriculture, climate resilience, and regional connectivity, aligning with Nan’s needs
	Technical Assistance for Climate-Smart Agriculture	Promotes sustainable farming and resilience against climate change	Provides resources and support for adopting climate-smart agriculture suitable for Nan’s highland environment
World Bank	Thailand Agricultural Development Strategy Review	Improves productivity and promotes sustainability in agriculture	Offers strategic pathways for enhancing productivity in Nan’s agriculture sector
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Thai-German Climate Programme	Supports climate-resilient agriculture	Encourages climate-resilient practices for sustainable farming in Nan
	Sustainable Rice Platform	Promotes sustainable rice cultivation	Aligns with Nan’s focus on rice cultivation, encouraging sustainable practices
Food and Agriculture Organization (FAO)	Country Programming Framework for Thailand (2017–2021)	Strengthens food security, sustainable agriculture, and resource management	Reinforces sustainable agricultural practices and food security efforts in Nan
International Fund for Agricultural Development (IFAD)	Country Strategic Opportunities Programme (COSOP)	Focuses on poverty reduction and sustainable rural development	Aids in improving rural livelihoods through sustainable farming practices in Nan Province

7. Multimodal Transport Initiatives: Implications for Nan Provinces

The multi-modal transport initiatives across Southeast Asia, especially those aligned with the ADB transport strategy and regional projects, also have indirect but significant implications for Nan Province in Thailand. Although Nan is geographically isolated and not directly connected to high-speed rail or major highways involved in these large-scale initiatives, the increased regional connectivity and infrastructure improvements can create opportunities for local economic development, cross-border trade, and enhanced access to markets.

The overarching impact of these projects would be to make Nan Province a more connected and accessible part of the regional economy. These transportation upgrades can make exporting more feasible and cost-effective for Nan's highland crops. Moreover, by improving connections within Thailand and across ASEAN, these transport projects may foster increased interest from investors in developing sustainable agribusiness in Nan, contributing to the economic resilience and growth of this agricultural region. These transport initiatives could make Nan Province's agricultural sector more viable for national and regional trade, facilitating efficient logistics for highland exports and potentially attracting agribusiness investment. The strategic improvements also align with the ADB's focus on sustainable and resilient infrastructure, positioning Nan to better capitalize on its natural and agricultural resources.

7.1 ADB's Strategy 2030 Transport Sector Directional Guide and Regional Investment Strategy

ADB's *Strategy 2030 Transport Directional Guide* underlines the importance of sustainable, inclusive transport infrastructure, particularly for rural and remote areas. This focus supports infrastructure investments in places like Nan Province, which needs improvements in road, logistics, and connectivity to increase access to national and regional markets.

ADB's emphasis on integrating green and resilient infrastructure also aligns well with Nan's goals of promoting sustainable agriculture. Improved transport infrastructure in the region, supported by ADB's commitment to inclusive growth, could indirectly support the development of "farm-to-market" roads, cold storage facilities, and digital traceability systems, all of which could help Nan's farmers and agribusinesses thrive (ADB, 2023).

7.2 Vietnam's Lao Cai-Ha Long Railway and Enhanced Access to China's Yunnan Province

As regional rail networks in Vietnam and China improve, Nan's proximity to the Laos border becomes increasingly strategic. Although Nan does not have direct rail access, local producers could potentially route goods through nearby provinces linked to these rail networks, facilitating exports to China.

Improved rail networks in Vietnam enhance the logistical infrastructure for the GMS, which includes Thailand. Nan could indirectly benefit as cross-border trade flows and partnerships within the GMS region are strengthened, potentially boosting export markets for high-value crops like medicinal herbs and cacao.

7.3 Thailand's High-Speed Rail Initiatives (Bangkok-Nong Khai Line) and Regional Integration

Thailand's Bangkok-Nong Khai high-speed rail project, connecting to the Laos-China Railway, creates a new rail route from Bangkok to Kunming, China, through Laos. While Nan is not directly

on this route, the project strengthens the trade corridor within Thailand, potentially making it easier to move goods from northern regions closer to the rail network. For Nan's local producers, this improved route to Kunming offers a faster, more cost-effective way to reach one of China's key economic zones, which could attract investment in Nan's agricultural sector, particularly in high-value export-oriented crops.

7.4 Malaysia's East Coast Rail Link (ECRL) and Connectivity to Pan-Asia Railway Network

Although Malaysia's ECRL does not extend into Thailand, its completion could eventually lead to further integration with the Pan-Asia Railway Network, creating a continuous land route from Southeast Asia to China. Improved connectivity through Malaysia could spur Thailand to accelerate domestic rail upgrades, indirectly benefiting border provinces like Nan by creating better logistics networks to route products. With Malaysia and China strengthening their logistics ties, Thailand's agricultural products, including those from Nan, could find easier access to Malaysia and Singapore markets, helping Nan-based agribusinesses potentially access ASEAN markets more efficiently.

Table 9:
Multimodal Transport Initiatives that are Relevant to Promoting Connectivity in Nan Province.

Project	Description	Relevance to Nan Province	References
ADB's Strategy 2030 Transport Sector Directional Guide	ADB's guiding strategy focusing on sustainable, inclusive infrastructure development across Asia	<ul style="list-style-type: none"> - Supports rural and remote infrastructure, indirectly favoring Nan through investments that improve connectivity to larger networks. - Aligns with Nan's goals of sustainable agribusiness by potentially supporting cold storage, farm-to-market roads, and traceability systems, key for rural agribusiness competitiveness. 	ADB Transport Sector Directional Guide 2022-2030, Thailand COBP
Vietnam's Lao Cai-Ha Long Railway	Rail project in Vietnam linking Lao Cai to Ha Long, enhancing connectivity to China's Yunnan Province	<ul style="list-style-type: none"> - Nan Province, near the Laos border, could benefit from improved trade logistics as goods can flow through neighboring provinces connected to these networks. - Supports regional GMS trade, facilitating Nan's export potential in high-value crops. 	ADB GMS reports, Vietnam Ministry of Transport updates
Malaysia's East Coast Rail Link (ECRL)	Malaysian rail project linking East Coast states to west ports, potentially connecting to the Pan-Asia Railway Network	<ul style="list-style-type: none"> - Though not directly linked to Nan, this project improves Southeast Asia's logistics, encouraging Thailand to enhance its transport infrastructure. - Better access to Malaysia and Singapore markets could drive demand for Nan's agricultural exports, especially if Thailand 	Malaysia Rail Link Sdn Bhd reports, Ministry of Transport Malaysia

Project	Description	Relevance to Nan Province	References
		strengthens domestic routes connecting Nan to central hubs.	
Thailand's Bangkok-Nong Khai High-Speed Rail	Connects Bangkok to Nong Khai, linking with Laos-China Railway, creating a direct line from Bangkok to Kunming, China through Laos	<ul style="list-style-type: none"> - While not directly accessible from Nan, it strengthens Thailand's trade corridor, benefiting provinces like Nan by providing easier access to regional and Chinese markets. - Nan's agribusiness sector could see growth in export potential for high-value products like cacao and medicinal herbs. 	Thai Ministry of Transport updates, ADB Thailand transport infrastructure projects

8. Agribusiness Investment, Alternative Livelihoods, and Value Chain Development in Nan Province

Climate change and evolving market demands necessitate a shift away from traditional monoculture practices toward CSA investments and diversified livelihood opportunities. The province's agricultural sector—particularly in high-value crops such as cacao, lemongrass, and essential oils—offers significant potential for sustainable economic growth. However, investment gaps, certification barriers, supply chain inefficiencies, and limited market access continue to hinder progress. This analysis explores the current state of agribusiness investment, obstacles in value chain development, and strategic interventions that can enhance climate resilience and economic opportunities in Nan Province.

8.1 Agribusiness Investment Landscape and Challenges

Transition from Monoculture to Diversified Climate-Smart Agriculture For years, maize cultivation has been a dominant agricultural activity in Nan Province, particularly in Na Noi District, where 90,529 rai (14,485 hectares) were under maize cultivation in 2017. However, monoculture farming has led to soil degradation, deforestation, and increased susceptibility to climate variability, necessitating a shift toward diversified and climate-resilient agricultural systems (ADB, 2023).

To address these challenges, farmers are transitioning to integrated farming systems that include pumpkin, cacao, avocado, banana, lemongrass, and peanuts. These alternative crops help enhance soil health, improve water retention, and reduce economic risks for farmers (IFAD, 2023). However, to scale up these efforts, strategic investments are required in areas such as input supply, irrigation infrastructure, and CSA training programs to ensure long-term sustainability.

8.2 Investment Gaps in High Value Crops and Alternative Livelihoods

Despite the strong potential of high-value crops, Nan Province faces significant investment gaps in processing facilities, certification programs, and market access. For instance, the cacao supply chain lacks centralized fermentation hubs and quality control mechanisms, limiting its ability to compete in premium international markets (World Bank, 2022). Similarly, while demand for essential oils and medicinal herbs is increasing, high processing and transportation costs continue to be a major constraint (UNIDO, 2022).

Additionally, sectors such as food processing, honey production, handicrafts, and ecotourism remain underdeveloped due to a lack of infrastructure, business support services, and financing mechanisms (ADB, 2023). A structured approach, including microfinancing programs, cooperative business models, and targeted training, is needed to bridge these gaps and enhance economic resilience in rural communities.

8.3 Supply Chain and Market Barriers

Supply Chain Inefficiencies in High-Value Crops. Nan's high-value agricultural products face challenges in production, processing, and distribution, which limit their scalability. Cacao farmers, for example, lack access to high-quality seedlings, proper post-harvest handling techniques, and direct linkages with specialty chocolate makers (GIZ, 2022). Similarly, the lemongrass and essential oil sector struggles with energy-inefficient distillation technologies, increasing production costs and reducing profitability (FAO, 2021). Poor transportation networks further compound these inefficiencies, raising logistics costs and restricting regional market expansion (ADB, 2023). To

overcome these barriers, investments in farmer training, cooperative processing hubs, and infrastructure improvements are essential.

Certification Barriers and Market Access Challenges. Entry into high-value domestic and export markets is hindered by certification challenges, land tenure issues, and weak export facilitation mechanisms. While Thailand has established certification programs such as Good Agricultural Practices (GAP) and organic standards, many smallholder farmers in Nan struggle to obtain certification due to high costs and strict land ownership requirements (IFAD, 2023). To address these issues, many farmers are adopting Participatory Guarantee Systems (PGS)—a community-driven certification alternative that reduces costs (TOAF, 2022). However, PGS remains limited in its ability to access international markets, highlighting the need for government support in aligning PGS with global certification standards.

Weak Branding and Traceability Systems. Furthermore, weak branding and traceability systems limit product competitiveness in premium export segments (UNIDO, 2022). Developing regional certification hubs, digital traceability systems, and branding initiatives can strengthen market positioning and create new economic opportunities for smallholder farmers.

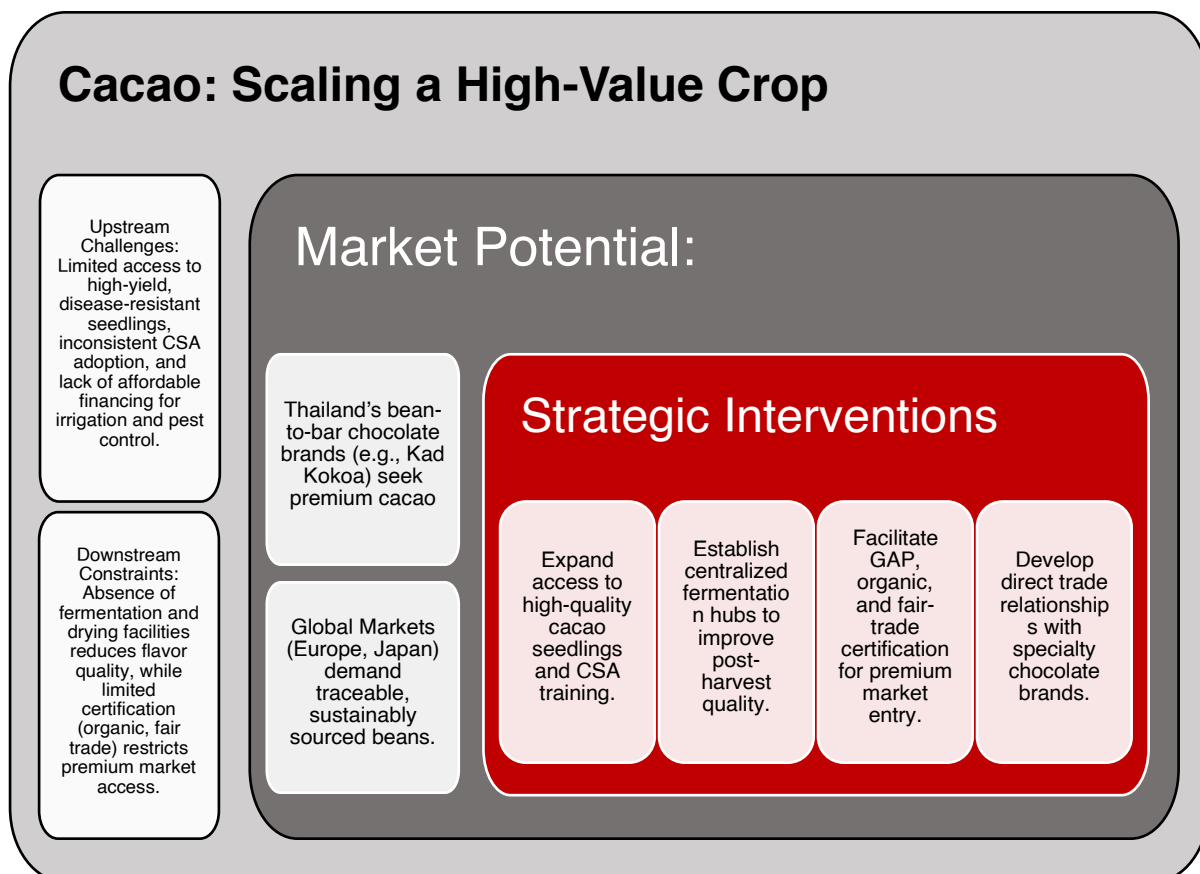
9. Scaling-up and Promoting Market Access for High Value Crops and Alternative Livelihoods

9.1 Transitioning to Climate-Smart Agribusiness

Nan Province is shifting from maize monoculture to a diversified, climate-smart agricultural system, leveraging high-value crops such as cacao, lemongrass, and essential oils. While this transition presents economic opportunities, challenges persist, including investment gaps, supply chain inefficiencies, certification barriers, and limited public-private partnership (PPP) engagement. Unlocking the potential of high-value agriculture requires strengthening both upstream (input supply, production efficiency) and downstream (processing, distribution, market linkages) activities.

9.2 Key Value Chains in Nan Province

9.2.1 Cacao: Scaling a High-Value Crop

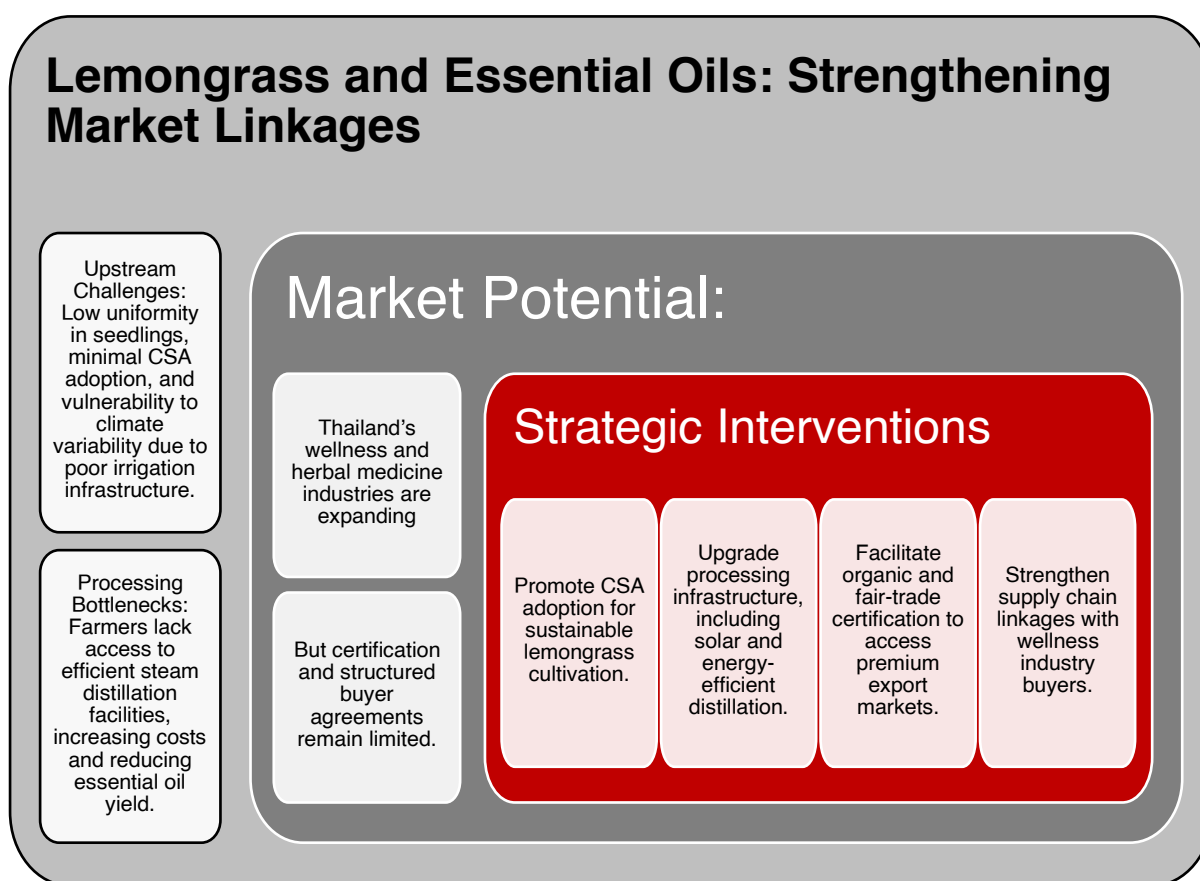


Cacao production in Nan is gaining momentum due to increasing demand for high-quality, single-origin cacao. However, Cacao production in Nan Province faces several challenges that limit its market potential. Upstream constraints include limited access to high-yield, disease-resistant seedlings, inconsistent adoption of Climate-Smart Agriculture (CSA) practices, and a lack of affordable financing for essential farm inputs such as irrigation and pest control. These factors

contribute to lower yields and increased vulnerability to climate-related risks. Downstream bottlenecks further hinder the industry, as the absence of fermentation and drying facilities negatively impacts flavor quality, reducing the competitiveness of locally grown cacao. Additionally, the lack of organic, fair-trade, and GAP certifications prevents farmers from accessing premium markets that demand strict quality and sustainability standards.

Despite these challenges, cacao holds significant market potential, both domestically and internationally. Thailand's emerging bean-to-bar chocolate brands, such as Kad Kokoa, are actively seeking high-quality, locally sourced cacao, while global markets in Europe and Japan show strong demand for traceable and sustainably produced cacao beans. To capitalize on these opportunities, several strategic interventions are needed. Expanding access to high-quality cacao seedlings and CSA training can enhance production efficiency and climate resilience. Establishing centralized fermentation hubs will improve post-harvest quality, ensuring consistency in flavor and market competitiveness. Facilitating GAP, organic, and fair-trade certification will enable farmers to meet premium market requirements and secure higher prices. Lastly, developing direct trade relationships with specialty chocolate brands can strengthen value chain integration, ensuring long-term sustainability and profitability for cacao farmers in Nan Province.

9.2.2 Lemongrass and Essential Oils: Strengthening Market Linkages



Lemongrass and essential oils present significant domestic and export opportunities in Thailand's growing health and wellness sector; yet supply chain inefficiencies hinder their competitiveness. Upstream challenges include low uniformity in seedlings, minimal adoption of CSA practices, and vulnerability to climate variability due to inadequate irrigation infrastructure. These factors lead to inconsistent yields and reduced overall production efficiency. Processing bottlenecks further constrain the sector, as many farmers lack access to efficient steam distillation facilities, resulting in high production costs and lower essential oil yields.

The market dynamics for lemongrass and essential oils are promising, with Thailand's wellness and herbal medicine industries expanding rapidly. However, market access is restricted by limited certification programs and the absence of structured buyer agreements, preventing farmers from securing long-term contracts with premium buyers. To overcome these barriers, several strategic interventions are necessary. Promoting CSA adoption will improve the sustainability and resilience of lemongrass cultivation. Upgrading processing infrastructure, including the introduction of solar and energy-efficient distillation technologies, will enhance oil extraction efficiency and reduce operational costs. Facilitating organic and fair-trade certification will open access to high-value export markets, particularly in Japan, South Korea, and China, where demand for sustainably produced essential oils is growing. Strengthening supply chain linkages with wellness industry buyers will further support market expansion, ensuring that lemongrass farmers in Nan Province can capitalize on rising global demand while improving profitability and long-term sustainability.

9.3 Alternative Livelihoods: Expanding Economic Opportunities

Beyond primary agriculture, value-added processing, honey production, and ecotourism provide income diversification for rural communities:

- (1) **Food Processing:** Farmers are interested in processing their produce (i.e. pumpkin, banana, mushrooms, and *Makwaen*) but lack modern food preservation equipment.
- (2) **Honey Production:** While demand for Thai honey is rising in China and South Korea, branding and traceability remain weak.
- (3) **Ecotourism:** Agritourism and homestays are gaining popularity, but digital marketing skills and structured tourism programs are lacking.

Strategic Interventions

- Develop a regional food hub for small-scale artisanal food producers.
- Facilitate honey certification and branding for premium export markets.
- Strengthen digital marketing and online sales channels for agritourism.

9.4 Key Actions for Strengthening Market Competitiveness

By implementing these strategies, Nan Province can strengthen value chains, expand market access, and drive sustainable agribusiness growth, positioning itself as a key player in Thailand's climate-smart agriculture sector.

- (1) **Investment in Processing & Infrastructure:** Build local fermentation hubs for cacao, distillation facilities for essential oils, and modern food processing units.
- (2) **Market Access & Certification:** Support farmers in obtaining GAP, organic, and fair-trade certification to access premium domestic and export markets.
- (3) **Supply Chain Coordination:** Strengthen cooperative-led value chains to ensure consistent quality and improve farmer bargaining power.
- (4) **Public-Private Partnerships (PPP):** Engage private sector investment in CSA-driven agribusiness, linking producers with high-value markets.

10. Strengthening Gender-Inclusive Agribusiness: Overcoming Barriers and Advancing CSA Adoption in Nan Province

10.1 CSA Adoption Among Women and Indigenous Communities

Gender disparities in land ownership, financial access, and decision-making power present significant challenges for women and indigenous communities in Nan Province seeking to engage in CSA. Women face structural barriers to land tenure, with traditional inheritance laws and legal restrictions limiting their ability to secure land titles, a prerequisite for obtaining agricultural financing and CSA investment opportunities. These constraints reduce women's participation in government incentive programs and limit their access to CSA technologies and training programs, further exacerbating gender inequalities in agricultural productivity.

Similarly, indigenous communities in Nan Province, including groups such as the Hmong, Yao, and Lisu, face distinct challenges in adapting to climate change. Their historical reliance on traditional farming systems makes the transition to CSA more complex, particularly given the lack of tailored extension services and financial mechanisms designed to support culturally appropriate CSA adoption. Data gaps on indigenous farmers' access to CSA resources, land rights, and training programs further complicate the development of targeted interventions that could enhance their resilience to climate change.

While CSA adoption is being promoted across Thailand, data on gender-specific adoption rates remain limited. However, existing studies suggest that women are less likely to adopt CSA practices due to financial constraints, lack of training opportunities, and lower decision-making authority within farming households. Key barriers include high input costs, lack of credit access, labor demands, and income disparities, which disproportionately affect female farmers. Addressing these disparities requires more inclusive CSA programs that provide targeted financial incentives, training initiatives, and policy adjustments to ensure equal access to resources.

Box 3:

Gender Issues.

Land Ownership: Women in Thailand often face challenges in land ownership due to traditional inheritance practices and legal constraints, limiting their access to this critical resource. [FAOHome](#)

Agricultural Inputs and Training: Gender inequalities exist in access to resources such as material inputs, funds, seeds, breeds, and plant varieties, as well as information and knowledge, including training courses related to livestock and farming techniques. [FAOHome](#)

Decision-Making Roles: Women's decision-making roles in agriculture are often limited, impacting their ability to influence resource allocation and farming practices. [Open Knowledge FAO](#)

CSA Adoption Rates

General Adoption: While CSA practices are being promoted in Thailand, there is limited data on the specific adoption rates among women and indigenous communities. However, studies in similar contexts suggest that women adopt CSA practices at lower rates due to constraints in access to resources and information. [CMU SPP](#)

Barriers to Adoption: Factors such as high input demand, cost of inputs, labor requirements, lack of credit opportunities, and income disparities contribute to lower adoption rates of CSA technologies among female farmers. **CMU SPP**

Indigenous Communities

Vulnerability to Climate Change: Indigenous communities in Northern Thailand, including young women and girls, are particularly vulnerable to climate change impacts, which affect their agricultural productivity and livelihoods. **SEI**

Data Gaps: There is a significant gap in research and data on the specific challenges and adoption rates of CSA practices among indigenous communities in Thailand. This lack of data hampers the development of targeted interventions to support these groups.

10.2 Gender and Social Inclusion

Overcoming systemic barriers. Women and indigenous communities play a vital role in agriculture in Nan Province but continue to face systemic barriers in accessing resources, financing, and decision-making. These challenges limit their participation in agribusiness and the adoption of CSA practices. Many women farmers in Bua Yai Subdistrict lack formal land ownership, restricting their access to credit, agricultural subsidies, and Good Agricultural Practices (GAP) certification, which affects their ability to enter premium agricultural markets. Indigenous farmers, particularly from the Hmong and Yao communities, face land tenure insecurity, which discourages long-term investment in CSA practices. Focus group discussions in Bua Yai revealed that while women contribute significantly to crop management and food processing, financial decision-making is largely male-dominated, affecting their ability to invest in agribusiness expansion.

Gender sensitive training and support, with market access. Gender-sensitive training and support are essential to address these challenges. Women in Nan have expressed strong interest in food processing and value addition training but often lack access to technical assistance. Indigenous women farmers face additional linguistic and cultural barriers that make standard agribusiness training less effective. Market access is also a major concern, as women-led agribusinesses struggle with post-harvest infrastructure and certification challenges. For instance, women honey producers and essential oil processors in Nan face difficulties in branding and marketing, limiting their ability to enter higher-value markets. Indigenous women cultivating local herbs and medicinal plants have growing demand but lack networks to connect with regional buyers.

Targeted support under the TA. In response to these challenges, targeted support has been provided under ADB TA 9993 through training and capacity-building programs. Women-focused CSA training workshops have been initiated in Bua Yai Subdistrict, focusing on food processing and preservation of *Makwaen*,⁷ mushrooms, and bamboo shoots, as well as honey production, branding, and packaging. Crafting and basketry workshops have been expanded to include bamboo furniture making and eco-friendly packaging production. The TA has facilitated a series of gender-inclusive training workshops in partnership with Nan Community College and Rajamangala University of Lanna-Nan, ensuring localized expertise and skill-building.

Financial Inclusion. Efforts to enhance financial inclusion for women and indigenous farmers have also been prioritized. Although microfinance institutions in Nan offer low-interest loans for CSA practices, gender-specific financing programs remain limited. In response to recommendations from focus group discussions, pilot programs have been launched to support women in forming financial cooperatives, enabling them to collectively save and invest in sustainable farming. Indigenous communities have received support from local cooperatives to

⁷ Makwaen (*Zanthoxylum limonella*) is a type of spice commonly found in northern Thailand, including Nan Province. It is used in traditional cooking, herbal medicine, and food processing. In local cuisine, Makwaen is valued for its aromatic and spicy flavor, similar to Sichuan pepper. It is often used in chili pastes and spice blends to enhance flavor.

explore community seed banks and cooperative-run CSA investments to enhance economic security.

Market Linkage Incentives. Market linkage initiatives have been introduced to help women-led agribusinesses improve their value chains. Local enterprises producing essential oils and herbal products have begun forming direct partnerships with buyers through TA-supported market linkage workshops. Training sessions with cacao farmers have helped women entrepreneurs address quality control challenges and position themselves in higher-value markets, particularly in export-driven chocolate processing enterprises. In collaboration with Na Ngua Cocoa Community Enterprise in Phetchabun, a cacao processing workshop was conducted, improving bean fermentation and quality control techniques among women-led farming cooperatives.

10.3 Lessons from Global Best Practices for Gender Responsive Strategies

Lessons from global best practices can further inform gender-responsive strategies in Nan Province. CARE's Pathways Program, implemented across six countries, has demonstrated the impact of increasing access to financial resources, gender-sensitive agricultural training, and community-led agribusiness models. A study showed that every \$1 invested in Pathways yielded a \$31 return, highlighting its cost-effectiveness. The World Food Programme's Purchase for Progress (P4P) initiative has helped women farmers secure direct market access by providing technical training on post-harvest processing, facilitating buyer connections, and supporting certification. The Women-led Climate Resilient Farming (WCRF) Model in India has demonstrated the benefits of positioning women as decision-makers in CSA adoption, providing them with training in sustainable water management and diversified cropping systems.

10.4 Strengthening Gender Responsive Agribusiness in Nan

To further strengthen gender-responsive agribusiness in Nan Province, several key recommendations should be considered. A detailed gender analysis should be conducted to assess agribusiness challenges specific to women in Nan. Policies that guarantee women's access to land, credit, and agribusiness resources should be developed, along with incentives for gender-inclusive agribusiness investments. Expanding gender-sensitive CSA training programs is crucial, with a focus on business development, sustainable agricultural techniques, and market access strategies. Enhancing financial inclusion for women in agribusiness can be achieved by developing gender-specific financial products, including microloans for women-led cooperatives and grant programs for women transitioning to CSA. Strengthening market access through certification programs such as PGS and organic certification will enable women entrepreneurs to enter premium markets and scale their businesses.

By addressing gender disparities in agribusiness, Nan Province can enhance the role of women and indigenous farmers in CSA adoption. Implementing global best practices while scaling up local initiatives will ensure equitable, sustainable, and climate-resilient agribusiness growth in the region.

Box 4: Successful Global Programs for Gender Inclusion.

Enhancing women's engagement in agribusiness is pivotal for economic development and gender equity. Globally, several successful models and programs have been implemented to empower women in agriculture. Here are some notable examples:

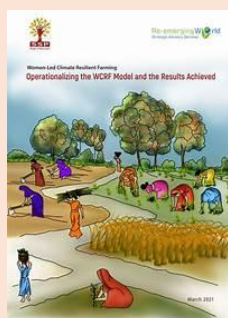
CARE's Pathways Program (Raks Thai). Implemented in six countries, this program aims to increase the productivity and empowerment of women farmers within equitable agricultural systems. It focuses on improving access to resources, enhancing skills, and promoting gender equality. An evaluation indicated that for every \$1 invested, communities received a \$31 return, highlighting its effectiveness.



Purchase for Progress (P4P) by the World Food Programme. P4P focuses on connecting smallholder farmers, particularly women, to markets by providing training and support to meet market demands. The program has developed a gender strategy to increase women's participation in decision-making and access to resources, contributing to their empowerment in the agricultural sector.



Landesa's Global Center for Women's Land Rights. This initiative emphasizes securing land rights for women, recognizing that ownership and control over land are fundamental to empowering women in agriculture. By providing legal assistance and advocating for policy changes, Landesa helps women gain the assets needed to improve their livelihoods and economic status.



Women-led Climate Resilient Farming (WCRF) Model. Developed by Swayam Shikshan Prayog (SSP) in India, this model positions women as farmers and decision-makers, building their capacity to practice sustainable agriculture and water conservation. It enhances food and income security for marginal farming households, demonstrating the effectiveness of women-led initiatives in building climate resilience. **UN SDGs**



FAO's Gender-Responsive Agribusiness Interventions. The Food and Agriculture Organization (FAO) has developed guidance on integrating gender equality and women's empowerment into climate-smart agriculture programs. These interventions focus on ensuring that women and men have equal access to profitable markets and business opportunities along agrifood supply chains.

11. Enhancing Investment Readiness and Policy Support for Climate-Smart Agriculture in Nan Province: Insights from Similar Regions

11.1 Investment Needs for Climate-Smart Agriculture in Nan Province

Despite ongoing efforts to promote Climate-Smart Agriculture (CSA) in Nan Province, data gaps hinder investment decision-making, policy design, and the scaling of CSA adoption. While investments in agribusiness, particularly for high-value crops such as cacao and lemongrass, are growing, there is no available investment data on the long-term feasibility, financial returns, and infrastructure needs for CSA-based businesses in Nan Province. The absence of detailed historical trends and future projections makes it difficult for stakeholders to assess the economic sustainability of CSA interventions.

The sparse information on distribution networks, transport logistics, and processing facilities reduces the competitiveness of local agribusinesses in regional and international markets. Furthermore, market intelligence and export data remain fragmented, with limited insights into consumer preferences, price sensitivity, and potential export barriers. This has resulted in missed opportunities for targeted investment in CSA-aligned agribusinesses, particularly in developing value-added processing and organic certification schemes that would enhance Nan's position in high-value export markets.

In addition to market and investment gaps, there is a shortage of long-term performance data on CSA technologies, particularly those related to solar irrigation, biochar, and climate-resilient seed varieties. While pilot projects and research initiatives have promoted CSA adoption, detailed impact assessments remain incomplete, limiting policymakers' ability to refine strategies for scaling successful interventions. Without evidence-based insights into yield improvements, cost reductions, and climate resilience benefits, farmers remain hesitant to adopt CSA technologies due to perceived risks and financial constraints.

11.2 Insights from Similar Regions

While specific investment data for CSA businesses in Nan Province is limited, insights from similar regions can inform potential opportunities. Highland areas in Southeast Asia share comparable topographies and agricultural practices, making their CSA experiences relevant.

Financial Returns and Investment Opportunities. Investments in CSA technologies across Africa and Asia remain limited, constituting approximately 0.085% of available debt and equity climate finance. A significant financing gap exists for scaling companies that have not yet achieved sufficient maturity and profitability to attract private equity investment. This underscores the need for early-stage venture capital and angel investing to support innovative CSA technology companies (CASA).

In Asia, the growing middle class and urbanization are driving significant increases in food expenditure. By 2030, Asia's population is expected to reach nearly 4.5 billion, with food demand projected to hit \$8.4 trillion annually. This demographic trend provides extensive investment opportunities in the food sector, including CSA initiatives. Annual investments of \$120 billion are needed until 2050 to enhance the region's food supply chain, predominantly driven by the private sector (THE AUSTRALIAN).

Infrastructure Needs. Scaling CSA requires understanding and leveraging business models, financial incentives, and innovative finance mechanisms. This includes developing strategies for scaling up CSA to reach millions of farmers, promoting agricultural technology adoption through novel financial instruments, and integrating value-chain innovations to benefit smallholder farmers (CCAFS)

Long-Term Feasibility. The World Bank has developed Climate-Smart Agriculture Investment Plans (CSAIPs) to guide countries in boosting CSA through investments and policies. These plans identify promising CSA technologies and associated costs, informing governments, development partners, and the private sector. For example, in Zambia, the CSAIP recommends focusing on crop diversification, commercial horticulture, agroforestry, and infrastructure to reduce post-harvest losses (WORLD BANK GROUP).

11.3 Case Studies on CSA Best Practices: Lessons for Nan Province

To enhance CSA adoption in Nan Province, it is essential to learn from successful local and international CSA implementations.

Improvement of Adaptive Capacity, Phufa Sub District. A study conducted in Phufa Sub-District, Nan Province, found that 68% of upland farmers adjusted their agricultural practices in response to climate risks by modifying their farm management strategies, diversifying their income sources, and altering crop calendars. These findings highlight the adaptive capacity of farmers when given the appropriate training and resources to integrate CSA practices into their farming systems.

Smart Solar Initiative. Another example is Nan Province's smart solar irrigation initiative, which has been implemented in drought-prone areas to address water scarcity challenges. The project utilizes solar-powered irrigation systems to reduce dependency on fossil fuels while ensuring efficient water use for sustainable agriculture. This initiative has demonstrated positive outcomes in improving water-use efficiency and reducing operating costs for farmers, making it a scalable solution for other regions facing similar climate constraints.

Indonesia REDD+ program. At the international level, Indonesia's REDD+ program provides valuable lessons for Nan Province. The program integrates climate adaptation strategies with forest conservation, offering a model for CSA adoption in forested highland regions such as Nan. By reducing deforestation pressures and promoting sustainable land management practices, the program demonstrates how CSA initiatives can be aligned with conservation goals to create long-term ecological and economic benefits.

11.4 Financing Options for Agribusinesses and CSA Adoption in Nan Province

Financing constraints remain one of the most significant barriers to CSA adoption in Nan Province. To address this challenge, multiple financial mechanisms and investment instruments have been introduced to support agribusinesses, farmer cooperatives, and smallholder farmers. The Bank for Agriculture and Agricultural Cooperatives (BAAC) offers long-term agricultural loans, specifically designed to facilitate CSA investments among small-scale farmers. These loans provide financial resources for solar irrigation systems, soil restoration projects, and organic farming transitions, making CSA technologies more accessible to smallholders.

Agri Climate Risk Financing Initiative. Additionally, climate-risk financing solutions are gaining traction in Thailand. Programs such as the Agri-Climate Risk Financing initiative focus on developing financial products tailored to the needs of Thai farmers, helping them manage climate risks more effectively. These financial mechanisms integrate insurance models, climate-responsive credit systems, and risk mitigation strategies, ensuring that smallholder farmers can safeguard their livelihoods against climate shocks.

Nan Province presents significant opportunities for CSA investment, but data gaps, gender disparities, and financing constraints must be addressed to fully realize its potential. Strengthening data collection on CSA adoption, investment trends, and market demand will be critical in shaping

evidence-based policies and financing strategies. Moreover, addressing gender and social inclusion gaps in CSA will require policy adjustments, targeted incentives, and capacity-building programs to ensure that women and indigenous communities benefit equally from CSA investments.

A coordinated approach involving local governments, international donors, financial institutions, and agribusiness stakeholders will be essential in driving CSA expansion in Nan Province. By leveraging best practices, innovative financing models, and inclusive policies, Nan Province can emerge as a leading model for sustainable agriculture and rural resilience in Thailand.

Enhancing agribusiness in Nan Province requires a multifaceted approach that addresses specific challenges through targeted interventions, engages key stakeholders, secures appropriate financing, and draws on global best practices. Below is a comprehensive table outlining these elements:

Table 10:
Enhancing Agribusiness in Nan: Challenges, Interventions, Potential Financing and Global Models.

Challenge/Issue	Intervention	Key Stakeholders	Potential Financing and Funding Sources	Global Models and Best Practices
Low Yield and Inefficient Processing (i.e., for Essential Oil Production)	<ul style="list-style-type: none"> - Promote Climate-Smart Agriculture (CSA) adoption to improve lemongrass yield and oil extraction efficiency. - Support processing facilities with modern drying and extraction technologies. - Develop branding and certification programs for organic and sustainable essential oils. - Strengthen supply chain partnerships with wellness industry buyers. 	<ul style="list-style-type: none"> - Ministry of Agriculture and Cooperatives (MOAC) - Agricultural Cooperatives - Essential Oil Processors - Wellness Industry Buyers - Small and Medium-sized Enterprises (SMEs) 	<ul style="list-style-type: none"> - Bank for Agriculture and Agricultural Cooperatives (BAAC) provides financial services to the agricultural sector. - BAAC - International Fund for Agricultural Development (IFAD) supports rural development projects. - IFAD 	<ul style="list-style-type: none"> - The Bio-Circular-Green (BCG) Economy Model in Thailand promotes sustainable agricultural practices. - SAWASDEE THAILAND - THAILAND.GO.TH - The Fashion Pact's Unlock Programme incentivizes sustainable cotton farming, serving as a model for essential oils. - Vogue Business
Limited Processing and Market Access for Food Products	<ul style="list-style-type: none"> - Establish food processing facilities to enable value-added product development. - Provide training in food preservation techniques (e.g., sun drying, vacuum packing, fermentation). - Enhance branding and regional market linkages for artisanal food products. 	<ul style="list-style-type: none"> - Local Food Producers - Agricultural Extension Offices - Food Processing SMEs - Ministry of Commerce - Regional Market Distributors 	<ul style="list-style-type: none"> - Asian Development Bank (ADB) offers loans to support micro, small, and medium-sized enterprises (MSMEs) in rural Thailand. - Asian Development Bank - Government stimulus schemes may provide funding opportunities. - Reuters 	<ul style="list-style-type: none"> - The Agricultural Innovation and Inclusive Value-Chain Development framework emphasizes integrating smallholders into value chains. - Emerald
Underdeveloped Supply Chain (i.e. for Handicrafts)	<ul style="list-style-type: none"> - Improve market access for handicrafts through structured e-commerce platforms. - Facilitate skills training and business incubation to enable handicraft sector growth. 	<ul style="list-style-type: none"> - Handicraft Cooperatives - SMEs - Online Retail Platforms (e.g., Lazada, Shopee) - Tourism Authority of Thailand 	<ul style="list-style-type: none"> - Microfinance Institutions - SME Development Funds - Public-Private Partnerships (PPPs) 	<ul style="list-style-type: none"> - Inclusive Business Models in Agriculture highlight the importance of integrating small producers into broader markets. - iBAN
Low Production Standards and Marketability (i.e., for honey)	<ul style="list-style-type: none"> - Introduce quality control and standardization in honey production to enter high-value markets. - Develop branding strategies and value-added honey products (e.g., infused honey, honey-based cosmetics). 	<ul style="list-style-type: none"> - Beekeepers - Honey Cooperatives - Ministry of Agriculture - Exporters - Organic Certification Bodies 	<ul style="list-style-type: none"> - BAAC and GIZ collaboration enhances green and sustainable finance in Thailand's agricultural sector. - Sustainable Agrifood Systems in ASEAN 	<ul style="list-style-type: none"> - The Global Value Chains in the Agrifood Sector report by UNIDO provides insights into standards and certifications. - UNIDO
Limited Ecotourism Development and Market Linkages	<ul style="list-style-type: none"> - Integrate agritourism with CSA practices, showcasing sustainable farming techniques. - Conduct community training in 	<ul style="list-style-type: none"> - Community Tourism Groups - Local Government - Ministry of Tourism and Sports 	<ul style="list-style-type: none"> - Tourism Development Funds - International Development Agencies - Private Investors 	<ul style="list-style-type: none"> - The Bio-Circular-Green (BCG) Economy Model supports sustainable tourism initiatives.

Challenge/Issue	Intervention	Key Stakeholders	Potential Financing and Funding Sources	Global Models and Best Practices
	hospitality, marketing, and digital tourism platforms. - Leverage eco-conscious travel trends to drive demand for homestays and cultural tourism.	- Travel Agencies - Homestay Operators		SAWASDEE THAILAND - THAILAND.GO.TH
Lack of Financial Support for Alternative Livelihoods	- Develop microfinancing and business support programs for food processing, crafts, and ecotourism. - Encourage cooperative models to scale honey and handicrafts production. - Establish regional hubs for artisanal products to connect with urban and international buyers.	- Microfinance Institutions - Local Banks - Agricultural Cooperatives - Business Incubators - SME Development Agencies	- Bank for Agriculture and Agricultural Cooperatives (BAAC) provides financial services to the agricultural sector. BAAC - International Fund for Agricultural Development (IFAD) supports rural development projects. IFAD	- The Agricultural Innovation and Inclusive Value-Chain Development framework emphasizes integrating smallholders into value chains. Emerald
Weak Public-Private Collaboration in Agribusiness	- Facilitate PPP-based investments in cacao processing, essential oil production, and alternative livelihoods. - Encourage collaboration between farmers, agribusiness firms, and food exporters.	- Private Agribusiness Investors - Farmers' Associations - Food Exporters - Public Sector Investment Funds	- Asian Development Bank (ADB) provides financial support for agribusiness development. Greater Mekong Subregion - Government initiatives under the 20-Year Agriculture and Cooperatives Strategy (2017–2036) aim to strengthen PPPs. Ministry of Agriculture and Cooperatives	- The Global Value Chains in the Agrifood Sector report by UNIDO provides insights into effective PPP models. UNIDO
Barriers to Climate-Smart Agriculture (CSA) Investment	- Implement targeted CSA investment incentives to attract agribusiness funding. - Develop regional CSA certification hubs to streamline access for smallholders. - Enhance infrastructure (e.g., roads, digital platforms) for agribusiness and alternative livelihood sectors. - Promote inclusive business models where smallholder farmers benefit from agribusiness investments.	- Asian Development Bank (ADB) - World Bank - Climate Finance Institutions - Government of Thailand - Agribusiness Corporations - Regional Development Agencies	- Asian Development Bank (ADB) offers loans to support micro, small, and medium-sized enterprises (MSMEs) in rural Thailand. Asian Development Bank - Government stimulus schemes may provide funding opportunities. Reuters	- The Bio-Circular-Green (BCG) Economy Model in Thailand promotes sustainable agricultural practices.

12. Pathways to Sustainable Agribusiness in Nan Province: A Roadmap for Inclusive and Climate-Resilient Growth

Nan Province stands at a pivotal moment in its agricultural transformation. The region's rich biodiversity, cultural heritage, and highland farming communities present an opportunity to establish a climate-smart agribusiness ecosystem that is both sustainable and inclusive. However, limited financial access, infrastructure gaps, and market constraints continue to hinder progress.

This roadmap aims to present practical pathways to unlock investment, strengthen CSA, enhance market connectivity, and position Nan Province as a leader in sustainable agribusiness.

12.1 Pathway to Financial and Technical Resilience

Access to finance remains a fundamental challenge for smallholder farmers and agribusinesses looking to adopt CSA practices. Despite microfinance programs, cooperative lending, and government-backed schemes, a significant portion of agribusinesses still rely on informal credit sources, limiting their ability to invest in long-term resilience. The Provincial Agricultural Extension Offices (PAEOs) provide crucial training, but financial constraints hinder widespread CSA adoption.

To scale investments in CSA, a blended financial approach—combining concessional loans, impact investment, and public-private partnerships (PPPs)—must be expanded.

12.1.1 Key Financial and Technical Support Interventions

- (1) Strengthen access to finance through local banks and microfinance institutions, ensuring tailored CSA loan products.
- (2) Expand village funds and cooperative-led financing models to foster community-driven CSA investments.
- (3) Leverage international development financing (ADB, Green Climate Fund) to accelerate climate-resilient agriculture in Nan Province.

12.2 Pathway to Investment Growth: Strengthening Government Incentives

Thailand continues to attract investment in high-value agricultural sectors, including organic farming and value-added food processing (ASEAN Briefing, 2024). The Board of Investment (BOI)'s Five-Year Strategy (2023–2027) prioritizes CSA through tax incentives and subsidies, aligning with local efforts in Nan Province.

To maximize this opportunity, agribusinesses should:

- (1) Access BOI tax incentives for CSA investments (solar-powered irrigation, biochar, renewable energy integration).
- (2) Engage with the Provincial Agricultural Office (PACO) to receive technical training and financial aid for CSA adoption.
- (3) Align investment strategies with Thailand's Bio-Circular-Green (BCG) Economy Model, ensuring long-term sustainability.

12.3 Pathway to Private Sector Expansion: Strengthening PPP and Impact Investment

Nan's high-value CSA crops—including cacao, lemongrass, and pumpkin—present strong export potential. However, agribusinesses require investment in processing and storage infrastructure to

meet international standards. The PPP model provides an opportunity to mobilize private capital alongside public resources to develop agribusiness infrastructure.

12.3.1 Priority PPP Actions

- (1) Develop rural agribusiness infrastructure to strengthen CSA supply chains and logistics.
- (2) Attract impact investors focused on organic and fair-trade agribusinesses, ensuring market access for highland farmers.
- (3) Expand blended finance models to scale private-sector participation in CSA.

12.4 Pathway to International Financing: Leveraging Development Funds

International organizations—including ADB, the World Bank, and the Green Climate Fund (GCF)—offer significant funding for climate-smart agriculture. While Thailand has received GCF funding for climate-resilient agriculture, Nan Province remains underfunded, presenting an opportunity for new financing initiatives.

12.4.1 Key Development Finance Strategies

- (1) Engage with Thailand's National Designated Authority (NDA) to secure GCF financing for CSA projects in Nan.
- (2) Develop targeted project proposals for ADB and World Bank support, focusing on CSA adoption, agroforestry, and renewable energy.
- (3) Align international funding applications with Thailand's Climate Change Master Plan (2015–2050) to enhance long-term resilience.

12.5 Pathway to Agritourism and Cultural Integration

Nan's unique cultural heritage and ecological landscapes create an opportunity to link agribusiness with sustainable tourism. Thailand is preparing Nan's nomination for UNESCO World Heritage status, which will drive tourism-related economic growth. Agritourism models—including organic farm stays, eco-tours, and farm-to-table experiences—can provide new revenue streams for CSA-driven agribusinesses.

12.5.1 Strategic Agritourism Actions

- (1) Develop agritourism business models, integrating organic farming and sustainable tourism.
- (2) Leverage UNESCO nomination efforts to enhance visibility and attract eco-conscious travelers.
- (3) Create marketing linkages between agribusinesses and tourism operators to position CSA products in premium markets.

12.6 Pathway to Infrastructure and Trade Connectivity

Nan Province's economic development is closely tied to improved infrastructure. Ongoing projects, such as the Nan Nakhon Airport upgrade and National Highway 101 expansion, will enhance transportation access for agricultural exports (World Highways, 2024).

In addition, cross-border trade projects (facilitated by Thailand's Neighboring Countries Economic Development Cooperation Agency - NEDA) will improve connectivity with Laos, Vietnam, and China, increasing export potential.

12.6.1 Key Infrastructure and Trade Recommendations

- (1) Leverage infrastructure upgrades to enhance supply chain efficiency and reduce transport costs.
- (2) Support cross-border trade compliance to help Nan's agribusinesses meet ASEAN food safety standards.

- (3) Invest in digital trade platforms, including e-commerce solutions and real-time market intelligence tools.
- (4) Pathways for Scaling CSA and Agribusiness Investments in Nan Province

12.7 Expanding Climate-Smart Finance and PPP Models

To scale CSA adoption and agribusiness expansion, innovative financing mechanisms must be diversified and expanded. Key financing models include:

- (1) Bank for Agriculture and Agricultural Cooperatives (BAAC): Microloans and CSA financing for smallholder farmers.
- (2) **ADB and IFAD**: Investment programs for SMEs in agribusiness value chains.
- (3) **PPP models**: Encouraging private-sector investment in CSA-focused cacao processing, essential oil production, and agritourism infrastructure.

12.8 Global Best Practices for CSA Adoption in Nan Province

Nan Province can leverage global agribusiness models to strengthen its value chains:

- (1) **Thailand's Bio-Circular-Green (BCG) Economy Model**: Supporting CSA, organic farming, and agritourism integration.
- (2) **The Agricultural Innovation and Inclusive Value Chain Model**: Ensuring smallholder integration into high-value supply chains.
- (3) **The Global Agrifood Value Chain Framework (UNIDO)**: Supporting CSA certification, traceability, and PPP-led investment.

12.9 Implementing a Comprehensive Agribusiness Strategy

A structured approach is essential to fully unlock the potential of CSA and agribusiness development in Nan Province. Key implementation steps include:

- (1) Develop CSA investment incentives to support climate-friendly financing models for farmers.
- (2) Expand agribusiness infrastructure, including food processing hubs and cold storage facilities.
- (3) Strengthen digital market access, linking Nan's agribusinesses to ASEAN and global e-commerce platforms.
- (4) Promote alternative livelihood programs, such as honey production, organic essential oils, and agritourism ventures.
- (5) Encourage inclusive agribusiness models, supporting smallholder cooperatives and SME-led CSA adoption.

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